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The 7th International Conference on Higher Education Learning Methodologies and Technologies Online (HELMeTO 2025) highlights the growing interest in merging learning methods with educational technology. This year's event once again embraced a cross-disciplinary approach, bringing together researchers, educators, and practitioners from various fields to explore innovative solutions for the future of higher education. HELMeTO has evolved significantly, marking its fourth year as a full-scale conference after starting as a workshop. Its growth has been impressive, attracting 143 submissions from more than 325 authors in 18 countries, including Italy, Brazil, Morocco, Ukraine, the United Kingdom, Hungary, Nigeria, Croatia, France, Germany, Latvia, Canada, Denmark, India, Slovenia, Spain, Sweden and the United Arab Emirates. This broad international participation showcases the conference's crucial role as a hub for exchanging ideas and best practices in online learning.

Hosted by the University of Napoli, the 2025 edition offered a rich programme. The event featured dozens of high-quality contributions, organized into seven special tracks and two general tracks. Presentations and discussions explored the complex link between technology and teaching, focussing on both established topics and emerging trends like artificial intelligence, augmented and virtual reality, learning analytics, and big data analytics in education. This volume aims to capture the depth and variety of research presented, serving as a valuable resource for academics and professionals interested in the current and future state of education. The contributions reflect the international landscape of online education and provide insights into the ongoing transformations in higher education driven by the combination of teaching methods and technology. This editorial is designed to help readers navigate the different tracks and find research that aligns with their interests, fostering further collaboration within the HELMeTO community. Note that this editorial provides a high-level overview of the main themes covered in the conference tracks rather than a detailed review of each individual paper.

The conference's main tracks are General Track 1 (GT1), focussing on "Online Pedagogy and Learning Methodologies," and General Track 2 (GT2), on "Learning Technologies, Data Analytics, and Educational Big Data Mining." GT1 centres on the strategies and practices for effective teaching and learning in digital environments, exploring how traditional pedagogical approaches can be adapted for online platforms using various digital tools. Meanwhile, GT2 investigates how learning technologies, data analytics, and large-scale data are transforming education by enhancing teaching, learning, and decision-making processes.

Special Track 1, "Rethinking Education: The Opportunities and Challenges of Artificial Intelligence," addresses the profound impact of AI on learning environments. This track promotes a critical dialogue on how AI can be leveraged to revolutionize education through personalized learning, intelligent tutoring systems, and automated feedback. It also tackles essential challenges, from ethical considerations and potential algorithmic bias to data privacy and the changing role of educators in an AI-powered classroom. Ultimately, this track showcases innovative applications, highlights the need for robust teacher training, and discusses the future of responsible AI implementation to create more equitable and effective educational experiences.

Special Track 2, "Formative Assessment in Higher Education: Conceptual Framework," focuses on the pivotal role of formative assessment in improving student learning. This track fosters academic dialogue on the conceptual and practical dimensions of continuous feedback, exploring its integration with summative strategies and its impact on instructional practices. It highlights how digital tools and learning analytics can enhance these processes across various learning environments, from traditional to hybrid and distance education. The track also considers the diverse cultural and contextual factors that shape effective assessment, offering valuable case studies and best practices from various disciplines.

Special Track 3, "AI-enhanced E-learning for 'Augmented' Mathematics Education at University Level," explores the integration of artificial intelligence into university-level mathematics education. This track examines how AI-based platforms, intelligent tutoring systems, and automated feedback technologies can be combined with traditional teaching methods to create innovative hybrid learning environments. It invites a discussion on the synergies between concrete and digital resources and the design of effective e-learning strategies for mathematics.

Special Track 4, "The Art of Learning Online: Creative Practices in Digital Higher Education" explores how art can be integrated into digital higher education to make online learning more engaging and human-centered. It focuses on using artistic practices, like visual arts, music, creative writing, and performance, not just as content but as pedagogical methods. The goal is to move beyond standardized, technical online education by investigating how aesthetics, storytelling, and improvisation can foster deeper connection, critical thinking, and collaboration. The track welcomes various contributions, from theoretical papers to case studies, examining how art can be a tool for creating inclusive, relational, and participatory online learning environments. It seeks to answer if and how art can generate new and effective pedagogical methodologies for distance education.

Special Track 5, "AI in Higher Education: Empowering Design, Critical Thinking, and Reflective Learning", focuses on integrating AI into higher education to enhance instructional design, critical thinking, and reflective learning. It aims to contribute to the global discourse on using AI to develop effective, inclusive, and adaptable educational practices. The research emphasizes AI's role in fostering metacognitive skills, self-regulation, and learner autonomy. It explores AI in three complementary dimensions: as a design partner for educators, a critical friend that provides constructive feedback to students, and a participant in group work to stimulate critical thinking and comparative analysis. The track welcomes empirical, theoretical, and review-based contributions on these topics.

Special track 6, “UDL and AI in Higher Education and in Pre Service Teacher Education: strategies, experiences, and perspectives for inclusive innovation” examines the intersection of Universal Design for Learning (UDL) and Artificial Intelligence (AI) to create more inclusive higher education. It focuses on how UDL principles, enhanced by AI, can improve accessibility, participation, and success for all students in digital, distance, and blended learning environments. The track serves as a forum for educators, researchers, and policymakers to share experiences and research on implementing these strategies. A key focus is on pre-service teacher education, exploring how AI can be used to train future educators in inclusive practices. The goal is to foster a university culture that values equity, innovation, and diversity through technology.

Finally, Special Track 7, titled “Human rights-based approach and practices for preventing and countering online hate speech: digital strategies and educational challenges in Higher Education”, explores how higher education can use digital strategies and technologies to prevent and counter online hate speech. It addresses the ethical and practical concerns of using AI and other digital tools, focusing on building inclusive and critically aware learning environments. The aim is to leverage technology and pedagogical approaches, alongside legal and ethical frameworks, to foster digital literacy and civic engagement. The track welcomes contributions on anti-hate strategies, human rights-based education, and the role of online learning and media literacy in combating toxic narratives, encouraging a multidisciplinary approach in cooperation with various stakeholders.

In conclusion, the 7th International Conference on Higher Education Learning Methodologies and Technologies Online underscores the evolving relationship between pedagogy and technology while stressing the value of inter-disciplinary collaboration. With tracks dedicated to themes such as Artificial Intelligence, assessment in higher education, reflective learning, inclusion, and innovative teaching, the conference offers a platform for meaningful exchange. The seven selected special tracks foster exploration of emerging research and practical applications, highlighting how diverse disciplines can converge to shape the future of learning. By engaging with both established and cutting-edge trends, HELMeTO 2025 delivers critical insights into the ongoing transformation of higher education.

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Doctoral Consortium

General Track 1

Online pedagogy and learning methodologies

Assessment in blended learning pathways of initial training for secondary school teachers

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1 Introduction

Assessment plays a crucial role in higher education, as it contributes greatly to shaping not only students' learning experiences and behaviors, but also to guiding cognitive and metacognitive behaviors, often exerting a more significant influence than teaching itself [1]. It is an integral part of the learning process and influences students' perceptions and approaches to learning [2]. Effective assessment requires the use of appropriate methods and tools and can be leveraged to improve teaching practices [3]. Given the relevance of providing students with timely feedback on their learning throughout their education, not just at the end, great importance is attached to formative assessment.

Peer review and feedback strategies have been shown to improve students' evaluative competence and design skills [4-7]. These participatory and formative assessment methods, implemented throughout the course of study rather than only at the end, enhance learning, support study, promote educational success, and develop students' evaluative skills [8-11]. The main function of feedback is to offer information that can support students' learning processes by providing new thinking and action strategies to achieve set goals [12]. For feedback to be truly effective, it is essential that it be formulated in a timely manner and provided in itinere throughout the learning journey, so as to support trainees in redirecting their efforts and progressively improving their performance.

2 The research on assessment in initial training

Based on this theoretical framework, an exploration was conducted into the assessment process within the initial training courses for secondary school teachers (Percorsi Abilitanti administered under the DPCM August 4, 2023). These courses were delivered in all universities in blended learning mode, with a substantial share of online hours concentrated mainly in teaching and remaining in-presence hours concentrated in laboratory and internship activities. Furthermore, the program was completed within a relatively brief period of time, approximately several months, with the objective of providing a prompt response to the ministerial educational mandate. As delineated in Article 9, Paragraph 1 of the Decree, the final evaluation comprises two components: a written examination and a simulated lesson. These components are intended to assess the attainment of professional competencies in accordance with the profile delineated in Annex A of the aforementioned Decree.

Consequently, the assessment is conducted at the conclusion of the course, with no explicit reference to the evaluation of the individual teachings and laboratories that comprise the curriculum.

In light of these considerations, the objective of this study was to survey the perceptions of trainees at two Italian universities (the University of Milan and the University of Molise) regarding assessment in initial training courses for secondary school teachers. To this end, an exploratory survey was conducted, which entailed the administration of an anonymous semi-structured questionnaire [13].

The questionnaire was administered after the course was completed, between April and May 2025, in a self-directed manner using CAWI (Computer Assisted Web Interviewing) methodology using Google Forms.

The questionnaire consisted of 7 sections investigating, respectively: socio-demographic characteristics (D1, 7 items), employment status (D2, 5 items), experience in other enabling pathways (D3, 2 items), evaluation on the training model attended (D4, 4 items), levels of compatibility and preferences with respect to an ideal model (D5, 10 items), and a final balance with respect to experience (D7, 2 items). One part of the questionnaire was constructed by placing a specific focus on the topic of assessment in the enabling educational experience (D6), with multiple choice (3 items) and one open-ended question. All questions administered were created ad hoc based on the relevant literature and adapted to the specific purposes of the research.

The questionnaire collected a total of 614 completions. In this paper, we will focus specifically on the analysis and discussion of the data collected in section D6 of the questionnaire and, specifically, on the responses of the trainees engaged in the 30-36-60 CFU enabling pathways.

3 Main results

The results saw the trainees divided into two clusters: 42.3% argued that they should be assessed only at the end of the pathway, while the remaining 67.8% argued that other moments of assessment should be included. Multiple responses were possible to this question, so considering the total sample, 31.9% believe that assessment should always be carried out at the end of each training activity. Considering the different responses, 23.3% consider it important to assess at specific periods dedicated to learning assessments.

The sub-cluster analysis clearly highlights a greater polarization of responses between those who indicate that one should assess only at the end and those who state that they participated in the course with the need to finish it as soon as possible, and a relevant reduction of this position by those who aim to obtain the best preparation in terms of skill development.

In the analysis, the data are explored in depth by also considering the motivations expressed in the open-ended responses. These answers show that those who indicate that assessment should not be concentrated at the end of the course do so in order to better distribute the learning load and consolidate knowledge. Conversely, those who prefer a final assessment argue that, by that point, students have acquired the necessary skills to respond correctly.

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Blended MOOCs to return on investment

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1. Introduction and objectives

Since 2014, Cremit (Research Centre on Media Education, Innovation and Technology), in collaboration with Ilab (Innovation for Digital Didactics) of the Università Cattolica del Sacro Cuore, has been producing and delivering MOOCs as part of the University's Third Mission.

The creation of a MOOC (Massive Open Online Course) requires significant organisational effort and has an important economic impact. Costs include both the use of advanced digital technologies and the employment of human resources in the various stages of its life cycle. All this has led Cremit to question the sustainability of the production process and the design of a return on investment (ROI) programme.

This study aims to: 1. provide a snapshot of the state of the art of MOOCs delivered to date and their performance through the analysis of monitoring data, in order to understand when a MOOC can be said to have completed its life cycle; 2. understand how design choices impact the cost of a MOOC by focusing on elements that characterise ROI; 3. identify possible forms of ROI through blended-instruction strategies.

2. Research framework and state of the art of Cremit MOOCs

In order to understand the costs and how to achieve a return on investment, it is necessary to explain both the considerations made regarding the life cycle of MOOCs and the pedagogical model used. With regard to the life cycle, the analysis of the three project stages outlined by Sanchez-Gordon & Luján-Mora [1] – Development, Management, Improvement – has made it possible to accurately identify all cost items attributable to two macro-areas: human resources and instrumental resources.

In terms of pedagogical model, Cremit/Università Cattolica MOOCs are rooted in three key principles: the social dimension of learning [2], the knowledge-building approach [3, 4], and relational pedagogy [5]. These pillars have been adapted to the post-covid scenario: a shift toward micro-learning (brevity and speed), ubiquitous learning [6], learner-centered approaches and the development of dynamic literacies [7]. Comparing pre-Covid and post-Covid MOOCs, we observe changes in time structures, an increase in self-paced learning, reduced feedback mechanisms, and fewer dedicated communication spaces. MOOCs have been systematically monitored through evaluation plans: participant feedback through final questionnaires, tracking data, forum message analysis, focus groups, and interviews conducted in various research projects (Table 1).

Table 1. Overview of the tracking data

Time	Learning Platform	No. MOOCs	No. Participants	% Certificates	% Final Q
Pre-Covid (2014-20)	Open Education	22	20.987	62, 2	45,9%
Post-Covid (2021-25)*	EduOpen	17	7.187	37	53,1

*Last updated date: August 14, 2025.

3. Proposal for ROI

To enhance and capitalize on the MOOC experience, in a third space pedagogy strategy [8], making sense of its increasingly short but costly course life cycle, we have outlined a retrospective of the results obtained from 2014 to date, focusing the analysis on the economic and pedagogical areas, to understand the overall value generated from a quantitative and qualitative point of view.

Economic ROI. The aspects investigated were: design choices and average costs of a MOOC, types of public/private funding and strategic partnerships, with reference to business models documented in the literature [9, 10].

Pedagogical ROI. This includes a broader assessment, which takes into account the extra-financial return and analyses the types of use. Alongside the conventional use, MOOCs have been used in five different blended education scenarios [11] shown in Table 2.

Tabella 2. Blended MOOCs

MOOC Type	Case	Teaching Scenario
Pre MOOC	Master (Level II) Third Mission Projects	Before the training course
In between MOOC	University courses	Within the course, as an in-depth study, starting and ending in the classroom
Flipped MOOC	Third Mission Projects	In preparation for seminars or workshops
Post MOOC	Third Mission Projects	After the training course
Parallel MOOC	European Projects	Two parallel courses, taken by teachers and students, on the same topics

4. Results and perspectives

As regards economic ROI, bearing in mind the costs and monitoring data that enable the break-even point for activating MOOCs to be identified, the elements that represent value are: reputation, third mission, educational marketing, and communication output.

With regard to pedagogical ROI, the factors highlighted by the experiment are: retention and loyalty, democratisation of knowledge, new forms of knowledge transfer thanks to blended learning, and communities of practice. These elements are important for the creation of a MOOC analysis system to be proposed at institutional level to enable the University to demonstrate the value of this type of training and to support the promotion of a MOOC culture among both administrators and teachers.

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Case study on formative memetics: learning, assessment and inclusion through digital languages

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1 Introduction

In contemporary education, increasingly shaped by the mediatization of language and the communicative codes of digital natives [1], there is a growing need to rethink teaching and assessment practices in light of new learning ecologies. Within this framework, the languages of digital culture not only transmit information but also mediate the construction of knowledge, influencing participation and expression among younger generations. Among them, internet memes stand out as iconic-synthetic artifacts that combine images and short texts with high communicative density [2]. Once viral phenomena, memes are now recognized as participatory narratives that make complex content accessible in immediate and culturally situated forms. Yet, their connoted nature often reproduces cultural, social, or political stereotypes, highlighting the need for critical decoding and source evaluation. This ambivalence, however, can become an educational opportunity to foster awareness, analytical skills, and critical thinking. Based on this assumption, memetic production may be re-signified as a didactic and evaluative tool capable of activating cognitive and metacognitive processes, stimulating creativity, conceptual synthesis, and reflection. If integrated with co-constructed rubrics, peer feedback, and documentation, memes could serve as resources for authentic and inclusive formative assessment [3], oriented toward autonomous learning regulation and shared meaning-making. Accordingly, this study explores how internet memes can foster transversal competences, which evaluative practices emerge from their educational use, and which constructs may guide assessment models inspired by them.

2 Methods

This qualitative exploratory study involved 72 university students (64 F and 8 M; average age = 20 years), selected by intentional sampling, with heterogeneous profiles in terms of sociocultural background and level of digital literacy.

The students were divided into six 12-member groups: three with an operational function, in charge of meme design and production, and three with an observational function, dedicated to the documentation and analysis of collaborative processes. The protocol consisted of several integrated phases: a theoretical-practical training on memetic language and formative assessment, with exercises in critical analysis of sources and cases; the participatory definition of the theme, school dispersion, through dialogic discussion; collaborative design and digital production of memes with open source tools, guided by a co-constructed rubric [4]. divided into twelve dimensions (creativity, critical thinking, inclusiveness, digital competence, coherence with sources, argumentative capacity, etc.), each divided into five levels with observable descriptors. The assessment was carried out using a five-level Likert scale (from 1= very weak to 5= excellent), accompanied by written justifications anchored to the rubric indicators. In parallel, the observational groups used structured grids to detect quality and frequency of interactions, while all students filled in logbooks to stimulate metacognitive reflection. The concluding phase involved collective restitution and shared negotiation of meanings.

3 Results

The memetic production fostered critical reworking of the topic, stimulating connections between theoretical knowledge, personal experiences and social visions. Some students employed popular formats, such as the Drake Hotline Bling, to ironically represent the tension between mnemonic learning and participatory approaches. On the relational level, the groups developed cooperative dynamics based on role assumption, negotiation of meanings and shared management of phases. At the metacognitive level, students learnt to justify their evaluations, recognise implicit stereotypes and reflect on the relationship between communicative immediacy and conceptual depth. In one feedback, for example, we read: 'although funny, our meme risked trivialising the theme, so we reformulated it by inserting a clear theoretical reference' showing critical self-reflection skills. Data from the rubrics and rating scales show medium-high levels in almost all dimensions, with strengths in creativity and involvement and weaknesses related to theoretical coherence and in-depth analysis.

4 Conclusion

The results confirm the validity of a generative formative assessment model, in which memetic production is configured as an opportunity for awareness, autonomous regulation of learning and collective negotiation of meanings. The didactic use of Internet memes, if accompanied by structured evaluative tool and reflective practices, could be an effective tool for activating transversal competences and for building an inclusive and participatory climate. The study has limitations related to the difficulty of generalising the results. Future research could explore the applicability of the model in other educational contexts.

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Designing an Instructional Model to Enhance Programming Education through Near-Peer Teaching and Algorithmic Problem Solving

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The International Olympiad in Informatics (IOI) aims to identify and recognize young talents in Informatics at a global scale, specifically targeting secondary school students. The participation of Italian students, made possible by the establishment of a national Olympic committee composed of university professors, institutional representatives, and members of the country's leading professional association for computer science, has led to increasing success over the years [1, 2]. However, the achievements of top-performing Italian students in international competitions do not reflect a widespread presence of algorithmic thinking and programming competencies within the broader context of secondary education. Despite the growing visibility of excellence, these skills remain confined to a relatively small group of learners and are rarely embedded systematically within school curricula.

For several years, the University of L'Aquila has organized regional-level training courses to support and guide students interested in the IOI selection process. The initiative has produced encouraging outcomes: several participants have earned medals in national competitions, and a few have achieved recognition at the international level. As a result, in recent years, schools throughout the region have increasingly requested training opportunities. To meet this growing demand, it became necessary to move beyond the traditional in-person format, which had previously been held entirely at a single school serving as the regional coordination center for the competition.

The transition to a fully online teaching format, however, had a clearly negative impact. It became evident that direct interaction with instructors and in-person facilitators, which characterized earlier editions of the course, played a key role in alleviating the frustration students often experience when dealing with the intrinsic complexity of IOI-style problems. In the absence of such support, many students struggled to stay engaged and ultimately dropped out, with attendance in the final sessions falling to just one third of the students who had initially enrolled.

To address this issue, we developed a new instructional model inspired by the Joint Creative Classroom experience [3], characterized by two key features. First, students attend training sessions by gathering in the computer lab of one of the participating schools. Each lab is supervised by one or two facilitator teachers, while the main instructor delivers lessons via live streaming from one of the participating locations. Second, the course is led by university students, adopting the near-peer teaching model [4, 5], in which instructors are only slightly more advanced in their academic path than the learners, fostering a more approachable and motivating learning environment.

This new model has proven effective in restoring students' confidence and significantly reducing, and in some cases eliminating, dropout rates. As a result, the course now actively involves a larger number of students and schools than in previous years. However, this increased participation has not yet resulted in a higher number of students attaining medals or top placements in the national competition. The difficulty of the IOI national selection rounds remains high and, if anything, has continued to rise over time.

Nevertheless, the increase in participation and student engagement suggests that a competition-based approach, supported by this instructional model, could be successfully adapted to enhance curricular programming education. In this work, we present the design of a learning path aimed at strengthening programming skills, inspired by the algorithmic problem-solving activities typical of IOI-style competitive programming.

The course will be delivered online, following an instructional model inspired by experience in IOI training. In 2025/26, it will be offered to five schools selected for participating in our IOI training activities over the past three years, involving about 80 students. In this pilot edition, the course will be an extracurricular program building on the programming skills acquired in the previous school year. Its goal is to give motivated learners the chance to deepen their understanding of core computational concepts and tackle advanced problem-solving in a supportive, structured environment.

The main features of the proposed learning path are as follows:

- it covers programming-related content typically included in school curricula;
- it adopts teaching strategies that have proven effective in previous training initiatives on competitive programming;
- it is centered on problem-solving activities, structured in the style of competitive programming but focused on simpler tasks designed to meet national curriculum objectives—while also introducing, where appropriate, basic algorithmic thinking;
- it is delivered online through a platform that enables automatic evaluation of students' problem-solving attempts, providing immediate feedback and supporting self-paced learning;
- it adopts a near-peer teaching model, where the role of expert is taken on by university students or, alternatively, by school teachers who, without prior access to problems and solutions, are encouraged to step out of the traditional instructor role and act as mentors or facilitators.

In our contribution, we present the structure of the proposed learning path, provide examples of instructional activities, and report preliminary evaluations of its educational effectiveness based on a set of administered tests.

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Integrating MOOCs into University Blended Teaching: A Pedagogical Model for Reflective Competence Development

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1 A proposed model for MOOC integration

Massive Open Online Courses (MOOCs) have emerged over the last decade as one of the most discussed innovations in higher education. While originally designed to enhance access and scalability, MOOCs are often perceived by students—especially in traditional instructional settings—as supplementary and cognitively overloading tools, detached from the core learning trajectory. This perception significantly limits their transformative potential and pedagogical impact [1,2].

This paper introduces a pedagogical model for the structured integration of MOOCs within a university-level blended learning framework, grounded in dialogical, situated, and reflective approaches to teaching and learning. The aim is to go beyond a mere digitalization of traditional content by proposing a coherent trajectory that alternates online engagement and face-to-face activities, supporting students' progressive development of disciplinary and transversal competences. The model is based on a cyclical instructional design which incorporates three typologies of MOOCs—anticipatory, consolidating, and amplifying—each aligned with distinct phases of the educational process and seamlessly interwoven with in-class practice, according to a principle of pedagogical "coupling" [3].

The anticipatory MOOC introduces the course topic and activates learners' prior knowledge through interactive content such as videos, quizzes, simulations, and self-assessment with immediate feedback. It enhances initial engagement and prepares the groundwork for in-class problem setting activities, in which key questions and learning needs are collaboratively identified. The consolidating MOOC represents the core learning phase, fostering elaboration and knowledge construction through problem-based tasks and digital environments designed for learning by doing. This is followed by in-class activities that leverage collaborative, situated learning strategies (e.g., cooperative learning, case-based discussions), anchored in constructivist and experiential pedagogies [4,5]. Finally, the amplifying MOOC supports metacognitive reflection and participatory assessment through peer review, performance-based tasks, and shared rubrics. It corresponds with a final phase of reflective learning, where knowledge is reconstructed and shared through dialogical classroom interactions.

The model is supported by a deliberate and modular instructional design approach inspired by the CLAS framework (Contexts, Languages, Environments, Strategies; [5]), which integrates formal and informal learning environments, multimodal communication, and active didactic strategies. Within this model, the teacher plays the role of educational coach [4], actively orchestrating pedagogical continuity across physical and digital spaces, without necessarily being the central actor in each learning phase. This blended MOOC-based approach aims at fostering autonomy, engagement, and transferable skills, aligning with current research on digital transformation and lifelong learning [6,7,8].

The model will serve as the theoretical framework for the professional development of university teachers at the University of Bologna. It has been jointly defined with the partners of the Digital Education Hub, in which UNIBO leads the work package on faculty training. It aims to support the strategic integration of MOOCs within blended learning practices.

The proposal contributes to the broader debate on instructional innovation in higher education, demonstrating that structurally integrated MOOCs—when situated within pedagogically coherent and intentionally designed blended courses—can offer both a response to the challenges of digitalization and an opportunity to reconceptualize the relationship between technology, pedagogy, and learner agency.

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From Integration to Inclusive Digital Citizenship: Rethinking Educational Technologies for Migrant Inclusion in Higher Education

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1 Introduction

The concept of integration, especially in the European context, has undergone a profound transformation over the last decades. While traditionally framed in terms of economic assimilation and institutional compliance, recent policy and academic discourse increasingly highlights the need for a multidimensional, bidirectional process of inclusion—one that recognizes migrants not as passive recipients but as active subjects in shaping democratic and intercultural societies. Yet, as several scholars have shown (e.g. Jesse, 2025; Scholten et al., 2022), this evolution remains contested, with integration policies often still marked by contradictions, asymmetries, and selective expectations. Even in the field of higher education, the implementation of inclusive practices remains fragmented and inconsistent.

In this evolving scenario, educational technologies represent both an opportunity and a challenge. While digital tools are often employed as means of access (e.g. to administrative information, language support, or preparatory learning), few initiatives adopt a more ambitious approach where technology becomes an enabler of inclusion, critical agency, and democratic participation. Furthermore, most digital learning initiatives still target primary or secondary education, especially for promoting inclusion among young and vulnerable migrants, while the potential of technology-mediated learning for fostering access to higher education, civic engagement, and intercultural competence among migrant populations remains significantly underexplored.

2 Rethinking Educational Technologies for Migrant Inclusion in Higher Education

This paper explores how digital innovation can support a paradigm shift in higher education toward a more inclusive and socially just framework for migrant students.

Through a design-based analytical approach, the paper proposes directions for the development of digital solutions in higher education, such as:

(1) mobile-first platforms supporting digital civic education, intercultural dialogue, language acquisition, and academic skills for adult learners with migration backgrounds;

(2) Open Educational Resources (OERs) for inclusive citizenship education co-designed with migrant communities and students;

(3) AI and data-informed adaptive learning tools that respect cultural identities and learning trajectories while providing equitable access to academic content;

(4) training programs for academic staff on inclusive pedagogy and digital equity;

(5) bridging programs and digital onboarding tools for migrant students en-tering universities across Europe;

To contextualize this reflection, we examine selected initiatives from Italian universities and research centers that have developed digital educational tools to foster inclusive higher education, and that offer training for academic staff on the inclusion of migrants. For instance, the University of Palermo (through ItaStra) and the University of Naples Federico II (via the Federica Web Learning platform and dedicated master's programs) provide structured learning opportunities on intercultural teaching, civic education, and the use of digital environments to foster access and engagement. Similarly, Roma Tre University and the University for Foreigners of Perugia have developed courses and tools aimed at supporting staff in managing linguistic and cultural diversity, often integrating hybrid or online formats. In this context, we draw on the experience of 'Studiare Migrando', a multilingual e-learning platform developed by CNR, ItaStra and UNICEF to support unaccompanied foreign minors in their preparation for the lower secondary school exam in Italy (CNR, 2020). The platform’s design emphasizes accessibility, cultural adaptation, and flexible learning paths. Although initially conceived for secondary education, its core principles can be transferred to higher education, particularly for adult and young adult learners with migration backgrounds.

In addition, we draw on recent international reports and frameworks, including the European Commission’s Pathways to School Success (2022), the OECD’s work on multilevel governance in migrant inclusion (2024), and the JRC’s Digital Education and Migrant Inclusion Framework (2023). These documents stress the urgency of rethinking migrant education not as an emergency or remedial field, but as a central component of sustainable, inclusive digital societies.

To conclude, we argue that the adoption of inclusive, human-centered digital technologies in higher education is not simply a matter of innovation, but of social justice. Migrant students, often navigating complex trajectories, must be supported not only through access but through meaningful engagement, recognition, and empowerment.

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Teacher Perceptions and Awareness of Physical Education related to Digital Technologies

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1 Digital Integration in Physical Education: Challenges and Opportunities

The ongoing digitalization of the school environment has profoundly transformed teaching and learning methods, affecting all subjects, including physical education. Despite the potential offered by digital technologies, their adoption in this field remains limited and is influenced by various factors, such as teachers' perceptions, the availability of technological resources, and the training received [1]. According to Saiz-González et al. [2], physical education teachers demonstrate a strong interest in integrating digital technologies into their lessons, acknowledging their value in enhancing learning, assessment, and communication with students and families. Furthermore, digital tools may support teamwork both inside and outside the classroom, fostering increased interaction and collaboration among students. The study identifies five main barriers hindering adoption: limited access to technological resources, insufficient training, lack of institutional support, time management challenges related to technology integration, and concerns about student data privacy. Previously, Jastrow et al. [3] analyzed the evolving use of digital technologies in physical education, with particular attention to gamification, wearable devices, and collaborative learning. Their systematic review highlights the benefits of digital integration, including increased student motivation and improvement in motor skills. The study also points to a gap between technology adoption and its actual educational value, with many teachers using digital tools to support teaching processes without fully integrating them into the curriculum. Further issues arise concerning data security, technological sustainability, and the need for a clear educational and methodological framework to enable effective application. However, the lack of a clear understanding of teachers' attitudes toward digital integration in physical education represents a limitation in developing effective strategies aligned with the needs of both educators and students in the digital age [4].
The current study therefore aimed to investigate physical education teachers' perceptions and experiences regarding the use of digital technologies, analyzing both the opportunities offered and the challenges encountered in their implementation. It also sought to explore didactic implications and future perspectives, enabling teachers to integrate digital tools into physical education in ways that maximize their educational impact without compromising the experiential and movement-based core of the subject.

2 Approach and Evidence on the Use of Digital Technologies in Physical Education

The study adopted a mixed-methods approach, combining quantitative and qualitative methods. A custom-designed questionnaire was distributed to 150 physical education teachers across various school levels. The survey explored: (1) the use of digital technologies in design, teaching and assessment, (2) teachers' perceptions of the effectiveness of technology for student motivation and inclusion, (3) obstacles to adoption, and (4) previous training and future training needs.

Data were analyzed using descriptive statistics to identify general trends, and correlational analyses were conducted to explore variations based on demographic factors such as age, teaching experience, and type of school. All quantitative analyses were conducted using *Microsoft Excel*, leveraging its built-in statistical functions. Additionally, semi-structured interviews were carried out with a subgroup of 20 teachers to gain deeper insights into emerging motivations and challenges.

The results revealed that although 82% of teachers acknowledged the potential of digital technologies to enhance motivation and personalized learning, only 38% reported systematically using them in their lessons. The study identified the main barriers as insufficient training (64%), limited access to technological resources (52%), and concerns regarding privacy and data management (40%). The qualitative analysis highlighted a significant gap between the generally positive perception of technology and its actual implementation in educational practice. Teachers with less than 10 years of experience exhibited a greater propensity for using digital technologies compared to their more experienced colleagues.

3 Educational Implications and Future Perspectives for Effective Digital Integration in Physical Education

The findings confirm that while digital technologies are perceived as beneficial, their integration into physical education is hindered by structural and training-related challenges. To ensure more effective adoption, it is necessary to: enhance teacher training through targeted courses on the use of technologies in instructional design, teaching, and assessment in physical education; invest in technological resources to ensure equitable access to digital tools across schools; and promote teaching strategies that balance the use of technology with physical activity, preventing digital integration from reducing movement and physical engagement among students.

The study emphasizes the need for a cultural shift in teacher training, so that the use of digital technologies is not perceived as an add-on but as an integrated pedagogical support within physical education.

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From Planning to Action: The DUE Model as a Resource in Critical Moments

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1 Introduction

Teaching in today's complex post-digital society [1] involves navigating multiple crises and rapid technological, digital, and socio-cultural changes, which often render traditional educational paradigms quickly outdated [2][3]. In this scenario, trainee teachers must develop the ability to handle uncertainty and the unexpected, along with the capacity to manage stress. The unpredictable nature of modern classrooms challenges both rigid, highly structured lesson plans - unable to adapt to emergent situations - and overly flexible ones, which require teachers to plan in detail directly in the situation [4]. To meet these contemporary challenges and support future teachers in managing uncertainty and stress, the Design for the Unexpected in Education (DUE) model [5] was developed and tested within the Master's program in Primary Education at the University of Macerata. While several studies have confirmed the model's effectiveness in helping trainee teachers plan and redesign during action, its potential to help trainees manage the stress and anxiety that often accompany the implementation phase - especially in the presence of unforeseen and destabilizing events - remains under-researched.

Starting from this gap, the research narrated in this paper aims to investigate whether the DUE model is a valid support, both theoretical and operational, for contemporary teachers so that they can identify the unexpected events and moments that are most anxiety-provoking for them and feel supported by the design artifact in dealing with them. From this initial hypothesis, the following research questions were formulated:

1. Can the triangulation between biometric data, personality profile identification, and direct observation of the teaching action help to identify critical moments of stress or teaching regulation?
2. Do the design strategies included in the DUE model support teachers during particularly anxious phases, helping them to manage the emotionality experienced during critical and unexpected moments?

2 Methods

The research was conducted with the voluntary participation of five students attending the third and fourth year of the Master's degree course in Primary Education at the University of Macerata. All five students, at the time of data collection, were engaged in direct internships in the classrooms of some Italian primary schools. Each participant was asked to design and implement a complete teaching session using the DUE model, which the participants were already thoroughly familiar with, having completed the Theories and Methods of Lesson Planning and Evaluation course in the third year of their program. During this course, each trainee had the opportunity to explore theoretical aspects related to the complex society, to experiment with the model under the guidance of the workshop tutors, and to discuss its criticalities and potential with the course lecturers.

The experimentation narrated in this paper focuses on the implementation phase of the lesson, conducted in a real-life context. Before the lesson, each trainee was asked to complete a personality survey questionnaire, the MBTI (Myers-Briggs Type Indicator) test [6], which made it possible to extrapolate some relevant personality traits of future teachers. During the course of their teaching, each trainee was equipped with a Polar OH1 optical heart rate (HR) monitor, a wearable IoT device capable of capturing 60 HR recordings per minute and storing them in CSV format that can be downloaded through the online Polar Flow application [7]. This device was chosen for its accuracy and non-invasiveness, allowing participants to carry out the educational intervention without interruption.

In parallel, a non-participating silent observer was present in the classroom to take structured field notes, focusing on: (1) the occurrence of unexpected events (e.g. student behavior, technical problems, misunderstandings about content); (2) the teachers' responses and regulation strategies; (3) their use of planning materials (both paper and digital) to regain control or adapt the flow of the lesson.

At the end of each session, the observer's notes were correlated with biometric data, interpreted in relation to individual characteristics identified through the MBTI test. This allowed the identification of moments of heightened physiological activation in response to classroom events. For each case, HR data were analyzed alongside evidence of action regulation and potential use of the DUE model's structure, as observed during the management of critical situations. The integration of physiological-quantitative and observational-qualitative data within a mixed-methods framework [8] provided initial insights into how trainee teachers function under classroom stress and whether the DUE model offers effective support for emotional self-regulation during action.

3 Conclusion

The comparative analysis of the five observed cases shows that all the subjects involved faced complex situations and difficult moments during the lesson. The triangulation between qualitative observations, personality profiles, and biometric HR data allowed us to outline how different trainees dealt with unexpected events and stressful moments in the classroom. The HR curves showed a common tendency for physiological activation coinciding with events such as loss of control of the class, unforeseen technical difficulties, unexpected demands from pupils, or interference from other actors (e.g. tutors, visiting lecturers). However, the use of the design artifact and the intensity, frequency, and duration of the peaks showed significant variations and could be linked to the personality profile to be better understood.

Despite individual differences, all trainees used the DUE model during the implementation phase, though in different ways: as an operational guide for more reflective individuals, as a restraining tool for those inclined to control, or as reassuring support in challenging relational situations. The integration of qualitative observations and biometric data showed that emotional activation peaks often occurred during relational breakdowns, unexpected demands, or external disruptions. This confirms DUE's potential in managing the unexpected, as long as a path of personal awareness supports it. From this perspective, the most significant insights from this experiment concern initial teacher training, which should not only promote structured yet flexible planning models but also foster the development of differentiated emotional self-regulation strategies tailored to individual profiles and needs.

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Digital Education Starts with Teachers: Exploring a Multimedia-Based Training Experience

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1 Introduction

Digital education has long been a central concern within both academic research and policy agendas [1]. In today's complex society, active and engaged citizenship increasingly depends on developing key competencies, including digital ones. An increasing number of international frameworks highlight the importance of technical skills and the broader concept of digital literacy [2, 3, 4]. One example is the *European Digital Competence Framework for Citizens* (DigComp 2.2) [5].

In this scenario, formal education plays a crucial role in helping individuals acquire these competences. Schools and educational institutions are now recognized as not only transmitters of knowledge but also key agents in mediating digital experiences and fostering critical digital awareness. The *European Framework for the Digital Competence of Educators* (DigCompEdu) embodies this perspective by defining 22 elementary educator-specific digital competences. While the discourse on integrating technology into teaching practices is well-established, research continues to emphasize the importance of strengthening teachers' digital literacy and their ability to integrate technology in a meaningful way [6, 7, 8. 9].

The effective use of digital tools in the classroom requires educators capacity to design and implement digitally enriched learning environments. In this regard, teacher professional development emerges as a decisive factor, especially when it combines traditional instruction with experiential and practice-based learning [10, 11, 12, 13].

This growing awareness is also reflected in recent national policy initiatives. In Italy, for example, a recent Prime Ministerial Decree (August 4, 2023) outlines the professional profile of teachers and explicitly highlights the relevance of digital competence as a core dimension of the teaching profession.

2 Context, Objectives, and Methodology

This study deepens a teachers' training experience delivered as part of the *Qualifying Pathways* provided by eCampus Telematic University (Italy) for the 2024/25 a.y.

The course, titled *Metodologie e didattiche innovative*, involved a total of 6,160 participants. Built on the course *Didattica generale*, this program was designed to support the development of digital competences in accordance with the DigCompEdu framework. These competences were embedded across both transversal and subject-specific pedagogical domains.

As outlined by the eCampus *Multidisciplinary Center for Teacher Training (CEMFI)*, the course combined synchronous online lectures and workshop activities, in order to provide foundational knowledge about educational technologies and encourage reflective and hands-on engagement with digital tools.

The main objectives of the study were to: map participants' familiarity with Canva (a graphic design platform) and Padlet (a visual collaboration tool), assess their ability to apply knowledge, evaluate the quality of the digital artifacts produced, and reflect on the alignment between the emerging teacher profile and the expectations set by the european competence framework.

The study was conducted in three phases, primarily through qualitative methods of data collection and analysis:

1. Design - definition of training content and workshop materials;
2. Implementation - training activities and use of formative feedback;
3. Assessment - development of analytic rubrics and assessment of artifacts.

In parallel, an exploratory line of inquiry was introduced to examine the potential role of artificial intelligence in supporting educational research. Specifically, the study explores the potential of Large Language Models to assess digital artifacts using the same rubrics applied by researchers. A subsequent phase of the study will investigate the suitability of generative AI for automated grading, with the aim of determining the consistency and complementarity between human and AI-driven assessments.

3 Early Findings and Conclusions

Preliminary findings reveal a strong interest among participating teachers and future teachers in the topic of digital education. However, the data also indicate areas in which digital competence needs further development. Out of over 6,000 participants, 1,292 digital artifacts were submitted and are currently being evaluated using both human and AI-supported methods.

Most participants (935) chose to develop Canva presentations. While the artifacts revealed several strengths, recurring areas for improvement were also identified: distracting or overly elaborate visual design, learning objectives copied from the National Curriculum Guidelines without adaptation, overly verbose or, conversely, oversimplified textual content. Among those who used Padlet (357), some designed boards for classroom use, while others developed environments to support individual or collaborative lesson planning, or to share thematic resources with colleagues. The overall quality of these artifacts is good, but further improvement is still possible.

Preliminary results reaffirm the importance of maintaining a focus on digital competence in teacher training, particularly through practice-based approaches. This is especially relevant considering the frequent discrepancy between expected and observed performance.

For future developments of the study, the insights gained from the course's implementation and assessment phases offer valuable input for developing a structured set of materials to support future workshop-based teacher training initiatives on educational technologies.

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Hands that count online: multidisciplinary Digital Humanities teaching activities for the Scholarly Digital Edition of historical account books and registers

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1 Context

In today's historical research, scholars increasingly need advanced digital skills to interrogate, edit, and disseminate primary sources. To meet this need, the University of Naples Federico II's Laboratory of Historical Documents on the Web (DSW Lab)[1] developed a training framework that in a.y. 2023-24 included an intra-moenia traineeship for students of Palaeography, Diplomatics, and Historical Sciences, and the Master Class *The scholarly digital edition of the account books and registers* (Naples and online, 3-4 May 2024), opened by Georg Vogeler's (University of Graz) *lectio magistralis From archival objects to historical data in the age of AI: human checks on automated and quantitative procedures*[2]. In the same framework, the DSW Lab organized a cycle of eight seminars (16 hours), *Mani che contano: dalla descrizione all'edizione critica digitale e all'interpretazione dei dati della documentazione storica a carattere amministrativo-contabile* (November 2024 – February 2025), for second-year students of the Master's in Historical Sciences[3] [1, 2].

2 Methodology

The programme adopted a distributed model, structuring learning over time (synchronous meetings, progressively provided materials), roles (trainer, tutor, evaluator, discussion community), and contexts (in person and online). It followed a blended approach, combining archive-based activities to foster situated knowledge with a strong

1 https://www.studiumanistici.unina.it/dipartimento/strutture-dipartimento/laboratori-e-archivi/dsw-lab-documenti-storici-nel-web-e-altrove/
2 https://www.coop-unina.org/wp-content/uploads/2022/02/Neaples-and-online_May-4-2024.pdf
3 https://www.coop-unina.org/wp-content/uploads/2022/02/Ciclo-di-Seminari__-2024_2025.pdf

online component. On Microsoft Teams, students took part in collaborative workshops, material sharing, revision monitoring, and tutor interaction. Training included Transkribus for layout analysis [3, 4], XML/TEI encoding with an ontology from the University of Graz [5, 6], and graphemic annotation with the open-source tool FRAt [7]. Each microgroup transcribed, marked up, and edited a section of a historical account book. The results were integrated into a collective digital edition, now in final review on the international platform DEPCHA, Digital Edition Publishing Cooperative for Historical Accounts[4] [8].

2.1 Integration of online learning

The training programme relied on the online component as a structural element. Microsoft Teams provided the environment for continuous collaboration, enabling synchronous activities and the progressive construction of the edition in a shared digital space where documents, annotations, versions, and comments were archived, discussed, and reworked in real time. In this environment, students and tutors simulated professional editorial dynamics in a distributed yet cohesive context. Remote working fostered student autonomy and strengthened skills in managing collaborative work in a digital environment.

2.2 Assessment and formative feedback

The programme included a multi-level formative assessment based on iterative cycles of personalised feedback. Each student received detailed feedback from a doctoral student, supported by two graduate tutors, through structured sessions on Teams. This review refined coding strategies and editorial awareness in a dialogical, reflective context. Before the final discussion with international expert Georg Vogeler, the results were also examined collectively with the DSW Lab team, following a co-evaluation logic grounded in peer comparison and progressive enhancement of the work. The evaluation was not summative but integrated into the activities, with an approach centred on process and active learning.

3 Results and pedagogical impact

Twenty-five students completed over 80% of the planned activities, producing digital editorial prototypes of about 5,000 words per group. 92% (N = 23) improved their skills in paleography and TEI encoding. Outcomes were assessed with a four-level rubric covering transcription accuracy, abbreviation handling, markup, and compliance with TEI guidelines, by comparing initial submissions with revised versions after feedback and online discussions. The final edition, soon to be published on DEPCHA, shows the integration of palaeographic skills, digital markup, collaboration, and progressive

[4] https://gams.uni-graz.at/context:depcha

online construction. Participants developed cross-cutting skills for research and communication, from transcription to XML coding, workflow management, and open access publishing [9, 10]. The project also strengthened cooperation between the Universities of Naples and Graz. Although rooted in the historical-documentary field [11, 12], the model is transferable to other corpora, such as notarial records, administrative documentation, or literary sources in digital philological editions. The experience highlights the educational potential of a blended, feedback-based approach that combines archival and philological dimensions with digital tools. Preserving the centrality of sources and student authorship, it fosters an active, participatory, and conscious learning model.

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Making Memories Stick: Designing MR Activities to Reinforce Learning

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1 Introduction

Augmented and Mixed Reality (AR/MR) have traditionally been employed in educational contexts primarily as a tool for visualizing tangible objects or environments that would otherwise be inaccessible, complex, or hazardous to interact with in real life. Typical examples include the three-dimensional reconstruction of mechanical components, anatomical structures, or archaeological artifacts (see for example [1], [2] and [3]). In such applications, "virtuality" serves as a means to augment the learner's perception of reality by overlaying virtual representations onto the physical world, thereby enabling a richer understanding of concrete subject matter. This object-centered approach represents the predominant paradigm ([4] and [5]). However, in any well-designed learning experience, content alone is not enough: educational effectiveness also relies on the activities that allow learners to process, apply, and consolidate that content. Reducing MR to content display would be like assuming that teaching can happen through textbooks alone, without the wide array of didactic strategies that bring knowledge to life.

For several years, a research group at Politecnico di Milano, in collaboration with Fifth-Ingenium and Vodafone, has been exploring a different approach: using MR not to replicate content, but to design and deliver learning activities [6]. This paper focuses on two such activities developed using MR.

2 Two case-studies

The first activity draws inspiration from the ancient Ciceronian "method of loci," which supports memorization through spatial association. The second activity is designed to help students consolidate the most relevant memories from a learning experience—such as a visit to a laboratory. While both were originally developed within a higher education context, they are also adaptable to lower educational levels.

Both experiences were developed as part of two Computer Science Engineering theses, with technical support from HOC-LAB and FifthIngenium, using the TINALP platform

— a Mixed Reality environment designed for accessible and customizable educational use.

The Ciceronian *loci*, also known as the “memory palace,” is an ancient memorization technique that involves associating concepts with familiar places that can be mentally walked through, making it easier to recall information. The developed application brings this technique into mixed reality, allowing users to build immersive, personalized and continuously saved memory palaces, giving to the user the possibility to revisit them when needed. The application is specifically developed for Meta Quest 3/3S. A typical user scenario involves a student who, after scanning their room, places virtual “magnets” on real-world objects, attaches multimedia content (images, videos, audio, 3D models) to these *loci*, and memorizes the associations through guided repetition and gamified tasks including scores and a shared leaderboard.

The escape room-inspired application consists of a series of challenges—such as quizzes and interactive puzzles—built around multimedia materials collected during a study-related visit, for example to a laboratory, research center, or exhibition. These materials, including photos, short videos, 3D models, and textual annotations, are subsequently uploaded to the platform and used as the foundation for learning activities, facilitating the recollection and consolidation of key elements from the visit. Both experiences shift the focus from content itself—which can be easily uploaded by teachers or students via the Tinalp platform—to the learning activity built around it.

3 Evaluation

Preliminary testing with students assessed the applications’ usability and perceived usefulness. The evaluation was conducted on two separate rounds: the first, held during the Politecnico di Milano Open Day (March 29, 2025), involved 63 participants and aimed at gathering initial feedback; the second, held during a classroom session with 7 students, provided the opportunity to carry out a focus group. All participants filled out a questionnaire about the experience. Findings from both sessions confirmed good usability of the applications and a strong perceived usefulness among students. These results align with previous studies that stress the motivational benefits of Mixed Reality in education ([7] and [8]). Despite the limited number of participants, the consistency of the responses and the fact that testers were distributed across the target age range suggest a reasonable degree of reliability. Nonetheless, further research is required to assess the pedagogical validity of the approach.

4 Conclusions

This work builds on a growing body of research that seeks to shift the focus of AR/MR in education from object representation to conceptual engagement, promoting active learning [6]. While preliminary findings indicate high usability and perceived usefulness, further studies are needed to assess long-term learning outcomes and curricular integration. Collaboration with teachers will be key in the next development phases.

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Teaching approaches, Educational Technologies and Faculty Development for Students' Employability: Evidence from the Top 100 Business Schools

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1 Introduction

The swift pace of technological innovation, combined with the unpredictability of the global economy, has given rise to an intensely competitive and constantly evolving job market that demands a highly specialized and adaptable workforce possessing strong technical and professional competencies (Tushar & Sooraksa, 2023; Saleem et al., 2024). In fact, there is a growing concern from employers worldwide about the inability of graduates to match current and future job demands (Nasreen et al., 2024).

The present study is conducted in the context of Business Education (BE) and Business Schools (BSs) are institutions specialized in providing business and management education (Kaplan, 2018). Therefore, BSs, in order to meet labour market changes and employers' expectations, should leverage new collaborative and interactive teaching and learning approaches (T&LAs), promote Faculty Development Initiatives (FDIs) and apply up to date Educational Technologies (ETs) able to promote and enhance student learning and their employability (Bond et al., 2020; Baldegger et al., 2022; Iqbal et al., 2024).

The research intends to define how T&LAs, ETs and FDIs may impact MBA student's learning and employability by submitting a survey to the professors/instructors of the top 100 Business Schools in the world.

Consequently, the present study aims to reply to the following research question:
RQ: To what extent do the Teaching and Learning Approaches (T&LAs), Educational Technologies (ETs) and Faculty Development Initiatives (FDIs) enhance MBA student's learning and employability?

2 Methods and materials

In order to reach the research objective, the study intends to carry out an online survey addressed to professors/instructors of the top 100 BSs in the world to gather their opinions and insights about the above-mentioned independent variables and their potential impact on MBA students' learning and employability. The sample examined is given by the Financial Times ranking 2024/2025 that lists BSs according to their MBA courses.

The survey consists of a questionnaire of four sections containing structured questions (dichotomous, multiple-choice, rating scales) on a 5 point Likert scale and an open-ended question in each section to collect comments and suggestions from the respondents.

The survey went through a pilot for 3 months and after that it was formally administered by email using Google Modules. Email addresses were automatically extracted from the websites of each BS involved by programming and coding with Phyton in Google Collab.

The survey collected, so far, 610 responses providing a significant sample for quantitative and qualitative analysis.

3 Preliminary findings

The present contribution builds upon the research conducted by Dipace and Dicataldo (in press). That study employed a conceptual content analysis for existence performed on the websites of the world's top 100 BSs aimed at analysing key themes related to T&LAs, ETs, and FDIs, with the aim of identifying best practices and the current state of the art. These dimensions are particularly relevant to the education of MBA students and may significantly influence their future professional trajectories. The content analysis findings revealed that experiential learning is the most prevalent pedagogical approach among the institutions examined. In contrast, references to educational technologies were comparatively limited. Faculty development initiatives were present across many schools, though not universally adopted.

The preliminary results of the survey show that the most adopted T&LAs include active learning, experiential learning, collaborative learning, and problem-based learning. In parallel, the ETs most frequently integrated into courses comprise Learning Management Systems (LMS), simulations, educational games, and online collaborative platforms. Faculty members frequently report engaging in multiple forms of professional development initiatives, combining training sessions, pedagogical support, and participation in teaching-related research. Moreover, most respondents consider the T&LAs they most frequently employ to be effective in enhancing both student learning and employability. Perceptions regarding the effectiveness of ETs are more nuanced. While a majority of instructors acknowledge a positive impact of such technologies on both learning outcomes and employability, a significant portion of respondents express more moderate or even critical views. Finally, FDIs are generally regarded as beneficial, particularly in enhancing the quality of student learning. However, when it comes to their perceived contribution to employability, the level of agreement is somewhat lower.

4 Conclusion

To deepen the understanding of these trends, further analysis will be conducted through qualitative examination of open-ended responses and inferential statistical techniques applied to closed-ended survey questions and then compared to content analysis results.

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The Role of Blended Learning in Supporting Neurodivergent Students: A Narrative Review

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1 Introduction

The term "neurodivergent" (ND) refers to individuals whose brains function differently, including those with autism, ADHD, dyslexia, dysgraphia, and other learning differences [1]. Although ND students are enrolling in higher education in rapidly increasing numbers, they consistently have lower completion rates than their peers [2]. This disparity is often due to various challenges, such as difficulties with standard assessments, managing independent study, and social inclusion [1]. A critical issue concerns accommodations for ND students [3]. Many students avoid requesting accommodations due to the stigma associated with disclosing their needs to faculty and peers [4]. Standard accommodations, such as extra time on exams and note-taking support, can help but often fall short of addressing the full range of needs [5].

The recent COVID-19 pandemic has accelerated the diffusion of online learning, leading many universities to integrate their new online teaching methods into their future strategies [6]. As a result, blended learning is increasingly being recognized as the future of higher education, considering its potential to reduce both time and financial burdens on students [7]. Despite several remaining challenges, particularly concerning online instructional design, online education and its various forms can provide meaningful benefits to ND learners [8]. Features such as flexible pacing, multimodal content delivery, asynchronous participation, and personalized feedback enable ND students to engage with learning materials in ways that better match their learning profiles [9, 6].

This narrative review aims to explore how blended learning can be tailored to support ND learners in higher education, with a specific focus on engineering programs.

2 Methods

A selective review of the literature from the past 10 years was conducted across interdisciplinary sources and relevant models, tools, and practices were synthesized and interpreted using the Universal Design for Learning. Following the framework proposed by Le Cunff et al. [10], we identified four key categories to guide the design of online learning environments for ND students in engineering education: format, delivery, assessment, and support.

3 Results and Discussion

Instructors should provide flexible content formats to accommodate diverse learning needs, such as diagrams, mind maps, images, videos, or audio versions [11, 10]. To ensure accessibility, captions and transcripts must be accurate and properly synchronized with audio content [1]. Another key element is the possibility to deliver information at an appropriate pace and level of density [8]. To support this approach, despite ongoing debate, video recordings of lessons (intended as the recording of traditional lectures, where student attendance is still expected) remain one of the most useful available tools [12]. Video recording can decrease the cognitive load of the traditional lesson and enable ND students to personalize, plan, and manage their study [13]. Additionally, they can provide accessible and multi-tiered support for consolidating learning rather than replacing attendance [14].

Accessible learning requires inclusive assessment practices [15]. Flexible deadlines, alternative assessments, and breaking complex assignments into smaller, well-defined steps, as well as providing clear, structured instructions and feedback, can help ND students reach their full potential [10]. In addition to ensuring access to support services, instructors can adopt a variety of tools (e.g., serious games, simulations) to support students both in the classroom and at home [11]. GenAI-based tools, such as conversational and pedagogical agents, further enhance personalization by offering structured, individualized learning interactions [16, 17].

The findings of this narrative review highlight an additional key point: these practices not only support ND students but also enrich the learning experience for all learners [14, 18, 8]. This evidence reinforces the need for continued pedagogical reflection on blended learning in higher education, particularly in light of the UNESCO 2030 Agenda, which advocates for inclusive and equitable educational opportunities for all [19].

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General Track 2

Learning technologies, data analytics and educational big data mining

Formative Feedback and Artificial Intelligence: the New Frontier of Educational Applications

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1 Introduction

Artificial Intelligence (AI) represents one of the most dynamic areas of contemporary technological innovation, with profound implications in every social, economic and professional sphere. In recent years, there has been a progressive democratization of the use of AI thanks to the emergence of no-code and low-code platforms. These platforms allow users without programming skills or with very basic technical knowledge to develop, test and deploy AI-based solutions via graphical interfaces, predefined templates and visual workflows. The no-code/low-code paradigm reduces barriers to accessing technology, enabling even small businesses, professionals and creative people to create intelligent applications to solve complex problems quickly and efficiently [1].

2 No-code/low-code AI applications in education

Among the areas where Artificial Intelligence applications built on no-code/low-code platforms are gaining most interest is education. In school and academic contexts, these solutions allow teachers, managers and even students to create customized tools to support learning and the management of teaching activities, without the need to know any programming languages. Notable examples include the creation of intelligent chatbots for study support, automated evaluation and feedback systems, personalized learning platforms that adapt content to individual needs, and predictive models to monitor school performance and prevent drop-out [2]. No-code/low-code platforms make educational innovation immediately accessible, turning ideas into concrete tools with just a few clicks. Teachers can build customized assessment tools, create automated practice modules, store and visualize learning data, and implement adaptive learning systems where learning content and activities adapt to the pace and needs of each pupil. These environments stimulate more inclusive learning paths, fostering the integration of students with special educational needs through accessible materials and customized pathways. The adoption of these technologies also encourages collaborative practices between teachers and students, through real-time sharing of resources, interactive quizzes and immediate feedback. Further potential emerges from the integration of gamification elements, such as digital badges, levels or dynamic quizzes, useful to stimulate students' motivation and involvement in the learning process. Thanks to no-code platforms, these solutions are feasible without the technical complexity, typical of traditional systems [3].

3 A case study: RiProVapp

A concrete and innovative example of the application of Artificial Intelligence in education, realized through no-code platforms, is the RiProVapp developed on Lovable.dev. This application was designed to offer teachers an intuitive tool that can generate customized formative feedback for students, optimizing the assessment and learning process. The model used for feedback generation is the RiProVa method, adapted from John Hattie [4], recognized in the educational field for its effectiveness in promoting learning improvement through structured, growth-oriented feedback. The application also allows the use of customized assessment rubrics: teachers can upload their own rubrics or generate new ones with the support of the Artificial Intelligence embedded in the platform. This flexibility allows assessments to be adapted to different teaching contexts and the specific objectives of each teacher or school, providing an even more targeted and meaningful assessment experience. The application allows students' papers to be entered in different formats and obtain, thanks to AI, detailed comments, specific suggestions and formative assessments calibrated to everyone's needs. Everything is done via a simple web interface, accessible even to users without technical skills. This saves time in repetitive tasks, while improving the quality and timeliness of feedback. RiProVapp integrates features for customizing assessment criteria, automating progress monitoring and producing useful reports for both teacher and student. Thanks to Lovable.dev's no-code technology, the development and testing of such tools can easily be extended to other educational contexts, making the innovation accessible to an ever-widening audience of educators and students. A future research step envisages testing the application in educational contexts to assess its degree of efficiency and effectiveness.

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Cultivating Data: Data Education and Participatory Botany in Schools*

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1 Goals and Results

Attention to the environment and climate change together with the adoption of big data technologies is becoming increasingly widespread in various fields. At the same time, there is growing recognition of the crucial role played by data education [1, 2] in the life of every citizen. In this context, the BotBid (From Botany to Big Data) project is a citizen science initiative that focuses on the creation of innovative and sustainable school gardens, with the aim of promoting data literacy, scientific and research methods, and citizen science practices [3].

BotBid is an initiative of an interdisciplinary group at the University of Genoa, in the context of the dissemination activities of the NRRP RAISE Innovation Ecosystem (STACY community of Spoke 5). The goal of the BotBid initiative is to provide teachers, and thus their students, with perspectives and tools to make the green experience of the school garden an opportunity to exercise a plurality of skills in the STEM area. The project is closely linked to the digital and ecological transition themes supporting the transformation of each school garden into a widespread biomonitoring experiment. Furthermore, it can be viewed as a starting point for building a citizen science network involving schools of different levels. Citizen science [4] can foster an understanding of engagement with science as well as the perception of the relevance of scientific topics, thus enabling earlier learning in formal science education. Citizen science can indeed enhance aspects including pupils' motivation, interest and knowledge as well as their scientific and communication skills. A high level of student involvement is found to be particularly promising in terms of achieving learning objectives [5, 6].

The experiment involves setting up in each school a garden with 30 control plants and 30 treated plants (submitted to stressful soil conditions) and kits for collecting and transmitting environmental data. The BotBid WebApp has been developed for this purpose to enable the collection of data associated with both

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Fig. 1. Using the BotBid Web app to compare data of different schools

environmental parameters and useful for monitoring plant growth. The project is supported by an Internet of Things/Big Data infrastructure used to collect observation data (e.g., plant biomass, plant growth, soil pH, temperature, etc.) from the school gardens to a central repository. The platform plays the role of digital accelerator for sharing data and knowledge with domain experts and project participants. Furthermore, it enables the creation of a dashboard for data visualization and aggregation, as shown in Fig. 1.

The educational proposal encompasses diverse learning outcomes for participants: 1) learning the fundamentals of environmental and applied botany; 2) acquiring a scientific method by participating in a citizen science project; 3) learning how to use digital devices and applications; 4) learning how to process, interpret, and graphically represent the data from their observations. On a dedicated portal, teachers find all the resources to complete the activities in their schools: in-depth resources, video-tutorials, and recordings of the seminars.

The 2025 edition was launched through online meetings with teachers between November and December 2024 and has already involved five secondary schools from Liguria and one secondary school from Sardinia (Sassari) and involves 10 different classes. The project also includes 9 first-cycle classes in a parallel activity using simplified tools and methods. Including previous editions, the project has reached over 3000 students and around 200 STEM teachers to date. In February 2025, the BotBid project has been selected among the 14 outreach case-studies submitted to the Italian Universities Evaluation process.

Using the BotBid WebApp, it is possible to visualize monitoring data from control and treated plants, following the expert's instructions to simulate soil stressful conditions from different schools and make comparisons and aggregate analyses using business intelligence tools as a concrete example of education on the importance of data, its manipulation and interpretation [7, 8]. In this paper, we present the overall organization of the initiative, the methods and technologies adopted in the 2024-25 edition, and the corresponding results obtained so far.

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Virtual Inclusive Museum: Integrating Learning Methodologies and Technologies in Online Higher Education

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1 Introduction

Higher education is undergoing a period of profound transformation, accelerated by the COVID-19, which has necessitated a review of educational models [1]. European and national strategies, from the Digital Education Action Plan 2021–2027 [2] to the National Digital School Plan [3] and the PNRR [4], have recognised digitalisation as a decisive lever for inclusion and resilience. In this context, virtual museums emerge as innovative educational spaces, capable of broadening access to heritage and promoting collaborative and inclusive learning.

2 Theoretical framework

New museology has redefined the museum as a dynamic and participatory space, where visitors actively construct meaning [5]. By overcoming the constraints of space and place, it can become a context for collaborative learning: "the virtual museum [...] transcends traditional methods of communication and interaction with visitors" [6]. The theoretical framework integrates Bronfenbrenner's ecological model [7] with Flipped Inclusion [8], a constructivist and inclusive approach that dialogues with the principles of UDL [9]and the Index for Inclusion [10]. In this systemic view, inclusion becomes cultural and participatory transformation, and the co-construction of knowledge becomes the central process. Concepts such as the third space [11]and Embodied Education [12] reinforce the idea of virtual museums as hybrid ecosystems, capable of intertwining sensory, cognitive and social dimensions. The ScanItaly project, developed at the University of Salerno, demonstrates how the digitisation of heritage and the use of personal devices can transform the virtual museum into a truly inclusive educational space.

3 Methodology

The research design was based on a mixed-methods approach, which allowed for the integration of quantitative and qualitative dimensions. Firstly, engagement data relating to time spent, frequency of interactions and performance in assessment activities proposed by museum platforms were collected and analysed. On the other hand, interviews and focus groups with students, teachers, and museum operators allowed us to explore subjective perceptions, experiences, and expectations regarding learning experiences mediated by virtual museums. The adoption of design-based research further enriched the methodological approach, allowing us to develop and test prototypes of virtual museums in an iterative manner. The experiments, conducted using immersive devices such as Meta Quest Pro 2, made it possible to progressively calibrate the technological and pedagogical solutions based on user feedback.

4 Results

The evidence in this first phase seems to confirm the transformative potential of virtual museums. Quantitative data indicate that students involved in such experiences achieved significantly better results than those who followed traditional paths, with an increase in learning outcomes [13]. Qualitative evidence further emphasised the greater motivation and engagement of students, highlighting how the immersive and interactive nature of the experiences promotes retention and the construction of a closer bond with cultural heritage. It also emerged that the use of personal devices not only makes the experience more flexible and customisable, but also strengthens the sense of belonging to the community and the connection with the heritage itself [14]. The integration of the Flipped Inclusion model into BYOD environments has helped to generate collaborative dynamics and knowledge co-construction processes, transforming virtual museums into truly inclusive laboratories.

5 Conclusion

The research results show that virtual museums can be an innovative bridge between education and cultural heritage communities, translating the principles of inclusion and accessibility. Their nature as a third space highlights their ability to overcome traditional models, creating learning contexts that hybridise languages, tools and communities. From this perspective, virtual museums are not only technological tools, but real places for sharing and co-construing knowledge, where students, teachers and communities generate meaning together and strengthen bonds of belonging. According to Nussbaum [15] 'A right society is one that enables every individual to develop their abilities, in a context of mutual support and care', future research will need to investigate how such experiences can consolidate the role of informal contexts in higher education. Virtual museums are therefore emerging as collective spaces for learning and well-being, capable of combining technological innovation, social sustainability and cultural enhancement, opening up new perspectives for increasingly inclusive, participatory and community-based university education.

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Teacher-Driven Feedback System for a Presentation Training Software

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1 Introduction

In educational settings, feedback is a crucial mechanism for supporting students in developing their communication skills, particularly in oral presentations. Feedback helps students identify mistakes, understand errors, and improve their future performance. Presentation training software systems, technically known as *Oral Presentation Automated Feedback* systems (OPAFs), offer automated feedback on aspects such as body language, vocal delivery, and content organisation [1]. While OPAFs offer students the advantage of being able to practice at their own pace and time autonomously and receive feedback, they often lack options for including the human teacher in the feedback loop [3]. The study presented in this paper addresses this gap by designing, implementing, and evaluating a teacher-driven feedback feature that complements automated feedback provided and supports richer, more actionable learning experiences. This study was guided by the central question: *How can a teacher-driven feedback system be effectively integrated into presentation training software to enhance the quality and efficiency of feedback provision?*. The investigation is structured around three sub-questions: identifying the core functionalities needed for contextual and personalised feedback, designing these features for usability and pedagogical effectiveness, and determining how feedback data should be structured and integrated into the software. In recent years, OPAFs have emerged as a significant application of multimodal learning analytics, aiming to support the acquisition and practice of oral presentation skills through automated, data-driven feedback [1]. OPAF systems integrate software and hardware to capture multimodal information during oral presentations (including body language, gaze direction, voice volume, articulation speed, and the use of visual aids) and then provide real-time or near-real-time alerts, recommendations, or performance reports to presenters. These systems offer scalable solutions to the challenge of providing regular, formative feedback in educational contexts where instructor time is limited [2]. Despite their promise, many OPAF systems remain closed or under-evaluated prototypes, limiting their adoption and pedagogical impact [1]. Even the most advanced OPAF systems often lack the contextual sensitivity and dialogic engagement that human instructors can provide. As a result, there is a need for integrating teacher-driven feedback mechanisms into presentation training software, allowing educators to supplement automated analytics with personalised, actionable guidance and to engage in two-way communication with students. In this study, we build on Presentable [5], a recent web-based OPAF designed to guide users through content development, recording, and rehearsal, offering automated analysis of both verbal and non-verbal aspects such as body posture, gestures, and vocal delivery. With Presentable, students receive real-time feedback and recommendations, allowing them to refine their presentations iteratively.

2 Method

The teacher-driven feedback tool is implemented as a web-based application with a Next.js frontend and a Django backend. The system supports rich text feedback, allowing teachers to format comments, use feedback templates, and insert clickable timestamps that link directly to specific moments in the presentation video. Teachers can annotate transcripts, highlighting and commenting on specific segments of spoken content, and engage in asynchronous dialogue with students through a comment section. The event validation feature enables teachers to confirm or reject AI-detected events, ensuring that only relevant feedback is shown to students. The architecture is modular, scalable, and designed for accessibility and mobile support. A qualitative study involving two secondary school teachers and two university-level tutors was conducted to assess the usability and effectiveness of the tool. Participants described the interface as clear and intuitive, appreciating the logical division of presentation details, detected events, and transcript. Features such as timestamp-based comments and transcript annotation were especially valued, as they align with natural feedback practices and support structured responses. Feedback templates helped focus attention on content rather than formatting, and the documentation of feedback allowed students to revisit comments for future improvement. Participants also identified areas for enhancement, including the need for draft-saving, richer formatting options, and better integration of transcript comments within the transcript view. Suggestions for future development included peer feedback, voice-recorded feedback, and more holistic AI event detection.

3 Conclusion

The exploratory methodology used in this study enabled the collection of insights into both usability and pedagogical needs of a teacher-driven feedback tool. While the small sample size limits generalizability, the findings provide actionable directions for further development. The teacher-driven feedback feature developed in this study significantly extends the capabilities of Presentable presentation training software by enabling educators to "close the feedback loop" of AI-based tutoring [4]. The positive reception among teachers and tutors, along with their constructive suggestions, demonstrates the potential of such tools to enhance both the quality of feedback in educational practice.

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Customized chatbots and Artificial Intelligence for physical activity design at school: the case of UniVersus

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1 Introduction

The introduction of Artificial Intelligence (AI) in education has ushered in a new phase in the redefinition of educational processes, opening unprecedented methodological and technological possibilities. Among the most promising applications, chatbots are emerging as effective tools to support teaching and learning in a personalized, continuous and adaptive way, fostering dynamic and learner-centered communication [1]. Embedded in the theoretical framework of social constructivism, they enhance interaction as a fundamental lever of the educational process, acting as a support to the teacher in instructional design, needs analysis and development of targeted strategies. They do not replace teaching interaction, but extend its potential by enhancing the teacher's mediation, observation and adaptation skills [2].

2 Customized chatbots for instructional design

In this context, personalized chatbots emerge as strategic allies of the teacher, designed not only to provide answers, but to support instructional design, guide learning paths and optimize the organization of classroom work. When calibrated to the educational objectives and specific context, they can suggest targeted activities, offer insights, prepare personalized materials and adapt in real time to the cognitive and emotional characteristics of students. Their effectiveness grows when they enhance instructional intentionality, allowing the teacher to maintain control of the instructional process and sharpen the ability to read and respond to educational needs. With configurable interfaces and modulable communicative behaviors, chatbots based on architectures such as ChatGPT lighten the teacher's cognitive load, systematize data analysis, support the selection of the most appropriate activities, and document in a structured way the paths taken [3]. The possibility of defining articulated prompts and adopting a communicative style consistent with the school's educational philosophy makes them true adaptive digital environments, capable of supporting the teacher at all stages of professional practice-from planning to formative assessment, from personalization to progress monitoring [4].

3 The case of UniVersus

This paper presents UniVersus, an advanced generative AI chatbot designed as a tool to support teachers in educational planning, with a particular focus on creating inclusive physical activities for students aged 3 to 19. Conceived and developed by one of the authors, UniVersus is currently available free of charge among ChatGPT's GPTs and is in the testing phase. The aim of this paper is to describe its conceptual framework and its construction and operating architecture, prior to experimental field testing. The system integrates a solid pedagogical framework based on ministerial guidelines, theoretical references to motor development, and principles of school inclusion. Through a dialogic interface, UniVersus guides teachers through a guided planning process, collecting and processing data from structured sources (such as student records and family questionnaires) and providing immediately usable project outputs: complete activity sheets, differentiated by age, educational needs, and learning objectives. The conversational flow allows teachers to analyze and interpret students' motor profiles and build educational paths tailored to individual and group needs. The operational proposals cover a wide range of objectives—from motor coordination to relationships, from emotional regulation to motivation—and include detailed information on objectives, descriptions, materials, spaces, times, and facilitated and enhanced variations.
This approach aims to offer truly flexible and responsive teaching, capable of respecting differences and enhancing the potential of each learner, in line with the principles of Universal Design for Learning and the idea of a school that adapts to students and not vice versa. Future research may investigate the impact of UniVersus in school contexts and its integration into initial and in-service teacher training courses.

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Special Track 1

Rethink Education: The Opportunities and Challenges of Artificial Intelligence

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X-IDEA: Explainable, Inclusive, Equitable Code-Learning Assistants

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1 Introduction

First-year programming courses persistently record the highest attrition in computing programmes. International reviews place failure or withdrawal between 30% and 50% [1, 2, 3]. Attrition is heavier among students who identify with groups historically excluded from computing, a pattern that limits workforce diversity and weakens social mobility [4].

Large-language-model assistants such as GitHub Copilot or ChatGPT offer rapid feedback and abundant worked examples, which seems attractive to instructors facing crowded classrooms. Empirical work, however, shows that students perceive these systems as inscrutable, that teachers worry about plagiarism and bias, and that institutions struggle with privacy regulations [5].

A recent qualitative content analysis of 156 Reddit posts and 3512 comments, grouped into twenty topics, paints a similarly ambivalent picture: enthusiasm for rapid feedback is matched by anxiety over explainability and academic integrity [6]. These forum voices supplied many of the requirements that shaped X-IDEA.

The present contribution introduces X-IDEA, a design framework for explainable, privacy-aware, and teacher-governed code-learning assistants. The framework is theoretical; it offers constructs and propositions that can be examined in future empirical studies.

1.1 Motivation and contribution

Introductory programming (CS1) still records 30–50 % failure or withdrawal rates, with disproportionately higher attrition among different groups [1, 2, 3]. Existing AI assistants such as Copilot or ChatGPT provide fast feedback but raise concerns about opacity, plagiarism, bias and data-protection regulations [4, 6]. We propose X-IDEA, a design framework that integrates five layers, Learning Objectives, Learner Modelling, Generative Support, Explainable AI and Teacher Governance, under a set of design principles explicitly aligned with the challenges of remote and bandwidth-constrained higher-education contexts.

The present paper advances three concrete contributions beyond previous drafts: a tighter mapping between each layer and the practical constraints of distance programming labs (e.g. intermittent connectivity, privacy legislation, large cohorts); an expanded theoretical grounding that links X-IDEA to the state of the art in explainable

AI for education, equity-centred design and programming-specific tutoring; a clarified empirical roadmap with explicit study designs and measurable outcomes.

2 The X-IDEA framework

X-IDEA is organised in five interacting layers. Each layer addresses one pressing opportunity paired with a technical or ethical challenge. Design principles (DP) are printed in italics.

1. Learning objectives. A graph of concepts spans syntax, semantics, and problemsolving patterns, indexed to Bloom levels.

DP1concept alignment: every AI action carries a pointer to a concept node, which later enables transparent assessment.

2. Learner modelling and personalisation. Local logs of compilation outcomes, test traces, and debugging paths.

DP2 Minimal-Intrusion Data: only telemetry created inside the development environment is stored, and all raw code remains on institutional servers.

3. Generative support. Several lightweight language models synthesise hints, partial solutions, or culturally localised storylines.

DP3 scaffold-before-solve: the default output is a Socratic question or micro-hint; direct code appears only when earlier prompts were exhausted.

4. Explainable AI. Two explanation modalities are provided: token-level concept labels and counter-factual test simulations.

DP4 dual-audience transparency: novice-friendly text expands, on demand, into a technical rationale that teachers can audit.

5. Teacher-in-the-loop governance. Dashboards visualise aggregate model accuracy, bias indicators, and student misconceptions; teachers can approve, edit, or block any suggestion.

DP5 human override: every override is logged and feeds back into the learner model and bias detector.

2.1 Development process

Design requirements were triangulated against insights from an earlier Reddit corpus study [6]. For example, the rule DP3 scaffoldbefore-solve mirrors the forum's recurrent complaint that "Copilot gives you code before you know what it does," whereas DP5 Human Override responds to lengthy discussions in which learners begged instructors to "step in and set boundaries."

The framework materialised through design-science research. First, literature on programming misconceptions, explainable AI, and AI ethics in education was reviewed to extract requirements. Second, low-fidelity prototypes were sketched, then inspected by three CS1 lecturers in semi-structured interviews. Their feedback informed the five design principles above. Third, theoretical propositions, reported in Section 3, were generated to guide future evaluation.

3 Research propositions

P1 Transparency fosters trust. Concept-level explanations are expected to improve perceived trust, which in turn mediates self-regulated learning.

P2 Scaffold depth predicts learning gain. Hints that progress from question to partial code, tuned to mastery, will raise post-test scores relative to either immediate solutions or no assistance.

P3 Governance engagement affects equity. Frequent teacher interaction with the governance layer will narrow achievement gaps across demographic groups.

P4 Privacy architecture shapes adoption. Institutions with limited connectivity will declare higher adoption intent when models run on local servers despite lower accuracy.

P5 Explainability has an optimum. Excessive detail can overload novices; a middle ground between brevity and completeness must be located.

First, in late 2025 a small group of engineering lecturers will read the framework and give straightforward feedback on what makes sense and what does not. Next, in early 2026 the assistant will be tried in a single course; we will record how much students learn from before to after the course and ask them how easy the tool feels to use. Finally, throughout 2026 the assistant will be deployed at several courses; we will compare a version that runs on each campus's own servers with one that runs in the cloud, and we will examine whether the system increases trust, improves learning, and reduces performance gaps between different kinds of students.

4 Roadmap and conclusion

Phase 1 Design validation: The twenty-topic Reddit taxonomy will be juxtaposed with expert walkthroughs: lecturers will judge whether each design principle truly addresses the community-voiced concerns catalogued by Di Leo [6].

Phase 2 Pilot deployment: A single CS1 laboratory adopts an early X-IDEA prototype for one semester; quantitative logs and qualitative interviews will be collected.

Phase 3 multi-site studies: Quasi-experimental trials across several institutions test propositions P1–P5 under diverse curricular and infrastructural conditions.

X-IDEA offers a synthesised blueprint for building AI coding assistants that are explainable, inclusive, privacy-aware and teacher-governed, with explicit affordances for remote learning infrastructures. Upcoming empirical work will assess whether the framework can indeed lower attrition while safeguarding academic integrity and learner equity.

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Towards an AI ecology

Educational approaches to generative artificial intelligence

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1 Theoretical Framework

This work is positioned at the intersection of constructivist pedagogy, psychoanalysis, and the philosophy of mind, with particular reference to the *Extended Mind Theory (*EMT) [1]. It conceptualizes *Generative Artificial Intelligence* (GAI) both as a "more knowledgeable other" within the *Zone of Proximal Development* (ZPD) [2] and as a site of "transference" [3–6], where the relation to knowledge is intertwined with desire. In this way, AI not only scaffolds learning but also reshapes the affective and unconscious dynamics of education.

1.1 Models for the mind–technology relationship

Three theoretical frameworks guide the analysis. (i) *Thought and Language*: Introducing the concept of the ZPD as "the distance between what a child can do alone and what they can do with help." His theories offer a fundamental framework for understanding how thought develops through social interaction and the support of more experienced individuals (cognitive scaffolding) [2, 7, 8]; (ii) EMT: external tools, including GAI, as extensions of the mind when meeting conditions such as reliability, trust, transparency, and personalization, effectively becoming cognitive extensions that amplify cognition beyond their usual limits [1]; (iii) and the *Architecture of Cognitive Amplification (*ACA): exploring the growing role of AI as an extension of human cognition through "system 0". The research identifies a fundamental paradox: while GAI can enhance cognitive abilities (problem-solving, learning, creativity), its user-friendly and "comfortable" nature risks inducing intellectual stagnation and complacency [9].

1.2 Educational Implications

Teaching GAI in schools has the potential to foster personalized and multimodal learning, broaden access to resources, enhance motivation, and stimulate critical thinking when embedded within reflective practices. At the same time, it also entails significant risks, including cognitive dependency and reduced autonomy, intellectual disengagement and complacency, homogenization of thought with a consequent loss of creative originality, and limited epistemic transparency, since outputs may appear plausible while still being erroneous. Addressing these issues requires the development of *AI literacy* as a transversal skill, encompassing critical questioning, source verification, and contextual interpretation.

2 Educational Design Proposal

In this study, we compared ChatGPT study mode, Gemini guide for education, and Claude for education. Drawing on Vygotsky's concept of scaffolding, we highlighted their opportunities and limitations. ChatGPT, Gemini, and Claude adopt distinct approaches to educational scaffolding: ChatGPT is flexible and adaptive, Gemini offers rich multimedia resources, and Claude fosters critical thinking through reflective questioning. All three support the ZPD but differ in style, interface, and age adaptation. This leads us to note that (i) GAI must be an epistemic partner, not a cognitive shortcut; (ii) educational systems should design interfaces that promote reflection, dialogue, and epistemological awareness; and (iii) GAI-based learning environments must ensure transparency, interrogability, and reliability, supporting student agency.

3 Conclusion

Only informed educational design, grounded in an understanding of the cognitive, relational, and transformative dimensions of GAI, can make schools places where technology does not replace the human mind but extends it critically, equitably, and humanely. Future research should systematically investigate the interaction between GAI and students, as well as the long-term dynamics associated with the transformation of epistemic habits. Special attention should be given to the teacher's role as mediator of the GAI experience, and to the development of educational tools based on explainable, interrogable, and culturally situated models.

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Exploring AI in Socio-Educational Practices: A Three-Dimensional Approach through Capabilities, Affordance-in-Practice and Sentiment

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1 Introduction

The TEACH-AI (Transformative Educational Approaches for Civic and Human-centered AI) research project, conducted by the CREDDI research group at eCampus University, aims to explore the perception, knowledge and use of Generative AI in Italian socio-educational services, aligning with a growing body of research on the relationship between AI and the socio-pedagogical sector [1; 2].

To initiate the research, the PAIR (Participatory AI for Inclusive Relationships) questionnaire was developed and validated, with the goal of investigating training needs within socio-educational contexts. The validation process involved an initial content evaluation by 15 academic experts and Third Sector professionals and then online administration to a sample of about 300 workers from 20 social cooperatives distributed across different geographical areas in Italy.

The tool allows to detect three key dimensions useful for developing the analysis and measuring the impact of AI in socio-educational contexts: Capability, which refers to the competence in using AI in both personal and professional experience; Affordance-in-Practice, which analyzes the frequency of AI application in the work context; and Sentiment, which records positive or negative emotions towards AI, from a socio-cultural perspective.

2 Theoretical Framework

The article explores the definition of each dimension through a dual analytical perspective. First, it examines connections with existing literature on each of the three identified concepts, with particular attention to their meaning in the digital context and their socio-pedagogical and educational relevance. Secondly, it identifies the potential uses and the dynamics of adaptation and transposition of each concept to the features and uses of AI, particularly in educational and socio-pedagogical contexts beyond the school setting [3].

Investigating capabilities [4; 5] in relation to the connection between social workers and AI goes beyond assessing competence in using available resources: it explores the actual possibility of meaningful use within a given social context [6]. It distinguishes between access to resources and the ability to benefit from them; it is based on a personalized reading of experience; it promotes empowerment and professional autonomy; it reflects on the dialectic between the potential offered by AI and the perception of efficacy and creativity; it identifies the coherence between the use of AI and the socio-educational mission; it captures the freedoms that AI enhances or inhibits in educational work.

The term affordance has been adopted by social scientists and media and communication scholars to describe the relationship between the features of technologies and the structure of social relations, as well as to highlight the technological qualities underlying user practices [7; 8]. The dimension of Affordance-in-Practice addresses affordances analyzed within the specific context in which the subject—technology user—applies their communicative style, a certain level of competence, and is systematically influenced by their socio-cultural background [9]. In this research, the focus concerns the application of AI in Italian socio-educational services.

The concept of sentiment assumes the centrality of emotions as a cognitive indicator of behaviors [10], measuring both the emotional polarity perceived in a communicative environment and its target audiences, and the emotional tone that it generates or reinforces [11]. The analysis of this dimension in the socio-educational world aims to identify the perception of professionals towards AI, what types of polarity emerge, which aspects and characteristics of AI influence sentiment, what kinds of emotions are associated, and what is the core object of sentiment: AI itself, the operational change it entails, the skills it requires, or the ethical dimensions.

3 Research Perspectives

The testing of these three dimensions not only support the structuring and further confirmation of the validity and applicability of the PAIR questionnaire, but also aim to build a broader research approach to the relationship between the socio-educational sector and AI from an interdisciplinary and articulated perspective. Future analyses will allow for further investigation of the collected data and reflection on the relationship between the investigated dimensions and their potential contribution to the definition of co-agency between socio-educational workers and AI. This will be considered not only as informational data, but also as a multifactorial indicator. This can help guide, more effectively and in a situated way, both the professional development of practitioners and the organizational and managerial aspects of associations and cooperatives, as well as methodologies of interaction with service recipients.

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Can Large Language Models produce effective educational feedback? A comparative analysis.

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1. Introduction

Feedback is recognised as a powerful means of supporting personalised learning in Higher Education, enhancing task achievement and improving performance [1].

Given its importance, this research explores the role of Artificial Intelligence (AI) in making high-quality feedback more scalable. Specifically, the study is focused on the potential of existing Large Language Models (LLMs) in scaffolding academics in the creation of educational feedback for students.

Starting from two previous studies [2, 3], the researchers investigated the features of the feedback generated by seven prominent LLMs (GPT-4o; Gemini 1.5 Pro Latest; Claude 3.5 Sonnet; Mistral Large (2402); Open Mixtral 8x22B (2404); Llama 3.1 70B Instruct Turbo; Qwen2 72B Instruct) operated to assess a specific authentic task—a lesson plan design—completed by university students enrolled in a habilitation program for teaching in secondary school.

2. Methods

The analysis was guided by Hughes, Smith and Creese's framework [4] which considers praise, critique, advice, and clarification as the four main features of a well-formed feedback.

The LLMs evaluation was implemented through the use of the big-Agi platform (https://big-agi.com/), which allowed us to use simultaneously seven different LLMs that were prompted, in a non-structured way in order to simulate a real teacher prompting process, for producing feedback for each criterion on which the students' tasks have been assessed.

Starting from the two research questions - (RQ1) Are LLMs able to produce descriptive feedback that effectively supports students' learning process? and (RQ2) Is LLMgenerated feedback well-formed? - it was decided to compare the quality of LLMs feedback adopting a qualitative analysis and a coding procedure, in order to understand if these systems could help instructors and students in a valuable manner, truly supporting teaching, learning and assessment processes. In specific connection to feedback, due to its powerful impact on students' learning progress [1], it seems important to understand how to make it scalable and sustainable with respect to production and its use through the use of AI.

3. Results and Discussion

The results showed consistent differences between the adopted LLMs ability to deliver nuanced corrective feedback and error detection. Specifically, Mistral Large (2402) seemed to be the best in overall performance related to feedback production in light of the framework of Hughes, Smith and Creese [4].

In fact, it delivered highly effective and well-balanced feedback, emphasising detailed analysis, actionable recommendations, and guidance for future progress. It skilfully blends positive reinforcement, constructive criticism, and practical advice, making it especially valuable for supporting student learning.

Answering the research questions, we found that while most LLMs could produce wellformed (RQ2) and descriptively supportive (RQ1) feedback, their consistency in crucial areas like error correction and clarification varied significantly, underscoring the need for human oversight. LLMs can generate descriptive feedback that supports student learning, combining praise, constructive criticism, and practical advice, though error correction and clarification are less consistent.

4. Conclusions

The overall overview, underlines that integrating LLM-generated feedback can significantly reduce educators' workload, enabling more timely and consistent formative assessment, in line with Hattie and Timperley's principles [5].

However, differences between models highlight the importance of well-designed rubrics and clear prompts to ensure that AI supports—rather than replaces—teachers' professional judgment. This is essential for preserving assessment quality and fairness, as emphasised by UNESCO's ethical guidelines [6].

In light of this evidence, future work should focus on improving prompt strategies, rubric design, and evaluating long-term learning impacts [2,3]. Moreover, professional development for educators is vital to align AI tools with pedagogical practice [7]. Overall, while LLMs hold promise for enhancing feedback in Higher Education, their success depends on the integration of technological innovation with sound educational design.

Ultimately, the research aims to structure our findings into clear guidelines for the educators to use these systems as feedback scaffold, integrating technological innovation with robust educational design.

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Artificial intelligence and eSport to innovate motor learning in youth football

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1 Introduction

In recent years, artificial intelligence (AI) has taken an increasingly central role in the development of adaptive and personalised learning environments, both in education and sport (Zawacki-Richter et al., 2019). In football, match analysis supported by AI algorithms and the realistic simulations offered by latest generation video games are transforming the way athletes and coaches develop and evaluate technical and tactical skills (Memmert & Raabe, 2019). Football eSports, such as EA Sports FC 25, utilise AI engines to generate credible virtual opponents, dynamic game scenarios and immediate feedback, replicating situations on the pitch and enabling immersive training sessions (Himmelstein et al., 2017). In addition, football eSports are experiencing rapid growth due to their educational and social potential, combining learning and entertainment (Fortes et al., 2022). Although predominantly focused on cognitive development, they are also able to stimulate physical skills, encourage participation in real physical activities and help counteract sedentariness (Ningning & Wenguang, 2023). ESports foster the development of cognitive skills such as concentration and quick decision-making, and professional players show reaction times comparable to those of elite athletes (Malone et al.,2022). However, while the cognitive effects of eSports are widely documented (Kowert & Quandt, 2014), there remains a lack of literature exploring how AI-based virtual environments can affect motor skill development and learning perceptions in young athletes. In addition, there is no consolidated evidence on the possible connections between improvements in physical and technical-tactical performance, achieved through a training protocollar integrated with recreational eSports experiences, and the athletes' perceptions of motor learning, analysed according to the two main approaches: cognitive and ecological-dynamic.

Purpose

This study aims to evaluate the comparative effectiveness of two different training protocols, based on cognitive and ecological-dynamic approaches respectively, investigating in particular how the integration of AI-powered virtual environments (football eSports) can develop the responsiveness, speed and technical-tactical skills of young footballers. In addition, the aim is to analyse the impact of such AI-based environments on perceptions of learning and motivation, helping to reflect on the pedagogical opportunities and challenges associated with the use of AI in sports education processes.

2 Methods

The sample consisted of 62 young male and female footballers (12-16 years), subdivided into a control group (GC) and an experimental group (GS). The GC followed a training protocol based on the traditional cognitive approach, while the GS performed exercises inspired by the ecological-dynamic approach, supplemented with football eSport sessions (EA Sports FC 25). These sessions utilised the AI-based game engine to generate adaptive challenges and provide immediate feedback aimed at enhancing responsiveness, speed and decision-making ability. The AI component is embedded in the game engine and is responsible for controlling the opposing team during gameplay. This AI dynamically manages in-game decisions, tactics, and responsiveness of the virtual opponents, thereby generating realistic and challenging scenarios for the user. Moreover, the difficulty level of the AI can be manually adjusted to progressively increase the complexity of the stimuli and the tactical demands, ensuring an adaptive and scalable training experience tailored to the players' skill levels.
Both groups were assessed in three moments (pre-, in- and post-intervention) using the BlazePod for measuring reaction speed and coordination, the 30-metre sprint test for linear speed, and the adapted Illinois Agility Test to assess agility with a technical-tactical component in a simulated game context. In addition, a standardised questionnaire was administered in all phases to collect the athletes' perceptions of the cognitive and physical improvements resulting from the use of AI-based virtual environments. A repeated-measures ANOVA was used for statistical analysis to compare performance data across groups and time phases, while the Wilcoxon test was applied to test for intragroup variation in learning perceptions across the three surveys.

3 Results

The GS showed significant improvement in all objective variables analysed. Specifically, mean reaction time decreased from 709.10 ms to 683.55 ms ($F = 31.687$, $p < .001$); 30 metre sprint time decreased from 4.908 to 4.651 seconds ($F = 74.076$, $p < .001$); agility, as measured by the adapted Illinois Agility Test with ball control, improved from approximately 17.33 to 16.51 seconds ($F = 52.663$, $p < .001$). In addition, questionnaire analysis revealed significantly more positive perceptions in the GS than in the GC regarding the cognitive and motor benefits of using AI-based virtual environments ($p < .001$; Cohen's $d \approx 0.85$). In the GC participants, on the other hand, perceptions scores remained virtually unchanged across the three survey phases.

4 Conclusion

The results indicate that a training protocol based on the ecological-dynamic approach and integrated with AI-powered football eSports can more effectively enhance reactivity, speed and techno-tactical skills than a traditional cognitive approach. The positive effect revealed in both objective performance and athletes' perceptions points to a significant educational potential for integrating AI-based environments into youth training protocols. However, the balance between automation and human interaction as well as the ethical and motivational challenges associated with the use of AI in physical education will need to be explored in future studies.

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Dialoguing with the algorithm: the role of AI-generated feedback in shaping pre-service teachers' design practices

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1 Introduction

The introduction of artificial intelligence into educational settings is reshaping the role of the teacher, increasingly called upon to renegotiate their professional identity within a hybrid and algorithmic learning ecosystem marked by a tension between familiarity and distrust [1-3]. Within this context, the notion of AI as a co-designer emerges - an agent capable of fostering not merely instrumental, but dialogic and reflective interaction [4, 5]. AI-generated feedback thus assumes a central role: its perceived quality and the teacher's ability to critically integrate it become key for assessing its effectiveness in instructional design [6]. This study explores how interaction with AI influences the perceived usefulness of such tools in educational planning, combining quantitative data and reflective practices to investigate AI's potential as a cognitive partner in teaching and learning.

2 Methods

This exploratory study was conducted in 2025 and involved 205 pre-service teachers (*response rate*: 93.17%) enrolled in the Primary Teacher Education program at the University of Foggia. Embedded within the *Educational Technologies* laboratory, the study adopts a sequential explanatory mixed-methods design (quantitative → qualitative) [7]. The first phase, quantitative in nature, aimed to identify the factors that predict the perceived usefulness of AI-supported instructional design. A CAWI questionnaire was administered, comprising closed-ended questions, Likert scales, open-ended responses. Within the laboratory, participants were asked to design a learning activity using AI as a co-design tool. Through real-time interaction with the system, they refined their drafts, producing coherent outputs that were then submitted to an AI-based digital environment to receive feedback. This feedback prompted further revisions and critical reflection on their design choices. Statistical analysis was conducted to test four hypotheses: that feedback quality positively influences perceived usefulness (H1); that this effect is mediated by the degree of uptake, defined as the number of revisions adopted (H2); that dialogic reflexivity predicts perceived usefulness directly or indirectly (H3); and that the level of perceived agency moderates the relationship between uptake and usefulness (H4). The hypotheses were tested through hierarchical multiple regression, mediation analysis using bootstrapping procedures (PROCESS, Model 4), and moderation testing (Model 14). Second, the qualitative phase - detailed elsewhere - explores reflective processes triggered by AI dialogue and design changes in final artefacts. Thematic analysis examined reflexivity, types of modifications, and perceptions of professional agency.

3 Analysis

The data analysis was carried out in multiple phases to explore the predictors of the perceived usefulness of AI-based support (SPI) during instructional design. First, a Pearson correlation matrix was conducted. The results revealed a positive and significant correlation between the perceived quality of feedback (QUALFEED) and SPI ($r = .43$), indicating that feedback perceived as clear, specific, and relevant is associated with a higher perception of the AI tool's usefulness. Smaller but still positive correlations were found between SPI and uptake ($r = .23$), as well as between SPI and dialogic interaction ($r = .09$). In contrast, perceived agency was negatively correlated with SPI ($r = -.22$), suggesting an inverse relationship between a sense of autonomy and the perceived value of AI support. Based on these findings, a multiple linear regression analysis was conducted, including six predictors: uptake, agency, stimulated reflexivity, quality of feedback, dialogic interaction, and the interaction term. The model was statistically significant ($F(6, 184) = 8.58$; $p < .001$), accounting for 21.8% of the variance in perceived usefulness ($R^2 = .218$; adj. $R^2 = .193$). Within the model, QUALFEED emerged as the most significant predictor ($\beta = .322$; $t = 5.54$; $p < .001$). Uptake also contributed significantly ($\beta = .083$; $t = 2.13$; $p = .035$), while stimulated reflexivity and agency did not reach statistical significance ($p > .05$). The interaction term between RDS and agency, as well as dialogic interaction, were included to test for moderating or joint effects, but neither was significant nor independently explained additional variance. Overall, the results provide partial support for the hypotheses. Hypothesis 1 (H1), regarding the effect of feedback quality on perceived usefulness, was confirmed. Hypothesis 2 (H2), which proposed a role of uptake, received preliminary support at the correlational level but requires further investigation. Hypotheses 3 and 4 (H3, H4) were not supported by the current model.

4 Conclusion

The study developed an explanatory model of the perceived usefulness of AI in design, integrating cognitive, affective, and relational dimensions. Results indicate that feedback quality is the most stable and significant predictor, while uptake exerts a more modest yet meaningful direct effect. Perceived agency and dialogic interaction did not yield statistically significant results, though they may operate at levels not detectable through aggregated measures. The approach emphasizes a mixed-methods design, in which the subsequent qualitative analysis will allow for a deeper exploration of the situated meaning of emerging practices and the formative trajectories they activate.

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Multisensory learning environments and Artificial Intelligence: an experimental study

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1 Theoretical Background

In recent years, the evolution of educational technologies has highlighted the central role of sensory experience in learning processes. Neuroscience and embodied cognition have shown that knowledge does not stem solely from abstract mental processes but is deeply influenced by the body's interaction with the environment [1, 2]. In this context, multisensory environments, originally developed for clinical and rehabilitative purposes, are increasingly being adopted in education as tools capable of simultaneously stimulating both cognitive and emotional dimensions [3, 4, 5].

In parallel, Artificial Intelligence (AI) is opening new prospects for personalised education, thanks to its ability to adapt content and strategies to learners' needs. Recent studies highlight its potential in enhancing learning personalisation, managing cognitive load, and boosting motivation [6, 7, 8]. Some applications also integrate AI with biometric data to enable environments that self-regulate in real time based on students' attentional or emotional states, using measures such as EDA, HRV, or eye-tracking [9, 10]. Nonetheless, further empirical validation is needed to confirm the effectiveness of these innovations.

This study contributes to this research area by analysing the effects of an immersive lesson conducted in a multisensory environment, with a dual aim: to evaluate its impact on information retention and to explore the potential evolution towards AI-driven adaptive environments.

2 Research Project

The study involved 72 students from the "Bianciardi" Art High School in Grosseto, equally divided into two groups: the control group attended the lesson in a traditional classroom, while the experimental group took part in the same lesson within a multisensory room designed with the SHX system. The participants, aged between 16 and 19, were randomly assigned to the groups. To exclude possible differences in verbal memory, all students were preliminarily administered the Rey Auditory Verbal Learning Test (RAVLT) [11], which confirmed equivalence between the groups.

The lesson, identical in content and focused on the structure of the neuron and synaptic communication, was delivered in a traditional frontal format for the control group, while the experimental group experienced the same lesson in the SHX room. The room featured adjustable blue lighting, 40 Hz sound stimulation, tactile vibration, olfactory cues, and audiovisual projections. Each session lasted 30 minutes.

Learning was assessed in two phases. Approximately four hours after the lesson, students completed a multiple-choice test (to measure cued recall) and an open-ended test (to measure free recall). Four weeks later, the same tests were administered again to assess long-term retention.

A qualitative component complemented the quantitative analysis. Focus groups were conducted, recorded, and transcribed. The transcripts were analysed using the GPT-4-turbo language model to identify recurring themes and classify expressed emotions.

2.1 Results

Quantitative results revealed significant differences between the groups. Post-lesson, the experimental group achieved average scores of 8.5 (multiple-choice) and 8.0 (open-ended), compared to 7.0 and 6.0 for the control group. Statistical analyses (t-test) confirmed the significance of these differences ($p < .001$), with a large effect size (Cohen's $d > 1.8$). In the follow-up phase, the experimental group maintained higher performance levels, with a 20% higher retention rate than the control group, suggesting more effective memory consolidation.

Qualitative analysis revealed different subjective experiences. Students in the experimental group described the session as "motivating," "stimulating," and "easy to understand," whereas the control group used terms associated with boredom, difficulty, and passivity. Emotional analysis showed a predominance of interest (88%) and engagement (81%) in the experimental group, compared to boredom (62%) and confusion (54%) in the control group.

3 Discussion and conclusions

The findings clearly show that the multisensory environment supported both immediate learning and long-term retention. The simultaneous activation of multiple sensory channels facilitated deeper processing of content, in line with theories of cognitive load and multimedia learning [12]. Furthermore, the immersive experience stimulated greater motivation and emotional engagement, key components of student-centred pedagogical models, suggesting that a sensory-enriched approach may foster more meaningful and engaging learning.

To ensure greater control over the variables involved, the intervention was designed so that both groups received the same lesson, delivered by the same teacher and focused on identical content. This methodological choice allowed us to isolate the influence of the learning environment, thereby strengthening the study's internal validity. However, this design also constitutes a limitation in terms of generalisability, as it does not allow for the extension of the results to more heterogeneous teaching contexts. Future studies should therefore involve a wider variety of teachers, subjects, and content to verify the replicability of these findings.

In this perspective, an interesting avenue emerges for the integration of artificial intelligence within multisensory environments, enabling real-time adaptation of stimuli and configurations based on students' biometric feedback. Although still in an exploratory phase, such developments point towards a promising future for increasingly personalised and responsive educational settings.

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Can Artificial Intelligence Replicate Human Grading?

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1 Introduction

Can artificial intelligence take on one of the most human aspects of teaching: grading open-ended student responses? This kind of assignment is essential in education, fostering critical thinking and revealing students' reasoning and conceptual understanding [1]. However, the evaluation of open-ended responses is time-consuming and difficult to scale [2]. With the advent of large language models (LLMs), the educational landscape has been significantly transformed, enabling new possibilities for automating complex tasks [3]. While recent studies have explored the use of LLMs for assessing open-ended responses [4–7], they rarely address adaptation to the specific and often variable evaluation criteria used by individual instructors. This work investigates whether LLMs, specifically GPT-4o and GPT-4o Mini, can replicate a teacher's grading process not only by producing plausible scores, but also by aligning with instructor-specific rubrics. Teachers often evaluate responses either explicitly, using structured criteria [8], or implicitly, based on experience. An effective AI grader must be able to emulate both. To explore this, we implemented two evaluation strategies: a *shot-based approach*, in which models infer grading criteria from scored examples (implicit rubric learning), and a *rubric-based approach*, which relies on structured rules (explicit rubric learning). We compare these strategies to assess the models' ability to reproduce human judgment and support scalable, consistent, and fair assessment in educational contexts.

2 Implementation and Method

A system based on LLMs and using LangChain (a framework that streamlines the integration of LLMs with external data sources) was developed to evaluate open-ended student responses, adopting two distinct approaches. In the **shot-based approach**, the model uses a few scored examples to infer grading criteria and assess new responses. It evaluates the model's ability to generalize and apply human-like judgment, also providing feedback to justify the score. The **rubric-based approach** uses teacher-provided rubrics and scoring formulas to grade structured responses. It ensures consistent, objective grading and includes feedback explaining the score. Two professors from Politecnico di Milano contributed datasets for this study. The first provided two sets used to evaluate the shot-based approach, each containing six open-ended questions from the Technologies for Information Systems course on communication, answered by 37 and 43 students respectively, with scores and optional feedback but no formal rubric. The second contributed a single-question dataset from the Leadership and Innovation course, including 276 responses. This set included a detailed evaluation rubric and scoring formula, allowing for rubric-based assessment.

3 Results

The findings of the study reveal that both GPT-4o and GPT-4o Mini show strong potential in evaluating student responses, particularly within the *mid-quality range*. In the **shot-based evaluation**, performance improved with more example answers, achieving better alignment with teacher scores for mid-range responses. Accuracy decreased at score extremes, where subtle distinctions and nuanced reasoning are harder to assess. This approach was especially effective for complex questions requiring deep reasoning, such as identifying and explaining key concepts in lengthy texts. In the **rubric-based evaluation**, complementary strengths were exhibited by the models: **GPT-4o Mini** excelled at detecting relevant content and assigning partial scores, leading to better overall alignment with teacher grading; **GPT-4o** was more consistent in computing final grades from partial scores. Human grading variability, due to holistic or interpretive judgments beyond strict rubric criteria, reduced model alignment. Introducing a tolerance margin improved correspondence, particularly for GPT-4o Mini, highlighting its robustness to flexible grading.

4 Conclusions

This study explored whether **GPT-4o** and **GPT-4o Mini** can replicate teacher grading by aligning with either implicit or explicit rubrics. Results show strong agreement with human scores, especially for mid-range responses, capturing both implicit and explicit grading criteria. LLMs demonstrate strong consistency, aligning well with teacher evaluations across a wide range of responses. Nevertheless, they struggle at the extremes, failing to fully recognize partial understanding in weaker answers and creative reasoning in outstanding ones, due to their strict adherence to rubrics. However, in scenarios where human grading is inconsistent or deviates from the rubric, LLMs have the potential to enhance assessment quality by improving fairness and alignment with established evaluation criteria. Rather than replacing human evaluators, these models offer valuable support as intelligent assistants, providing scalable and consistent evaluation. Future work should focus on improving LLMs' ability to balance rubric fidelity with the flexible, nuanced judgment characteristic of human grading, advancing their role as complementary tools in educational assessment.

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Enhancing Peer Formative Assessment Through AI: Implementing the ENGAGE Model in Initial Teacher Training

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1 Introduction

Peer formative assessment is widely recognized for promoting self-regulation, critical thinking, and collaborative learning in university settings [1-2]. Despite its pedagogical potential, it is often underused due to obstacles such as time constraints, lack of confidence in applying evaluation criteria, and discomfort with assessing or being assessed by peers [3-4]. These challenges are particularly relevant in teacher education, where reflective practice is essential.

In recent years, literature has highlighted how artificial intelligence can support the personalization of learning processes and educational assessment across both school and university settings [5]. AI-powered tools like ChatGPT can assist students in generating feedback, interpreting rubrics, and refining their work through iterative reflection [6]. However, questions remain about the reliability, transparency, and pedagogical alignment of AI-generated assessments, especially when used without adequate guidance or ethical training [7-8]. To address these gaps, the ENGAGE model [9] originally developed as a scaffolded approach to peer assessment - was adapted and extended with AI integration. The resulting ENGAGE AI-Based model fosters both peer collaboration and AI literacy, encouraging students to interpret, question, and complement AI-generated feedback through structured reflection. This study explores its implementation in a teacher education course and evaluates its perceived effectiveness, challenges, and impact on students' assessment competence.

2 Description of the study

The study was conducted at the University of Palermo within the course Metacognitive and Cooperative Teaching, involving 150 future teachers in primary and lower secondary education. The aim of the study was to evaluate the effectiveness of an AI-integrated version of the ENGAGE model for peer formative assessment in initial teacher education. A qualitative-quantitative exploratory approach was adopted to investigate how future teachers perceive and engage with peer assessment practices supported by Artificial Intelligence (AI).

Participants completed two project-based tasks—one metacognitive and one cooperative—and took part in a structured peer review process enhanced by AI. After being introduced to detailed evaluation criteria (e.g., relevance, lexical variety, coherence), each student used ChatGPT to generate feedback on a peer's work. They then added their own comments in a structured table containing: (1) the original text, (2) AI-generated feedback, and (3) human suggestions. This dual-assessment method encouraged critical interpretation of AI input and highlighted the complementary role of human judgment.

The AI-based ENGAGE model was implemented during a five-hour session, guiding students through six stages: Engagement, Negotiation, Guidance, Assessment, Generation, and Evaluation. These phases fostered the development of assessment literacy, reflective thinking, and collaborative responsibility.

To qualitatively explore perceptions of the AI-supported process, its benefits, and implementation challenges, ten focus group sessions were conducted, each lasting 45 minutes. All participants were involved in the focus group sessions. Feedback from the participants indicated high levels of engagement and increased awareness of both the potential and the limitations of AI in assessment. Regarding the qualitative data collected from the focus groups, these were fully transcribed and analyzed through thematic analysis [10]; two researchers independently coded the material and subsequently discussed their interpretations to ensure consistency and reliability.

The focus group session results indicate that the ENGAGE AI-Based model was received positively by participants. Approximately 91% of the students appreciated the structured feedback they received. While 68% described the AI-supported activity as more stimulating and engaging than traditional assessment, 79% expressed skepticism about AI's objectivity. Challenges emerged around AI literacy. 72% of students stressed the need for more training in using AI tools effectively and ethically in educational contexts. The model's reliance on both AI and human intelligence was seen as a strength, but also as a complex skill requiring development. Overall, the experience increased students' awareness of peer assessment processes and their own learning strategies. The model also encouraged them to reflect deeply on the potential and limits of AI in education.

This preliminary study demonstrates the potential of the ENGAGE AI-Based model in enhancing peer assessment practices in higher education. By integrating AI tools into a structured pedagogical framework, the model helps address traditional challenges of peer assessment while promoting higher-order thinking, engagement, and AI literacy among future teachers. The process was motivating and instructive, though concerns about objectivity and the need for training remain. Overall, AI can support—but not replace—human judgment, serving as a scaffold for deeper learning and reflection. Future research should continue exploring how AI and human intelligence can co-exist in formative assessment. Teacher education programs must also include specific training on AI to equip future educators with the skills necessary to implement technology-enhanced assessment ethically and effectively.

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Artificial Intelligence and the New Frontiers of Educational Equity: Opportunities and Challenges for Inclusive and Personalized Higher Education

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1 AI in Higher Education: Opportunities and Challenges for Equity

Artificial Intelligence (AI) is increasingly permeating the ecosystem of higher education, reshaping pedagogical practices, assessment systems, and institutional governance [1]. Its integration into digital learning environments – as Learning Management Systems (LMS), adaptive tutoring platforms, and data analytics dashboards – presents both a powerful opportunity and a profound challenge. On the one hand, AI can democratize access to education, personalize learning experiences, and optimize instructional strategies through adaptive technologies and data-driven insights [2,3]. On the other hand, it risks amplifying existing inequalities, introducing algorithmic biases, and depersonalizing the human dimension of teaching and learning [4].

This contribution investigates the transformative potential of AI in higher education by focusing on its capacity to support educational equity and personalized learning pathways, explicitly connecting these opportunities and challenges to the development of advanced learning technologies. Drawing from recent research, European pilot projects, and policy frameworks [1,5,6], we argue that AI-enhanced learning systems – when pedagogically and ethically designed – can foster more inclusive environments by tailoring instruction to diverse learner needs, reducing cognitive overload, and offering real-time, meaningful feedback.

1.1 Rethinking Higher Education Through AI

AI should not be conceived merely as a set of tools for automation, but as an epistemological and pedagogical shift in higher education [7]. By integrating machine learning algorithms, natural language processing, and intelligent tutoring systems within university-level curricula, educators can adopt more reflective, student-centered models of learning. These models, mediated by technology, emphasize learner autonomy, intrinsic motivation, and metacognitive development. Such transformation entails redefining the role of the academic teacher – from transmitter of content to designer of learning experiences and cognitive coach – supported by AI-enabled analytics that inform formative assessment and personalized feedback [8].

2 Personalized Learning and Inclusive Design in the Digital University

When grounded in the Universal Design for Learning (UDL) principles [9], personalized learning in universities can become a strategic pathway for equity. UDL promotes curricula offering multiple means of representation, engagement, and expression, which align closely with AI capabilities such as predictive modelling of student engagement, adaptive content sequencing, and multimodal feedback systems [10]. AI-driven personalization can, for example, support non-traditional students, learners with disabilities, and underrepresented groups by dynamically adapting course pathways in MOOCs, blended learning modules, or fully online degrees [11].

2.1 Risks and Ethical Challenges in Technology-Mediated Higher Education

Despite its promises, AI in higher education raises ethical concerns that must be addressed to ensure educational justice. These include algorithmic opacity, surveillance risks, commodification of student data, and the reinforcement of systemic biases when training datasets are unbalanced [4,12]. Furthermore, the over-reliance on automated systems risks diminishing the relational and dialogic dimensions that characterize high-quality academic teaching [13]. We advocate for a human-centered design approach in higher education AI, combining technological affordances with participatory governance, academic freedom, and transparent decision-making processes [14].

Drawing on case studies from European higher education institutions – including Erasmus+ AI literacy initiatives, national digital strategies, and institutional experiments in adaptive learning [5,15] – we identify critical success factors for meaningful AI adoption: robust teacher training in AI literacy, cross-sectoral collaboration between universities and industry, and continuous evaluation of AI impact on student success and inclusion.

3 Conclusion

The real potential of AI in higher education lies not in replacing educators but in augmenting their capacity to meet the diverse and evolving needs of students. Achieving this vision requires institutions to invest in research-informed policies, ethical frameworks, and a shared commitment to educational justice. AI can – and must – be shaped as a generative and transformative force: one that not only makes higher education smarter, but also fairer, more inclusive, and more responsive to the complexity of contemporary global learning contexts.

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Empowering early childhood educators:
transforming AI perceptions through targeted training

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1. Introduction

The integration of Artificial Intelligence (AI) into inclusive education holds transformative potential, particularly when educators are trained to use such technologies meaningfully within pedagogical contexts [1, 2]. In higher education programs preparing support teachers for early childhood settings, there remains a significant gap between the promise of AI-enhanced inclusion and actual teacher readiness. This contribution addresses that gap through a structured intervention within the Italian Tirocinio Formativo Attivo (TFA) national teacher specialization program.

The study involved 35 pre-service teachers at the University of Foggia, all enrolled in a postgraduate course for special education in preschool settings. The research aimed to examine whether targeted, experiential training could positively impact participants' perceptions of AI, increase their confidence in its pedagogical value, and foster willingness to integrate it into inclusive lesson planning.

2. Methodology

The intervention consisted of three integrated phases:

1- Myth-debunking lecture, introducing current discourses on AI in education and confronting common misconceptions;
2- Hands-on collaborative design, in which groups used generative AI tools (ChatGPT, Gemini, Perplexity) to co-create inclusive lesson plans aligned with Universal Design for Learning principles;
3- Reflective peer discussions, fostering critical dialogue and professional exchange.

The Unified Theory of Acceptance and Use of Technology (UTAUT) was employed as the conceptual framework for measuring change, using a version adapted to educational settings and inclusive pedagogical aims. The four UTAUT constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions—were measured using pre- and post-intervention questionnaires.

Of the 35 participants, 32 completed both questionnaires. Statistical analysis (paired-sample t-tests, $\alpha = .05$) revealed significant improvements across all four constructs. Performance expectancy increased from a pre-intervention mean of 3.49 (SD = 0.75) to a post-intervention mean of 4.02 (SD = 0.75); effort expectancy improved from 3.62 to 4.09. Notably, 50% of participants reported a clear intention to integrate AI into their future inclusive practices.

These results suggest a meaningful shift: participants began to view AI not merely as a technological novelty but as a pedagogical ally capable of enriching inclusive teaching through personalization and cognitive scaffolding. Their perception evolved from initial skepticism to proactive curiosity, facilitated by exposure to real-world instructional design challenges.

3. Discussion and Implications

This study contributes to ongoing debates on teacher education and digital inclusion by demonstrating how structured AI training can reframe teacher attitudes and reduce resistance to educational technology. The experiential format fostered not only technical familiarity but also reflective understanding of AI's ethical and contextual limitations [3, 4]. Despite the encouraging outcomes, participants highlighted persistent concerns over access, policy clarity, and long-term infrastructural support—concerns echoed in the literature on edtech governance and personalization ethics [5].

The study directly addresses higher education in teacher training programs and focuses on the pedagogical integration of learning technologies in inclusive settings. By using AI as both subject and tool of instruction, the intervention illustrates how higher education institutions can promote digital literacy and inclusive design capacity among future educators.

Although the sample is limited in size, the findings support the claim that teacher education programs must incorporate hands-on, critically informed experiences with AI to ensure effective, ethical, and inclusive classroom application. Future research may expand this approach longitudinally and across diverse cultural contexts.

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Artificial Intelligence as a Symbolic Mirror: A Pedagogical Model for Emotional Support in Adolescence

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1 Introduction

This paper presents an interdisciplinary framework integrating pedagogical theory, emotional education, and learning technologies to support adolescents affected by bullying and cyberbullying. Artificial Intelligence (AI) is conceptualized as a reflective partner that fosters insight, reformulation, and emotional support, without replacing human relationships [1–3]. Drawing on symbolic mirroring [4,5], AI-based dialogical systems can reflect users' emotional states to promote recognition and growth, aligned with Fonagy and Luyten's model [6]. Reflective dialogue [7,3] becomes an educational tool for processing trauma and building identity. This approach addresses emotional exclusion linked to school violence, including the non-consensual sharing of intimate content [8].

2 Objectives

The study aims to: (1) explore and outline a theoretical framework in which AI is conceived as a reflective partner fostering self-awareness and personal elaboration; (2) conduct a qualitative and comparative analysis of selected AI tools in their capacity to provide emotional and pedagogical support to young people in distress.

3 Methodology

The study adopts a qualitative-comparative design, combining exploratory testing of three AI applications—ChatGPT, Replika, and Woebot—with document analysis and user reports. Three typical scenarios of adolescents experiencing school violence were simulated, and each researcher interacted with all scenarios across all tools. Interactions were evaluated through a grid informed by Rogers' criteria of empathy, congruence, and unconditional positive regard [9,10], rated on a 5-point Likert scale, with inter-rater agreement calculated to ensure reliability. In parallel, each tool was examined along three dimensions: dialogical structure and reflective potential, emotional attunement and empathy markers and pedagogical capacity to support self-awareness and resilience. Ethical considerations—particularly the risks of delegating intimate matters to AI without professional mediation—were explicitly addressed.

4 Expected Results

The analysis is expected to identify interaction patterns—such as the frequency of empathetic prompts and the depth of reflective questioning—that enhance emotional containment, reflective dialogue, and pedagogical value. These findings will inform the design of a tailored, ethically grounded AI system for emotional support.

5 Conclusion

Positioned within the conference topic of learning technologies, this work reimagines AI as an educational ally that reflects and supports human vulnerability. Ethical considerations highlight the risks of delegating deeply personal matters to AI, reinforcing the role of trained professionals in oversight and intervention. Future steps include prototype development, validation, and adaptation across contexts.

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Rethinking Assessment in the Age of Generative Artificial Intelligence

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1 Introduction

The widespread availability of Generative Artificial Intelligence (GenAI) tools poses new challenges in education. While some researchers think that using GenAI could lead to over-reliance and cognitive atrophy [1, 2], recent research shows that students use this technology despite institutional policies, and generally view it positively, with evidence that GenAI can boost motivation and learning outcomes [3, 4]. In particular, improvements in student motivation have already been observed in a previous work by the authors themselves [5]. However, the increasing use of GenAI tools by students challenges long-standing assessment practices. As AI systems become highly proficient at producing polished final products (e.g., essays, translations, code, presentations) evaluating students based solely on the quality of their outputs becomes increasingly problematic.

Even before the advent of GenAI tools, assessment practices have always been a subject of discussion and change: for instance assessment was gradually shifting from memorization-based systems to skill development [6, 7]. However, students' final products were always used as a core part of skills' evaluation. GenAI is probably reshaping the epistemological foundations of education, by decoupling cognitive effort from the final artifact [8]. This paper builds on the long tradition of process-oriented assessment, proposing a concrete shift from evaluating final products to analyzing the cognitive processes that produce them – a change made increasingly urgent by the rise of GenAI. Research in portfolio assessment [9], authentic assessment [10], Bloom's taxonomy [11], and formative assessment [12–14] has long emphasized that the ability to generate a high-quality output is not, by itself, a reliable indicator of understanding or competence. Instead, the focus should move toward the learners' orchestration of the process: how they conceptualize a task, interact with the AI, evaluate the responses, and iterate based on those evaluations. Our proposal could have a significant implications for higher education, for example within teacher training curricula. Embedding such practices into university programs that prepare future educators would enable them to critically assess AI-supported learning and to transfer these methods into their own professional practice. In this sense, our work provides a framework for rethinking teacher education curricula strengthening the role of educators in guiding responsible and process-oriented uses of AI in schools.

2 Assessment strategies

The transition from product-based to process-based assessment calls for a redefinition of the learner's role. Traditionally, students were expected to demonstrate knowledge through autonomous creation. In AI-enhanced contexts, however, the learning value is embedded in how the student utilizes the AI as a cognitive partner. The student's intellectual contribution lies not only in the final output but in the intentional design of prompts, the understanding of AI limitations, and the ability to engage in meaningful dialogue with the machine. This process reflects higher-order thinking skills such as planning, monitoring, and evaluating – all of which are often hidden in conventional product-based assessments. We identify two promising assessment strategies in AI-enhanced contexts:

- **Reflective prompt logs (diaries):** Students maintain a structured log of their interactions with the AI, annotating each prompt with its intent, the evaluation of the AI's response, and subsequent actions. This diary supports metacognitive awareness and provides a traceable map of the student's reasoning. In the context of AI, such logs enable educators to assess not just what students produce, but how they think.
- **Automatic interaction tracking:** In environments that support it (e.g., educational platforms with integrated AI tools), systems can record the history of prompts and responses. When ethically and transparently implemented, these logs offer valuable insights into the student's process, enabling teachers to assess not only what the student asked, but how their thinking evolved. Such tools may also support large-scale learning analytics, helping identify patterns in how students engage with GenAI.

We recognize that both strategies come with important limitations: reflective logs, while offering insight into students' perspectives, may be affected by social desirability bias or by the learners' limited metacognitive awareness. Similarly, interaction data, although generated automatically, cannot be considered purely "objective", since meaningful interpretation always requires theoretical framing and careful analysis. Nonetheless, we argue that these methods remains valuable, moreover if they are applied complementary: reflective logs foreground the learner's subjective experience, while interaction tracking provides a trace of observable behaviors that can enrich interpretation. Together, they can provide a multidimensional view of the learning process and can form the basis of more authentic and formative assessment models.

3 Conclusion

GenAI is not merely a tool for producing answers; it is a catalyst for rethinking what counts as learning. By shifting the focus of assessment from the output to the process, educators can foster deeper learning and more meaningful engagement in AI-enhanced educational settings, encouraging the development of competencies such as the capacity to ask meaningful questions, critically navigate complex systems, and reflect on one's own learning process.

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Perceptions and awareness of technological and artificial physical education

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1 Introduction

The current lifestyle of children and adolescents is profoundly influenced by digitalization, through digital devices such as smartphones and platforms like TikTok, Insta- gram, or YouTube [1]. Artificial intelligence is also playing a growing role in children's development within the digital world, through virtual assistants such as Siri, ChatGPT, and other applications across various sectors [2]. This pervasiveness has reached significant levels among primary school students, who display different behaviors in school settings compared to social contexts. Consequently, there is an increasing need to systematically prepare students to navigate this media-rich world. One approach suggested to address the challenges posed by media to young people is the cultivation of media education. This responsibility falls upon formal educational institutions, including schools. In physical education, the integration of digital media has significantly evolved in recent years. Recent studies highlight a shift towards advanced technologies such as activity monitors, digital videography, virtual and augmented reality, exergames, online platforms, and social media [3, 4]. Although primary school children grow up immersed in complex digital environments from early childhood, a significant distinction emerges between how they use technology in daily life and how they experience it within the school context. In their social sphere, children access digital content autonomously and interactively: they engage with platforms like YouTube, TikTok, or video games, communicate with peers, express creativity, and develop digital skills in- formally [5]. In contrast, within the school setting, the use of technology is often more limited, structured, and aligned with educational objectives, offering little space for personal expression and the spontaneous communicative practices typical of digital environments [6].

1.1 Scope

Despite the increasing digitalization of the school environment, reflected in the integration of digital technologies across all subjects, including physical education in primary school, in lower secondary school and in upper secondary school, this integration does not reflect students' extracurricular digital activities. The adoption of educational kinesiology in formal learning environments such as schools remains limited and is influenced by factors such as teachers' perceptions, availability of school resources, and the training received by educators [7]. This may result in a parallel and largely unacknowledged dimension of the phenomenon, distancing the social reality experienced by primary school students from their school reality. The objective of this study is to measure the difference between these two dimensions, social and scholastic, to determine whether a perceptual gap exists, and to present these findings to educators.

2 Methods

The study adopts an experimental approach with a mixed-method (qualitative-quantitative) design. The sample consists of students from 4th and 5th grade classes in three territorial contexts in the Campania region of Italy: Naples (metropolitan area), Pontecagnano Faiano (semi-urban area), and Avellino (medium-sized urban area), to ensure adequate representativeness. A paper-based, custom-designed questionnaire was administered, using simplified and accessible language appropriate for primary school students. The questionnaire included 10 closed items on an emotional response scale, divided into two sections: the use and perception of technology in school settings (physical education) and in out-of-school contexts. An open-ended question was also included to explore students' wishes and expectations regarding the use of technology in physical education. Data analysis was conducted using SPSS 28.0, including descriptive statistics, chi-square tests to assess territorial differences, one-way ANOVA to measure significant differences between the school and social dimensions, and correlation analyses to explore the relationship between perceived use and level of engagement.

3 Results

The results indicate that students report greater familiarity, freedom, and creativity in their use of technology in out-of-school contexts, particularly for play-based, physical, communicative, and creative activities (e.g., video games, movement apps, YouTube and TikTok videos), compared to school settings, where technology use is described as more rigid and limited. Students stated that they have fun and feel engaged when using technology at home, whereas such experiences are less frequent and less stimulating at school. Significant differences emerged among the three territorial contexts: students from the metropolitan area reported higher use of digital devices, whereas more traditional approaches prevailed in the other areas.

4 Conclusion

The study confirms the existence of a digital disconnect already present at the primary school level: students use technology creatively and with enjoyment at home but experience it as rigid and limited at school. These findings align with digital media literacy [8] and the TPACK – Technological Pedagogical Content Knowledge model [9], which stress the importance of integrating technology into authentic, student-centered learning. To address this gap, schools should adopt innovative and experience-based approaches in physical education, using interactive and gamified tools that reflect children's real digital practices. Teacher training in TPACK is essential to combine content, pedagogy, and technology effectively, while flexible curricula should encourage creative and inclusive uses of digital media. Such actions can bridge the gap between formal and informal learning, fostering engagement and holistic development.

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Teaching with AI for Inclusion: A Socratic Approach

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1. Introduction

The rapid evolution of Artificial Intelligence (AI) in educational contexts poses both challenges and opportunities for teacher professional development, particularly in inclusive education. While generative AI systems are increasingly used in curriculum support and lesson planning, the integration of dialogic and reflective AI remains underexplored in teacher training. This study investigates whether a combination of Socratic AI (EULER) and generative AI (ChatGPT) can foster inclusive instructional design and critical pedagogical reflection among in-service teachers.

The research involved 152 teachers enrolled in the Italian national Tirocinio Formativo Attivo per il Sostegno (TFA Sostegno), a higher education program for specialization in support teaching. The study is situated at the intersection of learning technologies and professional formation, aligning directly with HELMeTO's focus on the future of digital learning in higher education.

2. Methodology

The intervention was structured in two phases and grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT), adapted to measure perceptions in higher education settings. The constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions guided the development of the evaluation tools.

In Phase 1, participants engaged with EULER, a Socratic AI system designed for structured, question-led dialogue [1, 2]. Through guided interrogation, they developed inclusive lesson plans and revised them in response to reflective prompts, fostering metacognitive engagement.

In Phase 2, teachers worked with both EULER and ChatGPT, blending critical interrogation with generative ideation. Lesson plans were co-constructed in small groups, reviewed in peer sessions, and revised iteratively. This approach positioned AI as a partner in epistemic inquiry rather than a passive assistant.

Data collection combined UTAUT-based questionnaires and qualitative responses to open-ended prompts. Quantitative results were analyzed using descriptive statistics and matched-pair comparisons, while thematic analysis was applied to the qualitative data.

3. Results

Participants reported significant improvements in their perceptions of AI's educational value. Specifically:

- 87.6% described EULER as intellectually stimulating and beneficial for deep lesson planning.
- 79.3% indicated that combining ChatGPT with EULER increased usability and creative potential.
- Participants widely adopted the view that AI tools could augment cognition, supporting inclusive differentiation and critical pedagogical awareness.

Importantly, qualitative responses emphasized a shift in conceptual framing: teachers moved from viewing AI as a task automation tool to recognizing its dialogic potential. Many reported a reinforcement of professional identity through the reflective nature of the interaction. This finding resonates with emerging research highlighting AI's capacity to support inclusive educational aims and democratize access to knowledge [3].

However, several systemic concerns were raised. These included institutional barriers, limited infrastructural access, and the need for targeted training—concerns also well documented in recent AI-in-education scholarship [4, 5].

4. Implication for Higher Education

This study contributes to the broader discourse on AI integration in teacher education, particularly in university-level professional training programs. It affirms that AI tools, when embedded within ethically framed, professionally scaffolded contexts, can serve as catalysts for pedagogical innovation.

The findings support the inclusion of AI literacy and critical dialogue as core components of teacher preparation curricula. By aligning reflective Socratic processes with generative language models, the dual-tool approach promotes cognitive augmentation, pedagogical depth, and inclusive thinking—key priorities for 21st-century education.

This research reinforces the imperative for ethically responsible AI integration in higher education, and the necessity of preparing teachers not only to use AI tools, but to interrogate their assumptions and potentialities. Such training advances the goals of equitable, inclusive, and critically informed digital pedagogy.

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Artificial personal trainer

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1 Introduction

The integration of artificial intelligence (AI) into health and exercise promotion pathways represents one of the most developing frontiers in technological and educational innovation [1, 2]. Recent progress in large language models (LLMs), such as ChatGPT, has opened new opportunities for creating adaptive virtual coaching systems capable of generating personalized training protocols and providing real-time feedback based on user input. These AI-driven virtual assistants can simulate the role of a human trainer, offering tailored exercise sessions, monitoring adherence through self-reported feedback, and progressively adapting the training plan. Despite the growing interest in AI-assisted health promotion, scientific literature remains limited regarding studies that evaluate both the objective effectiveness of ChatGPT-driven exercise protocols and the subjective perception of users in terms of enjoyment and perceived educational value [3].

1.1 Scope

The aim of this study is to explore adult participants' perception, enjoyment, and perceived educational value of a four-week personalized exercise protocol generated and managed entirely by ChatGPT, used as an AI-based virtual trainer. The virtual assistant produced customized training sessions, adapted weekly according to participants' feedback, and aimed to foster self-regulation, autonomy, and digital competence in managing healthy lifestyles.

2 Methods

A total of 52 non-athlete adults (aged 20–50 years) were recruited and randomly assigned to an Experimental Group (EG) or a Control Group (CG). The EG followed a four-week exercise program generated and managed by ChatGPT, used as an AI-based virtual trainer. The virtual assistant produced personalized training sessions, adapting the weekly protocol according to self-reported feedback provided by participants regarding perceived exertion, enjoyment, and adherence. No wearable devices or automated physiological monitoring tools were used. The CG followed a standardized exercise program of equal volume and intensity, supervised weekly by an instructor, but without AI support or dynamic adaptation. Data collection took place at three time points (pre-, mid-, and post-intervention) and used both quantitative and qualitative validated instruments: 6-Minute Walk Test, Countermovement Jump (CMJ), Sit & Reach Test, and Body Mass Index (BMI), a Likert-scale questionnaire developed to assess perceived enjoyment and educational value of the training experience. Statistical analysis involved the use of descriptive statistics for all variables surveyed. An ANOVA for repeated measures will be used to analyze the quantitative data and scores obtained from questionnaires administered at several points in time; if the assumptions of normality are not met, the Friedman test, its non-parametric alternative, will be used. In case of significance, post-hoc tests with Bonferroni correction will be applied to identify differences between the individual measurements. For the comparison between two-time steps (pre-post) for qualitative variables, the Wilcoxon Signed-Rank Test will be used.

3 Results

At the end of the four weeks, the EG had average increases of approximately 7% in cardiovascular endurance (6-Minute Walk Test), a 9% increase in lower limb explosive strength (CMJ), and an improvement in flexibility of approximately 9% over initial values. These changes were statistically significant ($p < .001$) and associated with an effect size of moderate magnitude (η^2_p=.25), higher than those observed in the CG, which reported only marginal changes. Furthermore, the qualitative analysis revealed a significantly higher level of liking for the use of AI in the EG ($p < .001$), confirming a positive perception of the personalized training experience.

4 Conclusion

The results show that an exercise protocol generated and managed by ChatGPT significantly improves physical performance and perceived enjoyment compared to a standardized program. The objective effectiveness and high level of satisfaction indicate a promising educational potential to promote autonomy, self-regulation, and digital competence in lifestyle management through AI-driven personalized training. These findings highlight the potential for integrating AI tools like ChatGPT into health and exercise education [4, 5], offering scalable and accessible personalized coaching solutions. This could empower individuals to take greater control over their health behaviors, while also providing educators and practitioners with innovative resources to support behavior change and lifelong learning in physical activity and wellness.

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ChatGPT As a Tool for Student's Scientific Research

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1 Introduction

The education sector is one of the most important platforms for innovation, as it shapes the intellectual potential of future generations. Technologies such as artificial intelligence (AI), virtual and augmented reality (VR/AR), and intelligent machine learning algorithms are increasingly being integrated into key areas of social life, including education [1-3]. As noted by Henri-Paul Rousseau [4], "…the digital revolution, not even 50 years old, has already clearly illustrated how quickly new technologies must be adopted and how quickly institutions must adapt".

In the context of the new learning paradigm, the use of ChatGPT is becoming increasingly popular, affecting various aspects of learning and teaching [5; 6]. As of 2024, the platform attracts approximately 100 million weekly active users. Modern research shows that ChatGPT is actively implemented in students' learning activities. In particular, according to a survey conducted in Germany [7], 63.4% of students surveyed said they used AI-based tools for their studies, and one in four students (25.2%) used AI-based tools very often. Similar results were recorded among high school students: ChatGPT is actively used as an aid to the learning, particularly for generating ideas, explaining complex topics, and self-examination. Forman et al. note [8] that students perceive ChatGPT as a "new learning tool" that shapes new approaches to self-education and digital literacy.

Research is being conducted on how artificial intelligence systems and chatbots can complement human knowledge and judgement, assist in educational research [9; 10], as well as on the potential negative impact they may have [1].

2 Methods and results

Universities are developing policies and tools for the responsible use of AI, and more and more professors are integrating ChatGPT to improve learning efficiency. We believe that ChatGPT can play a significant role in the organisation of student research, helping at all stages of the research process - from choosing a topic to presenting the results. The key areas in which ChatGPT will be useful are highlighted in Table 1 (data generated by https://chatgpt.com/g/g-69HnvSsrn-ukrainian-voice).

As part of the course "Fundamentals of Scientific Research" for 1st year bachelors of Lutsk National Technical University, an algorithm for using ChatGPT to work on a student research project was developed. Students wrote promotional materials and improved them based on the analysis of the responses received.

Table 1. Using ChatGPT in the organisation of scientific research.

№	The research stage	ChatGPT generation
1	Choosing a topic and formulating a research problem	Generating ideas for research in a particular area. Assistance in formulating research questions and hypotheses. Analysing the relevance of the topic based on current trends.
2	Working with scientific literature	Recommendations for scientific articles, books and authoritative sources. A summary of the main ideas of research on a particular topic. Explanation of complex scientific terms and concepts.
3	Writing and structuring the text	Assistance in drawing up a research plan. Editing and improving the scientific style of the text. Generate short abstracts, summaries, or introductions to scientific papers.
4	Data analysis and visualisation of results	Explanation of data analysis methods (statistics, correlation analysis, etc.). Generate codes for data analysis in Python. Create charts, tables, or graphs for clarity.
5	Preparing for presentations and conferences	Writing reports, abstracts and presentations. Recommendations on the structure of the speech. Generation of possible questions from the audience and answers to them.
6	Making work in accordance with the requirements	Formatting references in APA, MLA, etc. Checking the text for plagiarism and uniqueness. Correction of grammatical and stylistic errors.

Numerous cases of "hallucinating" about non-existent sources of information or fictitious names of researchers were identified. Therefore, the service https://scholar.google.com/ was used to search for literature sources. ChatGPT was used to analyse the given journals, create comparative tables, and format the bibliography. All generated texts were re-checked and edited in accordance with the requirements. ChatGPT was used to create conclusions and annotations, and to prepare a presentation for an oral presentation. As an element of academic integrity, it was mandatory to indicate the use of ChatGPT in the course of the work. As a result, 74% of the students wrote papers that were published in the collection of student research papers of Lutsk National Technical University.

3 Conclusion

The use of ChatGPT as a tool for writing student papers is appropriate because of its ability to quickly generate structured, grammatically correct and topically relevant text. However, it is important to use it as an auxiliary resource, adhering to the principles of academic integrity and critically evaluating the information received. The best results are achieved when students, as well as their supervisors, use ChatGPT as a tool for inspiration, analysis and improvement. Thanks to the use of AI, students learn self-organisation and critical thinking - key skills of a 21st century professional.

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TEACH-AI: Transformative Educational Approaches for Civic and Human-centered AI

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1 Introduction

Further study of the development of specific Artificial Intelligence literacy skills is required because it raises profound cultural issues concerning the practices of various professions, including those in education and the social sphere [1]. AI literacy, defined as the knowledge and skills that foster awareness of the opportunities and risks of AI, as well as the potential harm it can cause, is becoming increasingly important in socio-educational work [2-3]. About the three different levels of AI implementation in the socio-educational field (operators, organisations and beneficiaries of socio-educational services), careful mitigation of ethical, social and practical risks is necessary, specifically those related to algorithmic bias, user data protection and, above all, the preservation of the human and relational dimension of social work [4].

The TEACH-AI (Transformative Educational Approaches for Civic and Human-centered AI) project aims to explore the impact of, and the potential of integrating , Generative Artificial Intelligence in socio-educational services in the Italian context. The research, conducted by the CREDDI research group at e-Campus University, will take an action-research approach. The aim is to analyse how generative AI is used and, subsequently, to co-design strategies, policies and skills with the organizations involved in the research, in order to integrate AI in an ethical and sustainable way. The purpose is to develop shared guidelines and promote AI literacy to ensure that technology supports and does not impact negatively on human relationships. The expected results will encompass the formulation of organizational principles that are designed to facilitate a positive impact on the ongoing AI transition [5-6]. Subsequent paragraphs, however, are indented.

2 Research-action overview

The research presented constitutes the initial phase of a comprehensive exploratory and transformative project aimed at supporting educational and organisational innovation processes, using a mixed-methods approach [7].

The preliminary phase of the research entailed the development and preliminary validation of a self-report questionnaire (PAIR - Participatory AI for Inclusive Relationships), which aims to support the analysis of training needs in socio-educational contexts. The initial version of the instrument was evaluated by a panel of 15 experts, comprising academics and members of the Third Sector. Each expert contributed to the content validation process by assessing the clarity, relevance and theoretical consistency of the instrument. The questionnaire was submitted for validation to a sample of approximately 300 workers from 20 social cooperatives distributed across different geographical areas of Italy (online administration, QuestionPro platform). The validation results are encouraging, the factorial solution fits the data well, and good internal consistency emerges. In the subsequent phase, the various stakeholders will be involved at different levels in the research through a bottom-up approach to the creation of AI governance. This will include the involvement of local communities and various social groups interested in organisational changes in the current phase of technological transition.

3 Conclusion

This methodological approach is participatory and considers research not limited to data collection, but also as an active process of co-development and implementation of a network of individuals, aimed at strengthening human relations and care in the field of education and welfare. The possible expected results of the action research include the development of shared policies and guidelines, the integration of AI to enhance educational practices, the promotion of AI literacy and continuing education, and the redefinition of existing organisational processes to facilitate the strategic integration of AI.

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Scaffolding UML Modeling with AI: A Tool-Supported Educational Approach

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1 Introduction

This paper analyzes UML Miner, an AI-powered educational tool for scaffolding UML class diagram learning. UML Miner combines process mining conformance checking, and Retrieval-Augmented Generation with a Large Language Model to provide personalized feedback, implemented as a plugin for Visual Paradigm. Through student modeling behavior tracking, it delivers real-time, context-aware guidance aligning with ongoing tasks. The tool supports discipline-specific learning through reflective, adaptive feedback. This work contributes to applications of generative AI in education, promoting transparency, learner agency, and instructional alignment.

2 AI-Powered Scaffolding: Principles and Implementation in UML Miner

The notion of *scaffolding*, providing structured, temporary support to learners until independence is gained [1], is widely established in educational theory. In terms of AI-enhanced learning, scaffolding becomes dynamic and responsive through systems capable of interpreting learners' actions and adapting feedback accordingly. In this paper, we analyze how this paradigm is concretely realized in *UML Miner* [2,3,4], an already implemented AI-powered tool designed to support students during UML class diagram construction.

UML Miner delivers AI-powered scaffolding through three integrated components: (1) real-time behavior tracking via event logs in the Visual Paradigm environment, (2) adaptive feedback based on declarative process mining and conformance checking, and (3) a retrieval-augmented generation (RAG) mechanism using a Large Language Model (LLM) to provide personalized suggestions.

This layered architecture permits the system to detect misconceptions, interpret student actions, and provide timely, targeted guidance.

A unique feature of the tool is the use of *Process Mining (PM)* to model learning behavior. Logs from modeling sessions are analyzed using the *Declare Miner* and *MINERful* algorithms to reconstruct typical workflows and compare them with reference processes derived from expert solutions. Conformance checking then identifies deviations, which are semantically processed and encoded into structured descriptors.

These descriptors feed into the RAG-LLM engine, which generates pedagogically meaningful feedback. Rather than merely flagging issues, UML Miner explains modeling choices in context, referencing prior examples and domain-specific knowledge. The LLM is tailored to the UML domain and supported by a curated vector store of common misconceptions, best practices, and reusable educational content.

This feedback mechanism acts as a form of scaffolding that evolves with the learner's actions, delivering just-in-time support aligned with the *Zone of Proximal Development (ZPD)*. Essentially, the feedback is not prescriptive but encourages metacognition and iterative refinement—crucial for building modeling competence.

From a design standpoint, UML Miner addresses key challenges in AI-enhanced education:

- **Transparency and interpretability**: feedback is grounded in observable modeling behavior.
- **Student agency**: the system accommodates multiple valid modeling strategies.
- **Instructor support**: logs and diagnostics are available for reflection and instructional use.

Further information on the architecture, source code, demo videos, and general feature descriptions, as well as references to publications with more technical and conceptual details, is available at the UML Miner website [5].

3 Conclusion and Future Perspectives

Through the combination of process mining, conformance checking, and retrieval-augmented generation, *UML Miner* provides personalized, context-aware feedback that supports learners during UML class diagram construction. UML Miner encourages *exploratory modeling* and reflective learning, rather than enforcing correctness. It exemplifies how generative AI may be integrated responsibly into educational workflows, complementing human instruction and adapting to individual learning trajectories.

Future work will focus on extending the tool to provide feedback with pedagogical metadata and evaluating its impact across diverse student groups. We also plan to explore mechanisms that involve instructors in the co-design of reference models and feedback strategies, reinforcing their central role in AI-supported educational settings.

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Fostering AI Literacy through Adaptive Virtual Assistants in Primary Education: A Pilot Study

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1 Introduction

This pilot study examines the effectiveness of adaptive virtual assistants (AVAs) powered by language models like ChatGPT in enhancing AI literacy among primary school students (Rakap, 2024). Combining theoretical lessons, practical workshops, and ethical discussions, it fosters technical skills and critical thinking about AI's societal role. AI integration in education is gaining attention (Bond et al., 2024), showing promise for personalized learning and cognitive development (Holmes et al., 2019) yet challenges remain in addressing ethical and social aspects at early educational levels (Aoun, 2017). In Italy, interest grows despite limited teacher training (Pretti-Frontczak & Bricker, 2000). Alongside student interventions, an exploratory survey of primary and secondary teachers assessed AI tool usage and training needs, highlighting the importance of aligning student and teacher initiatives. Supporting this, UniDistance Suisse reported up to a 15% academic improvement with GPT-3 AI tutors (Baillifard et al., 2024). The study underscores AVAs' transformative potential as educational tools and drivers of critical AI engagement.

2 Materials and Methods

The pilot study used an experimental framework to assess AI literacy among primary school students through a six-week training program with twelve 90-minute sessions. Each session included theoretical introduction, practical activities with adaptive virtual assistants (AVAs), and guided discussions covering key AI concepts like algorithms, machine learning, bias, and societal impacts, ending with a simple AI system design project.
The study involved 37 students (86% girls, 14% boys), aged 8–10, from grades 3, 4, and 5 in a southern Italy primary school STEM program. Sessions took place in the school computer lab with individual computers and a smartboard.
Students completed a 14-item questionnaire before and after the course assessing AI knowledge, applications, and ethics; data were analyzed using descriptive statistics and Student's t-tests (Sejnowski, 2018).

Simultaneously, an exploratory survey of in-service primary and secondary teachers collected demographic data and responses on AI perceptions, tool experience, training needs, and AI's educational role through 15 items on a 5-point Likert scale, analyzed descriptively to evaluate AI training relevance in professional development.

3 Data analysis

Descriptive analysis of 37 students (19 eight-year-olds, 18 nine-year-olds; 86% female) showed an average post-test score of 82.21%, with a significant improvement from pre-test (M=3.30) to post-test (M=10.38) confirmed by a paired t-test (t=22.430, p=0.000). No significant differences were found between age groups (t=-0.092, p=0.928) or genders (t=0.075, p=0.944), indicating uniform learning outcomes.
Challenging topics included machine learning, bias, and algorithm fairness, with only 62.16% correctly answering if a computer can "learn on its own." Qualitative analysis revealed growing student interest in AI but highlighted the need for further exploration of ethical and creative aspects.
Among 61 teachers, high agreement emerged on AI's ethical importance and the need for training (e.g., "Schools should prepare students to use AI critically," M=4.52), but experience with AI tools was limited (M=2.89), and openness to early AI education was moderate (M=2.92). Primary teachers showed more enthusiasm for inclusive AI use, while secondary teachers expressed greater demand for professional development. Differences by school level were not statistically significant.
These results confirm the effectiveness of AVA-based training for students and highlight the need for tailored teacher training to support AI integration in education.

4 Conclusion

This study highlights the significant potential of adaptive virtual assistants (AVAs) in enhancing AI literacy among primary school students by providing personalized, engaging learning experiences that foster both technical knowledge and critical thinking (Zawacki-Richter et al., 2019). However, widespread adoption faces challenges, particularly the urgent need for comprehensive teacher training that combines technical skills with effective pedagogical strategies addressing complex AI topics like ethics and algorithmic bias. Our survey of 61 teachers confirmed strong support for structured professional development and critical AI education, yet revealed gaps in practical experience and hesitancy toward early AI integration. Future research should develop adaptive, context-aware teaching methods and longitudinal studies to evaluate long-term impacts, while fostering collaboration among educators, researchers, and technologists to sustain innovation. A multidisciplinary approach is crucial to fully realize AVAs' educational benefits and prepare students to be knowledgeable and critically aware of AI's societal implications (Wang et al., 2024).

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Fostering an Inclusive Ecosystem in AIED through Pedagogical Innovation and Legal Safeguards

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1 Introduction

The use of artificial intelligence (AI) in educational settings dates back to the 1970s, when research began to develop computer-assisted instruction (CAI), highlighting how the extensive application of AI techniques could effectively support learning with personalised tutoring to meet individual educational needs of each student [1]. The use of AI in education (AIED) has revealed significant potential, particularly to innovate teaching and learning practices and accelerate the achievement of the Sustainable Development Goal 4 [2], which aims to ensure inclusive and equitable quality education and promote opportunities for lifelong learning for all. However, rapid technological advancements entail unavoidable risks and challenges, such as insufficient training in technology and user-computer interaction, which frequently fails to match the pace of digital transformation in educational systems and society. Furthermore, integrating AI into schools poses ethical, social justice, and child rights concerns [3]. The use of automated decision-making algorithms in teaching, assessment, and student management carries significant risks, including cognitive biases, profiling, and implicit discrimination. Even before they become digital users and consumers, minors are legally vulnerable.

1.1 Legal perspectives

European law recognises the need for augmented protection. EU Regulation 2016/679 (GDPR) establishes a minimum age for consent to personal data processing (art.8) and imposes obligations of transparency and information simplification (arts.12-13). Automated decisions with significant consequences, such as profiling, are prohibited unless they are accompanied by adequate guarantees (art.22). This vision is reinforced by the AI Act (EU Regulation 2024/1689), which identifies minors as a vulnerable group (Recital 28), prohibits the use of AI that exploits age-related vulnerabilities (art.5(1)(b)), and classifies the educational use of AI as "high risk" (Annex III), imposing strict transparency, surveillance, and preventive evaluation requirements. The goal is to ensure that AI does not undermine young users' dignity and autonomy, but rather improves their educational opportunities. Similarly, the Digital Services Act (DSA, EU

Regulation 2022/2065) protects minors as digital consumers. Very large platforms and search engines (VLOPs and VLOSEs) must conduct annual systemic risk assessments for minors' use (art.34). The identified risks must be mitigated through changes in design, algorithms, advertising, and parental control tools (art.35). Introducing AI in schools requires a holistic approach that goes beyond simple legal protection, integrating ethical design principles and strong pedagogical responsibility [4]. In this context, digital and critical literacy plays a fundamental role: educating students, teachers, and families to understand, question, and consciously use AI-based technologies is essential to prevent risks of surveillance, discrimination, or exclusion [5]. Only a transparent and participatory ecosystem can ensure that artificial intelligence becomes a true educational resource, rather than a vector of surveillance or exclusion.

2 Approach and Objectives

In this work, we take an interdisciplinary approach, combining legal studies with pedagogical and social science evidence, as well as tools provided by technical profiles related to cybersecurity, data protection, and platform algorithmic governance. We present a theoretical analysis that emphasises the importance of transforming the roles of educational stakeholders, who are tasked with becoming crucial mediators among technology, education, and rights [6], addressing the ethical and pedagogical implications of digital technologies [7, 8] and AI [9].

Our aim is to examine the issue of ensuring the minor's safety within a hybrid education model, intersected by the growing prevalence of digital technology and AI, using the perspective of Canevaro's concept of "competent accompaniment" [1]. In a digital educational setting providing a "competent accompaniment" means creating a new approach that combines the development of teaching methods with a strong focus on protecting the rights of minors. This perspective implies a critical reflection on AI literacy within the school context [9, 10]. It is essential to ensure the safety of minors while also empowering them to navigate the digital world consciously and responsibly, recognising their increasing capacity for self-determination. To this end, the project is organised in two dimensions: *i)* Promoting a critical evaluation of the frameworks and legislation currently in place at the European level, focussing on protecting minors in the digital educational environment. This entails exploring the current state of the art and identifying the practical challenges that emerge; *ii)* Evaluating new scenarios to develop a framework that aims to create synergies among stakeholders in the educational ecosystem: school leaders, teachers, families, and students. With the aim of promoting practices that ensure legal security, foster pedagogical innovation, and maintain technological sustainability, as well as promoting digital well-being in line with ongoing cultural and technological transformations, we want to contribute to the development of a school community vision that can effectively address AI challenges in an inclusive, critical, and rights-orientated manner.

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Exploring Students' Research Engagement on Digital Technologies and AI. The MENS Group and UNIMORE Case Studies

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1 Theoretical Framework

In this paper, two research experiences are presented that have led to the creation of two bottom-up research groups made up of university students who have not yet graduated and/or have just graduated. The first is the Mind Education Neural Studies (M.E.N.S.) research group, active at the Department of Humanistic Studies part of the University Federico II Research Center on BioEducation and Technology of the University of Naples Federico II, coordinated by Flavia Santoianni and Alessandro Ciasullo. It is an experimentation and reflection group in which students (mainly from the Philosophy course) participate in advanced research and dissemination paths dedicated to the impact of emerging technologies in educational processes.

The other research group hinges on the master's degree course in Digital Learning Theories and Methodologies, of the Department of Education and Human Sciences of the University of Modena and Reggio Emilia, coordinated by Liliana Silva.

The principles underpinning the birth of the two groups, albeit with physiological differences, are based on a common theoretical-epistemological foundation including the one that sees "conceptual stimulative solicitation" as an evolved form of adaptive learning environments on a bioeducational basis [1-3].

Ausubel, in his text *The Acquisition and Retention of Knowledge* [4], an updated and expanded revision of his 1963 text *The Psychology of Meaningful Verbal Learning* [5], asserted that learning and retention of knowledge, in order to be meaningful, had to break free from the classical modes of training. It explained how relevant learning was utilized as cognitive tools throughout the lifespan to support competence, the ability to manage and implement everyone's daily activities. He thus opened up to the scientific debate the educational significance of all those non-codified, episodic but qualitatively high forms of training, capable of breaking the classroom pattern in favor of a process of acquiring meaningful knowledge made up of personal and external experiences.

The approach using the subjective cognitive organization suggested by Ausubel revises the classic curricular scheme (of neo-behaviorist matrix) made up of standard learning units and opens up to the profound connection between knowledge that is meaningful for everyone.

The cognitive structure at this point is determined as an organizational space capable of activating different forms of meaningful learning. The approach can be either derivative or correlative, depending on the new information's reliance on previous organizational schemes.

The scientific referees of the group are tasked with promoting active organizational formulas that focus on student study and research interests. An organizational premise supported by the lecturers that recalls those advanced organizers who are able to introduce conceptual tools that prepare the student to take in new information, rewrite it, and extend it on the basis of their own interests by activating the cognitive heritage they possess.

2 The groups' activities

A further requirement of the MENS group is to pave the way from the bottom up to the so-called Fairness, Accountability, Transparency, and Ethics (FATE)[6][7] through a series of seminar initiatives held directly by students that go in the direction of that strand of AI research called XAI, or eXplainable AI. FATE is an acronym that summarizes a series of research and approaches related to the ethical use of AI in education, and MENS is part of the wider field of research known as AIED.

Furthermore, the dynamics of learning communities, communities of practice, and epistemic construction groups are consolidated by bottom-up research experience [9]. These approaches have multiple effects, but there are some basic parameters that can be highlighted:

1. ability to focus attention on common specific research objects by mediating them with specific personal interests;
2. possibility of acquiring greater awareness of teamwork;
3. possibility of lecturing at conferences, lectures and seminars by accustoming students to scientific public speaking;
4. possibility of organizational management of all phases of the preparation of a scientific event;
5. possibility of publishing contributions in scientific journals (in the case of MENS in the journal Research Trends in Humanities)**.**

The Research Group of the University of Modena and Reggio Emilia also has some peculiar characteristics. It is characterized by three further aspects: a) the link with in-house apprenticeships; b) the establishment of a research group among the course lecturers - in continuity with the University's Interdepartmental Research Centre on Game and the Play - aimed at the in-depth study and application of innovative didactic models linked to educational research; c) the didactic reference to the Playful Learning (PL) approach applied to artificial intelligence. It is essential for students and teachers to acquire new skills due to the significant impact of artificial intelligence (AI) on education. The integration of generative AI-based tools and PL methodologies are potential catalysts for digital transformation in higher education in this scenario. The current literature has largely focused on the technical functionalities of AI, failing to consider its potential in facilitating playful processes of learning and knowledge co-construction. According to the perspective of Kangas & Heljakka [10], analysing the interaction between students and generative AI as a form of Playful Knowledge Co-Creation, a preliminary theoretical proposal for an AI Play model is put forward, based on the reflections of the students involved in a research and design/re-design process of their own learning and - with the support of the lecturers - of the degree course itself.

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Mapping the Landscape of Human-Centered Explainable AI in Education: A Systematic Review

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1 Introduction

In recent years, the integration of Explainable Artificial Intelligence (XAI) into education has accelerated, reflecting the growing need for transparency, trust, and interpretability in AI systems [1]. Within this context, Human-Centered XAI (HC-XAI) has emerged as a framework designed to align AI explanations with the cognitive and pedagogical needs of learners, educators, and institutional stakeholders, promoting not only understanding but also human agency and ethical engagement [2].

To investigate the application of HC-XAI in education, this study presents a Systematic Literature Review (SLR) of research published between 2022 and 2024. The goal is to map the field by examining how HC-XAI is conceptualized, identifying the user groups it addresses, the methods employed, and the trends emerging in system design and evaluation.

To guide the review process, the following research questions were defined:

- RQ1 : How is Human-Centered XAI conceptualized and operationalized in educational contexts?
- RQ2 : What types of users (e.g., students, teachers, institutional stakeholders) are targeted by HC-XAI systems, and how are their needs addressed?
- RQ3 : What explanation techniques are adopted, and how are they evaluated in terms of effectiveness and user alignment?
- RQ4 : To what extent do current approaches incorporate participatory design principles, ethical considerations, and bias mitigation?

2 Methodology

The review follows the PRISMA 2020 protocol to ensure methodological rigor, transparency, and reproducibility in the selection, screening, and synthesis of relevant literature [3]. The search process covered the Scopus electronic database, including peer-reviewed articles published in English between January 2022 and December 2024.

To facilitate the systematic screening and selection process, the mySLR platform[1] was employed. An initial pool of 1044 articles was identified. After removing duplicates and applying eligibility criteria, 44 primary studies were retained for full-text analysis.

In addition to article selection and analysis, risk of bias assessment was carried out using a dedicated tool that evaluated five key aspects, including research aims, data collection, and methodological transparency [4].

3 Discussion and Conclusions

RQ1: The review reveals that HC-XAI is predominantly framed in terms of supporting learner understanding and autonomy, with a focus on enhancing transparency in AI-driven feedback or recommendations. However, conceptual definitions of HC-XAI vary considerably. While some studies explicitly adopt human-centered design principles (e.g., usability, interpretability, user empowerment), others refer more generally to "explainability" without a structured human-centered perspective. The operationalization of HC-XAI often lacks theoretical grounding in pedagogy or cognitive science, and user needs are not always clearly articulated during system development.

RQ2: The vast majority of studies (approximately 75%) target students as primary users, providing explanations intended to improve self-regulated learning, engagement, and trust in AI recommendations. Fewer works (around 20%) involve teachers as decision-makers or system users, typically in the context of analytics dashboards or recommendation systems. Only a small number of studies include institutional stakeholders or curriculum designers. This user distribution highlights a gap in addressing the broader educational ecosystem. Furthermore, while students' cognitive and affective needs are sometimes considered, their direct involvement in system design or validation is generally limited.

RQ3: A variety of explanation modalities are employed, including visual explanations (e.g., saliency maps, graphs), rule-based systems, and natural language generation. In some cases, multiple modalities are combined to enhance comprehension. Evaluation methods often prioritize technical metrics (e.g., accuracy, fidelity, comprehensibility) and usability testing, with only a few studies incorporating educational impact measures, such as learning gains or changes in metacognitive behavior. The alignment between the chosen explanation type and user needs is not always systematically justified. Few studies evaluate explanations longitudinally or in authentic classroom settings.

RQ4: Only a minority of studies (less than 15%) adopt co-design or participatory approaches, such as workshops or iterative user feedback, during system development. Ethical considerations, such as fairness, transparency, and bias mitigation, are often mentioned but rarely operationalized through concrete strategies. Few

[1] `https://myslr.unical.it/homepage`

works perform fairness audits or assess how explanations affect users' perception of bias or equity. Similarly, while some systems aim to promote student agency, mechanisms for safeguarding autonomy or preventing over-reliance on AI are generally underdeveloped.

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From Theory to Dialogue: Simulated Patients for Early Training in Clinical Psychology

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1 Introduction and Related Work

In several medical disciplines, students are expected to develop a range of complex, practice-oriented skills, essential for professional competence: active listening, empathetic communication, the ability to formulate clinical hypotheses, and to navigate emotionally charged or ambiguous situations. Furthermore, students must learn to structure anamnestic interviews, manage the therapeutic setting, and reflect critically on their own interventions and biases. However, these competencies are often acquired only late, typically during postgraduate specialisation programmes, when direct patient interaction becomes mandatory. This limits exposure to realistic, high-stakes communicative scenarios, which are crucial for developing clinical intuition and confidence. While these challenges are present across all medical disciplines, they are particularly pronounced in the fields of psychology and psychiatry. Here, symptoms tend to be more ambiguous, overlapping, and variable over time, making it more difficult for students to navigate diagnostic categories and theoretical models. For students, this complexity presents an additional challenge: it is not enough to learn the criteria of diagnostic systems, they must also develop a clinical sensitivity capable of capturing individual variability and the role of context in the manifestation of distress. Therefore, it is essential to explore alternative approaches, allowing students to engage with experiential learning earlier in their training. Yet, involving real patients in undergraduate classroom activities is not a viable option, because they are costly, labour-intensive, and challenging to scale [1]. In contrast, simulations based on Large Language Models (LLMs) offer a promising alternative by providing scalable, emotionally expressive, and context-aware practice opportunities [2]. Several recent systems have demonstrated the value of LLMs in clinical and psychological training, like CureFun [3] and PATIENT-Ψ [4], simulating patient interactions with improved realism and skill transfer compared to unstructured dialogue. Embedding structured feedback enhances learning outcomes: Louie et al. [5] report significant gains only when feedback is provided alongside simulation. In medical education, LLM-powered simulations have supported clinical decision-making [6] and achieved near-human accuracy in assessing student performance [7].

Despite these advances, current LLM-based simulations face important limitations [8]: lack of clinically relevant information, hallucinations, or inarticulate responses. These raise concerns about reliability in educational settings [7]. Moreover, most systems are limited to one-off sessions and cannot model continuity over time, restricting their ability to simulate sustained therapeutic relationships or evolving patient dynamics.

2 Proposed Framework: LLMPatient

We propose a novel framework leveraging LLMs to simulate realistic patients for training psychologists. Unlike existing chatbot-based mental health simulations [4], our system will support multi-session therapeutic interactions with coherent memory and adaptive behaviour. The key innovation lies in the ability to dynamically adjust patient responses over time based on the quality and style of therapeutic input, enabling a more authentic and pedagogically valuable experience for learners. Therefore, our framework also offers the possibility to interact not only via a text chat, but also with voice, enabling trainees to speak as they would with a real patient.

The framework is based on a modular architecture that integrates symbolic representations of patient traits with neural language modelling. Each virtual patient is defined by a structured profile comprising 68 attributes, which encode demographics, symptomatology, personality traits, and therapeutic goals. This profile governs how the simulated patient behaves and responds, promoting consistency and psychological plausibility.

The system implements a dual memory mechanism: i) a short-term memory component tracking intra-session dialogue, ii) a long-term vector-based memory that retrieves relevant content from previous sessions by sentence-level embeddings. These elements are orchestrated into a dynamic prompt, conditioning the responses and ensuring alignment with both the patient's persona and their therapeutic trajectory.

A defining feature of the system is its adaptive behaviour module, evaluating therapist input (either through symbolic rules or machine-learned classifiers) and updating patient behaviour. For example, empathetic and effective interventions may lead to reduced resistance or improved affect over time, while confrontational or ineffective interventions could elicit defensive or withdrawn responses. This progression emulates realistic therapeutic dynamics, offering a safe environment for psychologists to explore the consequences of different clinical strategies.

The system is developed in close collaboration with mental health professionals. Each design choice, from persona construction to memory retrieval logic and adaptive behavioural rules, is iteratively validated through expert feedback. This ensures that the simulated interactions not only align with theoretical psychological models, but also reflect the practical needs and expectations of clinicians. The goal is to provide a training experience that is not only technically-sophisticated, but also grounded in the realities of therapeutic practice.

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Entangled Intelligences.

A post-phenomenological Approach to AI in Education

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1. Introduction

This paper reconsiders educational practices in light of the growing use of artificial intelligence, particularly large language models (LLMs). It draws on post-phenomenology, mediation theory, and information theory, with empirical reference to classroom practices in secondary-level philosophy teaching. The paper is organized into three sections: (1) theoretical and methodological perspectives, (2) a discussion of the state of the art and empirical studies on LLMs in education, and (3) examples of constructive and complementary uses of AI as cognitive artifacts in learning environments. Technologies are not neutral [1] but actants that co-constitute cognition and meaning-making [12]. The original AI ambition of replicating human cognition has been replaced by statistical approaches. Unlike symbolic "good old-fashioned AI," contemporary machine learning, especially Transformers can be defined "statistical artifacts" [5]. Cognition, from a neurophenomenological view, remains the prerogative of natural, autopoietic beings [17; 11] , while phenomenological approaches deny machines intentionality [2]. Floridi [9] argues that LLMs exhibit agency without cognition, they therefore have a significant role in reshaping communicative ecologies. Luhmann's systems theory helps clarify this: communication is not merely interaction but structural coupling between systems [16]. Human–AI relations should thus be conceived less as "thinking" than as artificial communication [6]. Such shifts redefine human being-in-the-world in the "Infosphere" [10]. Given the widespread use of LLMs in students' and educators' practices, critical reflection on their pedagogical role is urgently required. Within Actor-Network Theory, LLMs appear as non-cognitive actants that nevertheless influence learning environments. They can be considered *cognitive artifacts*, i.e. tools supporting human cognitive tasks [8]. Constructivism (Dewey; Vygotsky) already emphasized learning as an interactive process involving subjects, tools, and contexts, while Tomasello's research underscores the mutual interaction of cooperation and learning [24]. Today's hybrid settings, however, involve both human and non-human agents, raising the question of how to integrate AI agency into cooperative and individualized learning contexts, without undermining autonomy.

2. Integrating AI in Learning Environments

AI in education displays a Janus-faced character. It may act as a reflective partner but, if overused, risks weakening learners' independence. Meta-analysis [24] illustrates this ambivalence: AI tools improve engagement and outcomes but also foster dependency, bias, and reduced deep reading. Sok and Heng [23] similarly highlight opportunities and risks. While AI supports learning, it also enables misconduct such as assignment outsourcing, thereby undermining fairness [4]. Habitual reliance can erode critical thinking, problem-solving, creativity, and research capacities [14]; Roncaglia [21] further emphasized that AI may be treated as an oracle and an authority, without recognizing that these technologies are structurally prone to "hallucinations". To balance innovation with integrity, scholars propose designs that integrate AI critically. Smithson and Zweber [22] introduce "LLM dialogues," in which students debate with models and annotate the exchange, strengthening argument-tracking and reflection. Lemasters and Hurshman [15] advocate oral examinations, emphasizing live reasoning beyond AI-generated text. Mouser [18] proposes "writing with ChatGPT" protocols requiring disclosure of prompts and revisions, making AI engagement transparent. Rivoltella [20] explores structured disputation formats where AI mediates cooperative reasoning. At a broader level, Peláez-Sánchez et al. [19] map LLMs to Education 4.0 pedagogies such as heutagogy, peeragogy, and cyber-pedagogy, stressing both opportunities for autonomy and risks for integrity. Comparative studies [7] confirm that human tutors excel at personalized inquiry, yet students appreciate LLMs for accessibility, pacing, and non-judgmental questioning, pointing toward hybrid models where AI complements, not substitutes, human guidance. These contributions converge on a common insight: the task is not to exclude AI but to design practices where it augments reflection, dialogue, and collaboration rather than displacing them.

3. Conclusion: AI as cognitive artifact

Following Fasoli [8] and the extended mind theory [3], cognitive artifacts may be constitutive, complementary, or substitutive. In education, LLMs should be used in constitutive and complementary ways that foster learner autonomy, rather than substitutive ones that diminish it. From a Kantian view, this integration extends synthetic knowledge and sharpens analytical capacities. Assessment should address not only results but also reasoning and inquiry [13]. Drawing on philosophy teaching, I finally suggest practices such as Debate, ArguMate, and Debate With Me, where LLMs serve as dialogical partners. Here, AI functions not as a surrogate for thought but as a catalyst for autonomy and critical engagement in hybrid learning.

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Special Track 2

Formative Assessment in Higher Education: Conceptual Framework

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Mapping the Spectrum of Teaching Styles for Physical Education Teachers in Italy: Insights from the Architecture of Teacher's Behavior

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1 Introduction

Physical education in schools contributes to supporting and promoting the educational development of children: motor tasks and the organizational methods used by the teacher to present these tasks offer meaningful opportunities for disciplinary, interdisciplinary, and cross-curricular learning. Proposing motor tasks through different teaching styles and strategies allows PE teachers to highlight different components and domains of Physical Literacy [1,2]

The Spectrum of Teaching Styles model [3] describes different teachers' behavior scenarios, moving from an instructional approach where the teacher assumes the highest degree of responsibility and decision-making in selecting activities and methods, to one in which decisions and motor responses are increasingly left to the student and the class group. The present study aims to provide an exploratory factor analysis to assess the architecture of the Italian version of the Spectrum of Teaching Styles Questionnaire in Physical Education.

2 Materials and Methods

The sample was recruited from both first and second grade of secondary school's Italian PE teachers, involved in Pre-Service Teacher Education Programs at the University of Salento. The sample involved 80 PE teachers (M = 45, F = 35, main age = 37,14 ± 10,76). The assessment has been carried out during teacher's training courses in May-June 2025. Participants were asked to fill in an online version of the questionnaire used in previous study [4].

3 Statistical Analysis and Results

An Exploratory Factor Analysis (EFA) was conducted to examine the underlying structure of the teaching styles assessed in the study. The overall KMO value was 0.63, indicating a moderate level of sampling adequacy, while Bartlett's Test was significant ($\chi^2 = 374.73$, df = 55, $p < .001$), confirming the appropriateness of factor analysis. The factor extraction was conducted using principal axis factoring, and an oblique rotation (Oblimin) was applied, given the assumption that factors could be correlated. Based on parallel analysis, two factors were retained, explaining a total of 43% of the variance (27% and 17% for Factor 1 and Factor 2, respectively).

However, several items showed weak loadings and high uniqueness values, suggesting potential conceptual overlap or poor item fit. Fit indices for the two-factor model indicated a modest fit (RMSEA = 0.18 [90% CI: 0.144–0.212]; SRMR = 0.07; CFI = 0.77; TLI = 0.62; BIC = -28.91). These results suggest that while the two-factor solution is supported by theoretical considerations, the model may require refinement (see Fig. 1).

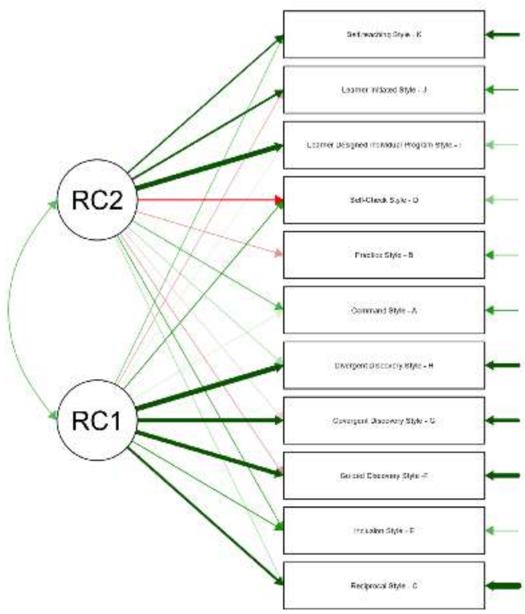

Fig. 1. Path diagram

4 Discussion and Study Limitations

This study aims to examine the factorial structure of the "Spectrum of Teaching Styles Questionnaire" in Italian physical education teachers, highlighting a two-factor model "Teacher-centered " and "Learner-centered”, respectively. However, despite CFA indicates an acceptable model fit, the empirical structure of the questionnaire might require further refinement, as suggested by other findings in literature [5,6].

Moreover, some study limitations need to be pointed out. Firstly, it is important to emphasize that the main limitation may be due to teachers' knowledge and practical experience of the teaching styles model. Although initial training was provided for all teachers involved, not all of them may have developed a thorough understanding of teaching styles, enabling them to respond accurately to the questionnaire (e.g., they may have confused one style with another). This suggests that the study should be replicated with more robust participants and analytical methods to confirm the factorial structure. Moreover, while sampling encompasses both secondary and primary school teachers, the sample size and representativeness of the sample are crucial in ascertaining the generalizability of the findings.

5 Conclusion

This study provides preliminary evidence of a two-factor structure underlying teaching styles in physical education, distinguishing between teacher-centered and student-centered approaches. While the model shows theoretical consistency, the highlighted limitations in fit indices and item reliability suggest the need for further refinement and validation.

These findings underscore the importance of using different and multiple instructional strategies to support meaningful motor learning and students' engagement in educational settings.

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The Impact of Team-Based Learning on Student Outcomes in Undergraduate Economics: Evidence from a Quasi-Experimental Study

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1 Introduction

Economics education has long recognized the importance of connecting abstract theoretical concepts with real-world applications to enhance student engagement and learning outcomes (Becker, 2000). This recognition has spurred growing interest in active learning, with Team-Based Learning (TBL) providing a structured framework where permanent, diverse teams apply theory to practice (Michaelsen et al., 2004). Yet, although TBL has achieved widespread adoption in several higher education fields such as medicine and nursing, its implementation in economics remains relatively limited (Cagliesi and Ghanei, 2022).

Research on the use of TBL in economics can be grouped into three main strands: studies that highlights its potential benefits and offer practical guidance for instructors (Clerici-Arias, 2021; Imazeki, 2015), qualitative contributions that investigate students’ experiences and perceptions of learning with TBL (Espey, 2018; Imazeki, 2015) and quasi-experimental analyses that compare student outcomes in TBL and non-TBL settings, drawing on both quantitative and qualitative measures (Abío et al., 2019; Artz et al., 2016; Cagliesi and Ghanei, 2022; Hettler, 2015). Much of this literature remains concentrated on short-term or course-level outcomes, with relatively little attention to longer-term effects on academic trajectories and degree completion.

2 Methodology

This study evaluates the impact of Team-Based Learning implementation on student academic performance in undergraduate economics education, examining effects across short- and medium-term periods. Drawing on comprehensive administrative data from a large Northern Italian university, we evaluate the effectiveness of TBL methodology introduced on a pilot basis across multiple cohorts of undergraduate students of a second-year Introductory Macroeconomics course between 2017 and 2023.

Our analysis employs a quasi-experimental design where the treatment group includes students who participated in TBL while the control group consists of students from the same institution who did not participate in TBL. Control group members either followed a parallel course in Introductory Macroeconomics within the same department, with identical syllabus, textbook, and duration, or were enrolled in the same course as the treatment group but represented pre-intervention cohorts (sharing the same professor).

To address potential selection bias and to ensure comparability between treated and control students, we apply propensity score matching (PSM) using a logistic regression model including a comprehensive set of pre-treatment student characteristics, such as gender, year of birth, high school type, high school graduation grade, university entry test scores, geographic origin, area of residence, and first-year university credits (CFU). Matching was performed one-to-one without replacement and within a caliper of 0.05 (Rosenbaum and Rubin, 1983). The procedure ensures that each treated student is paired with a control student exhibiting a similar likelihood of participating in TBL. Post-matching diagnostics confirm strong covariate balance between groups.

We conducted two complementary analyses. A first analysis examines the full matched sample of students, focusing on short- to medium-term academic outcomes, including second-year CFU and average grades, cumulative third-year CFU, and the probability of graduating on time. The second analysis focuses on the subsample of students who graduated during the period of analysis and considers medium-term program completion outcomes, such as final graduation grade, time to obtain the final degree, overall grades, and on-time graduation probability. Continuous outcomes are estimated using ordinary least squares (OLS), while binary outcomes are modeled with probit regressions. Both sets of models include the same covariates used in the matching step. Combining matching with regression adjustment provides a doubly robust framework, reducing concerns about residual imbalance or model misspecification, while enhancing the reliability of causal inference.

3 Results and discussion

Preliminary evidence points to systematic advantages for TBL participants across both short-term and medium-term academic outcomes. In the short term, students exposed to TBL earned more university credits (CFU) and achieved superior average grades in the exams by the end of the academic year in which the TBL was implemented relative to matched peers.

On average, treated students demonstrated a faster accumulation of CFU, suggesting that TBL helped them manage coursework more effectively and engage more actively with learning activities. These patterns are observed consistently across both the control groups, indicating that the positive effects are not driven by idiosyncratic differences in curriculum or cohort characteristics. TBL students also accumulated more CFU by the end of the academic year following the TBL implementation, implying that the intervention fostered ongoing academic progression rather than temporary improvements. This sustained effect may reflect enhanced collaborative skills, better time management, and higher motivation fostered by TBL activities. Additionally, the probability of graduation was higher among TBL participants, indicating that the intervention contributed to sustained engagement and reduced the risk of academic attrition. The consistency of these gains across different control groups supports the robustness of the causal inference derived from our matched design.

In the medium term, analyses of the graduate subsample reveal that TBL students obtained higher final graduation grades and were more likely to graduate on time. This finding suggests that the benefits of TBL extend beyond immediate performance improvements, influencing students' ability to complete their academic programs efficiently while maintaining high academic standards. Furthermore, medium-term outcomes such as average performance across all courses suggest that TBL participants generalized their newly acquired skills across the curriculum. This points to a broader effect of the intervention on academic habits, critical thinking, and learning strategies. Taken together, these results highlight that TBL can contribute to both immediate performance gains and improvements in overall academic trajectory.

These findings are consistent with prior research highlighting the effectiveness of active learning interventions in improving academic performance and student persistence. The observed advantages are not confined to particular cohorts or programs but emerge consistently across time and courses, reinforcing their external validity and generalizability. Overall, this suggests that structured team-based learning activities provide measurable benefits for student engagement, learning outcomes, and degree progression, while even small-scale interventions can generate lasting educational gains.

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Assessment and self-assessment in teacher training: a survey of practices and perceptions among trainee teachers

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1 Introduction

Assessment in education is a critical component that serves multiple purposes, ranging from measuring student achievement to enhancing the learning process
Research consistently highlights the value of Assessment as Leaning in fostering students' metacognitive skills and enhancing their engagement in the learning process.
By including strategies such ad self-assessment [1].and peer assessment, learners gain deeper awareness of their own progress while contributing to a cooperative and interactive classroom environment. From an educational point of view, this paradigm departs from traditional classificatory logics that tend to crystallize student learning within predetermined categories, while also opposing evaluative systems of a merely quantitative or synthetic nature [2].
Nowadays the focus shifts instead toward a processual perspective that privileges the evolutionary analysis of learning This methodological approach enables teachers to acquire a more in-depth understanding of each learner's cognitive and formative profile, thereby creating conditions for implementing operational strategies. This framework translates operationally into the design to differentiated instructional pathways, the careful selection of content, the arrangement of functional learning environments and the valorization of multiple expressive dimensions for the evidencing of acquired competencies.
This goal of this paper is to reflect on the relationship between the educational and evaluative use of technology and teachers' perceived self-efficacy in initial school teaching training courses.

2 Research design

2.1. Methodology

The analysis aims to highlight the pedagogical, didactic, and assessment aspects that should be incorporated into initial and in-service teacher training programmes to equip teachers with the tools necessary to facilitate meaningful learning among their students in terms of their cognitive, emotional, and social development [3]. drawing upon recommendations from cognitive educational research [3], [4].
Effective teaching strategies generate positive learning outcomes and are derived from appropriate training that addresses elements of methodology, attitude and awareness

among teachers. Numerous studies [2,5-9], demonstrate that teacher training is one of the most effective ways to improve the quality of an education system. The study is based on the processing of quantitative data from a survey conducted between the 2nd April and 25th June 2025 at the Online University eCampus and the University of Catania. The sample consisted of 1100 students from pre-school to secondary school enrolled during the Qualifying Pathway courses for the secondary school teachers (DPCM 4/8/23) and the Specialization Pathway Courses in Teaching Support for Students with Special Needs. It can be considered a convenience sample (non-probabilistic, accidental) as the selection of the participants was not carried out using randomized control procedures [11], but it identifies trends of interest for education and school teaching, offering an opportunity to reflect and analyzes its current objectives. The tool used for the survey is the Questionnaire for Self-Analysis of Teaching Practices (QAPD) [13], it was previously applied in 2022 in a different survey of 504 Italian teachers from the nursery to the secondary school. It consists of 149 items with closed and two open tasks which are divided into five different sections: personal data, teaching and assessment practice, organizational practice and summary description of a typical lesson in class. In this study, from the set of items available in the questionnaire, attention is given to those most directly are linked to inclusive teaching and assessment practices. These include defining learning objectives that stimulate cognitive processes, planning specific activities to assess the cognitive processes students use when acquiring new content, and developing initiative to enhance both cognitive and emotional-relational abilities.

2.2.Preliminary findings

The analysis revealed tendencies and correlations crossing multiple and different dimensions of teaching and assessment practices. These include the use of varied instructional strategies such as delivering lectures and encouraging collaboration through pair or small-group work. Equally significant is the design of activities aimed at fostering a positive classroom atmosphere while supporting students' emotional, relational, and social development. Attention is also directed toward the promotion of cognitive abilities and fundamental skills, including comprehension, logical reasoning, and problem-solving.
Furthermore, the integration of formative assessment approaches, encompassing self-assessment, well-constructed rubrics, and authentic, skills-based tests, emerges as a key element for monitoring learning progress and enhancing overall educational outcomes. limit itself to methodological and technological competencies, but must cultivate a more reflective awareness, pedagogical flexibility and the ability to design inclusive learning environments.

3 Conclusion

The findings of this research reinforce the idea, widely supported by international research, that high quality initial and in-service teacher training must not limit itself to methodological and technological competencies, but must cultivate a more reflective awareness, pedagogical flexibility and the ability to design inclusive learning environments. In this perspective, teacher education programmes should adopt an integrated approach that connect the pedagogical theorical framework and formative assessment. Overall, the survey provides a partial picture of the use teaching and assessment practices adopted by "technological" teachers and compares them with the findings of studies on teacher effectiveness [14], in order to identify similarities and differences.

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The Ideal and Real Profile of the University Professor: Evidence from an International Student Survey

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1 Introduction

Over the past two decades, the quality of university teaching has become an increasingly central topic in European higher education policy. Since the Bologna Process, key documents—such as the Paris Communiqué [1] and the Yerevan Communiqué [2] — have stressed the need to strengthen the educational dimension of the academic role, promoting evidence-based, inclusive, and active learning-oriented teaching practices [3]. However, despite the importance attributed to quality teaching, university instruction [4] is still often perceived as secondary to research [5 - 7]. Within this context, the European project QUALITI – Didactic QUALity Assessment for Innovation of Teaching and Learning Improvement, funded by the Erasmus+ programme, was implemented in collaboration with academic and non-academic institutions in Italy, Spain, Lithuania, Romania, and Poland. The project's main objective was to develop an integrated model for improving university teaching, through the definition of quality indicators, the design of a student- and teaching-centered lecturer profile, and the implementation of professional development programmes for academic staff [8 - 10]. QUALITI adopted a holistic approach at three levels: a) Institutional, through the creation of a system of indicators for assessing teaching quality (IO1); b) Curricular, through the definition of a student-centered lecturer profile (IO2); Individual, through pedagogical and methodological training for lecturers (IO3).

The theoretical framework is grounded in the recognition that teaching has often been marginalized in comparison to research at the European level, despite increasing student diversity and the need to ensure equitable, inclusive, and personalized learning experiences [11 - 12]. Hence, the need emerges for direct indicators of teaching quality that capture process effectiveness rather than merely post hoc outcomes. The project's overarching goal was to identify innovative strategies and tools to enhance the quality of university teaching, foster professional development for lecturers, and promote student-centered pedagogies. Overall, the project aimed to support teaching innovation through an integrated system of evaluation, training, and methodological development. Within this interpretive framework, a mixed-methods research design was developed, structured into three phases: 1) Theoretical research: literature review and meta-analysis of existing evidence; 2) Exploratory research: data collection via questionnaires for students and lecturers, interviews, and focus groups; 3) Experimental research: implementation of pedagogical training for university professor.

2 Research Focus

One of the project's core activities involved an international survey on the "ideal" university lecturer profile, as perceived by students. The survey had a dual purpose:

on the one hand, to identify the characteristics students consider essential for effective teaching; on the other, to compare this ideal profile with their perception of actual lecturers encountered during their studies. This initiative responds to the growing call across Europe to systematically incorporate the student voice into the evaluation and enhancement of academic teaching [13 - 15]. The study also aimed to support the development of more engaging, inclusive, and personalized learning environments, in line with recent international recommendations on higher education [16 - 19].

3 Methodology

The survey involved 7,724 undergraduate and graduate students from the five participating European countries. A bilingual questionnaire—comprising both closed-ended (Likert scale) and open-ended questions—was used to collect both quantitative and qualitative data. The research adopted an integrated methodological approach, including descriptive statistics, subgroup comparisons, and content analysis of open responses. The questions aimed to:

- Investigate the skills and qualities students consider essential for effective university teaching;
- Assess students' actual experiences with University Professors;
- Identify training needs and suggestions for improvement.

The questionnaire was translated and culturally adapted to the respective linguistic contexts to ensure cultural validity and cross-national data comparability. Data were analyzed using both statistical and qualitative software tools, allowing for a triangulated interpretation of the findings.

4 Results

The findings indicate that, from the students' perspective, the ideal lecturer should balance strong disciplinary expertise with relational and empathetic abilities. Key qualities also include clarity of communication, the use of active and inclusive teaching methods, mindful integration of educational technologies, and the ability to tailor instruction to student needs. Moreover, lecturers should be able to assess students in alignment with learning objectives, foster active participation, and support students' personal as well as cognitive development. However, comparisons with students' experiences of "actual" lecturers revealed several gaps: limited use of innovative teaching practices, low integration of digital tools, and a certain rigidity in managing content and instruc- tional time [20]. Despite this, students acknowledged several strengths in their lectur- ers, including openness to dialogue, personal support, and a sense of teaching responsibility. These informal aspects were seen as key to fostering a climate of trust and motivation—conditions considered essential for meaningful learning. The study outlined a complex yet coherent picture of the ideal university lecturer, offering useful insights for both assessment and training purposes. The competencies identified by students serve as direct indicators of teaching quality and provide a solid foundation for the development of training and self-evaluation models for university teaching staff. In this regard, The QUALITI project offers a significant contribution to the ongoing debate on the professionalization of academic teaching, supporting the creation of inclusive and pedagogically informed learning environments.

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Engineering Students' Perception of Formative and Innovative Assessment in the Physics Course: Potentials and Challenges Compared to Traditional Methods

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1 Introduction

This qualitative research explores in-depth the perceptions and experiences of Electronic Engineering students regarding an innovative formative assessment model implemented in the Physics course at a federal university in Brazil. The study critically examines how the reformulation of evaluation practices—moving away from conventional summative exams toward more pluralistic, contextualized, and interactive frameworks—impacts student engagement, meaningful learning, and the development of autonomy. By integrating active methodologies with a formative evaluation structure, the course sought to overcome the limitations of traditional assessment methods prevalent in engineering education (Pinho & Mello, 2020; Filatro & Cavalcanti, 2018).

2 Materials and Methods

By integrating active methodologies with a formative evaluation structure, the course sought to overcome the limitations of traditional assessment methods prevalent in engineering education (Pinho & Mello, 2020; Filatro & Cavalcanti, 2018).

The redesigned evaluation approach combined diagnostic, formative, and summative components, providing continuous feedback and opportunities for students to reflect on and self-regulate their learning. This strategy was embedded within a hybrid learning environment that complemented face-to-face with synchronous and asynchronous digital activities through platforms like Google Classroom. These methods align with current trends advocating for technology and active learning to foster a more flexible, student-centered educational experience (Hadji, 1994; Cassati, 2020). The reformulated assessment promotes a dynamic and dialogic process, breaking away from rigid, one-dimensional testing and enabling the cultivation of critical technical and socioemotional competencies essential in modern engineering practice (Borrachero Cortés, Dávila Acedo & Airado, 2017; GEE, 2005).

Data collected through participant observation, field diaries, and especially student-produced documents such as self-assessments were systematically analyzed using Bardin's (2016) Content Analysis framework. The methodology ensured a comprehensive understanding of student perceptions, encompassing cognitive, emotional, and social dimensions linked to the evaluation process (Rosa et al., 2023).

3 Analyses and Results

Students recognized the formative design's positive impact on their learning trajectory, highlighting the assessment's role in encouraging them to assume a more active, responsible role in their educational development. Respondents appreciated the assessments' collaborative and negotiated nature, which promoted metacognitive awareness and enhanced autonomy in managing study time and technological resources (Sant'Anna, 2014; Bacich & Moran, 2018).

Moreover, several students emphasized the alignment between evaluation activities and professional skill development, marking a growing awareness that learning extends beyond mastering theoretical content to acquiring competencies valued in the labor market, such as problem-solving, communication, time management, and critical thinking (Arruda, 2020; Santos, 2016).

Nonetheless, the research also uncovered significant challenges experienced by students. One of the most prevalent difficulties concerns the management of task overload, as learners struggle to balance multiple simultaneous demands from various courses, which sometimes generates anxiety and compromises the learning process. Reflecting on this challenge, one student noted, "*The high volume of tasks made it difficult to plan my studies effectively, leading to stress and fatigue*."—a finding consistent with previous studies on student emotional responses in higher education (Agén & Ezquerra, 2021; Bzuneck, 2018). Additionally, the emergency remote teaching environment introduced obstacles related to limited access to adequate technological resources and diminished opportunities for hands-on practical activities, which are crucial in engineering education (Arruda, 2020).

The research highlights the necessity for ongoing instructional assistance and capacity development among educators to craft and apply versatile, context-responsive assessment strategies that address various student situations. Professional development should prioritize technology literacy and innovative assessment strategies to ensure the feasibility of formative assessment in online and hybrid teaching (Agén & Ezquerra, 2021; Rosa et al., 2023). Particularly, the research demands measures to confront structural inequities to prevent the further expansion of education disparities amidst the growing utilization of digital instruction and assessment.

4 Conclusion

This research contributes to the growing body of evidence advocating the transformative potential of formative and diverse assessment strategies in the engineering curriculum. By actively involving students in the evaluation process and valuing both cognitive and socioemotional aspects of learning, these methods foster more profound understanding, greater learner autonomy, and the development of integral competencies vital for the modern engineer (Bacich & Moran, 2018; Filatro & Cavalcanti, 2018).

Such innovative evaluation frameworks could significantly enhance teaching quality and student outcomes in complex STEM disciplines.

Follow-up research should take this question to additional engineering curricula and academic fields to test these formative strategies' generalizability and common applicability to different educational settings. In addition, longitudinal research would be essential in determining the long-term effect of formative measurement on student learning, motivation, and professional ability. The explicit incorporation of formative measurement techniques into engineering education is consistent with national curriculum standards (GEE, 2005) that support integrated competency development and diverse assessment mechanisms.

In conclusion, formative and innovative assessments present promising pathways for transitioning engineering education toward more inclusive, flexible, and student-centered paradigms. These practices provide meaningful feedback, promote student accountability, and prepare learners to face the increasingly complex demands of the engineering profession and society.

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Focus Groups and Reflective Practice: Expanding Teachers' Perceptions of Large-Scale Assessments for Pedagogical Development

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1 Introduction

International education systems are progressively using large-scale educational tests as diagnostic tools to measure student learning outcomes and inform policy and instructional practice. In Brazil, the "*Prova Paraná"* stands out as one of the flagship tests carried out at the state and municipal levels to determine areas of strength and weakness among the students (Delalibera, 2025). Although such tests provide much quantitative data, their impact on teachers' attitudes and teaching practices is a less researched and multifaceted phenomenon. As central facilitators in the learning process, teachers play a fundamental role in making sense of and acting upon assessment outcomes. However, their voices tend to be silenced in large-scale evaluative systems long dominated by statistical metrics and policy mandates.

Consequently, there is a pressing need to employ qualitative methods that adequately capture teachers' complex experiences as they navigate the challenges of conducting and reflecting on the implications of these assessments. Focus groups are a particularly suitable qualitative research methodology since they provide a social, interactive environment where respondents can articulate and debate their observations, beliefs, and real-time responses to assessment outcomes. As noted by Gatti (2005), focus groups provide a means to collect sophisticated data through group discussions and interactions, thereby providing richer insights that extend beyond personal views. This approach is particularly valuable where teachers undergo everyday experiences of challenges associated with high-stakes testing like "*Prova Paraná"*, which assesses students' learning and has policy-making, instructional emphasis, and institutional reputation implications.

2 Materials and Methods

This study underscores the value of employing qualitative methods, particularly focus groups, to capture nuanced teacher experiences and promote reflective professional dialogue. Focus groups foster collaborative reflection on diagnostic outcomes, enabling teachers to collectively analyze data, share insights, and develop pedagogical strategies oriented toward student learning improvements.

3 Analyses and Results

Reflective practice is also a key to understanding the relationship between large-scale testing and classroom instruction. Theories of reflective practice, especially those offered by Schön (2000) and Alarcão (1996), emphasize constant professional reflection on one's teaching to adapt to student needs and environmental demands. Including focus groups based on assessment information creates a rich setting for collaborative reflection, whereby teachers work together to consider diagnostic results, share meaning, and develop strategies for improving teaching practices. This reflective practice supports teacher agency, potentially countering mechanistic and control-oriented uses of external assessment through a formative perspective based on improvement in education.

Incorporation of focus groups in educational research requires careful ethical deliberation. Informed consent, confidentiality, and voluntary participation should be provided, as dictated by the Brazilian National Health Council's Resolution 466/2012 (CNS, 2012). Ethical conduct fosters an environment of trust and openness for the participants, essential to candid discussion and sharing of real information. Also, the facilitator is key in directing discussion, managing group dynamics, and establishing equitable participation to ensure no individual dominates while encouraging the generation of varied ideas.

Formulation of study groups around the "*Prova Paraná*" or equivalent assessments can potentially institutionalize reflective practices and professional development within educational institutions and municipalities. The study groups represent a platform for teachers to access, analyze, and use assessment materials and data, which teachers may otherwise find difficult to access or deal with due to the nature of their workload or unfamiliarity, as Delalibera (2025) noted. In the Paraná state scenario, projects like "*Formadores em Ação*" illustrate the value of the guided group discussion in helping clarify the evaluation process. This enables teachers and pedagogical staff to analyze the results collectively to search for effective strategies to close knowledge gaps.

4 Conclusion

The use of focus groups also works to amend the unintended consequences of education testing decried in political and scholarly communities. Large-scale testing has been critiqued to foster an enterprise discourse within schools that values outcomes and accountability measures at the expense of the broader educational experience (Delalibera, 2025). By facilitating dialogic space where teachers are actively involved in contemplating the promise and restrictions of these assessments, focus groups can re-center the pedagogical dimension, convincing teachers not to submit to reductionist interpretation but to view assessment data as diagnostic tools for understanding and formative growth.

This study underscores the methodological merits and pedagogical worth of using focus groups in large-scale assessments such as "*Prova Paraná*". This qualitative methodology enhances the evaluative process by elevating teacher knowledge, fostering reflective professional discourse, and facilitating the conversion of statistical findings into meaningful pedagogical initiatives. The use of focus groups in assessment practices thereby contributes to the cultivation of teaching communities that are more reflective, receptive, and empowered, and in this way, ultimately increases the formative influence of educational assessments and advances student learning trajectories.

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AI-driven Formative Assessment For Learning (from Research to Action)

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1 Background and Introduction

Artificial Intelligence (AI) has been used in many fields with significant results for many years. With some exaggeration, it is an integral part of our lives. Think of our online banking, our communication in the digital space, route planning, or even diagnostic imaging in health. Nowadays, on the basis of the research findings and under the umbrella of lifelong learning, AI is reshaping higher education, fundamentally shaking up old structures from curricula to teaching methodology to assessment [1]. A range of studies, articles, conferences, round tables, workshops, and projects address the links between AI and education, from ethical issues to the concept of knowledge and learning, and from the practical to the developmental [2]. In our paper, we are focusing on assessment, especially formative assessment. From the output view, the significant and effective starting steps of this process to change and transform the functions of assessment, especially from summative to formative assessment, come to the forefront, which affects the innovative teaching methods. As Black and Wiliam defined, "…formative assessment when the evidence is actually used to adapt the teaching to meet student needs" [3]. Higher education institutions have different strategies for personalized learning, feedback culture, and using responses and feedback for improving assessment and teaching.

2 Objective

This paper aims to contribute to both national and international discussions on AI-driven assessment under the umbrella of the transformational change in higher education. Through research findings (international, national, and local) to present some practical examples using AI-driven formative assessment in practice at higher education.

3 Methodology

This study adopts a qualitative, exploratory research design, grounded in teachers' and students' interviews conducted at Budapest Metropolitan University (METU). So far, we have completed 10 semi-structured interviews, each lasting on average 1.5 hours. As this is an ongoing research project, the current findings represent a first phase of data collection. While there are naturally differences across disciplines and personal perspectives, the analysis also revealed clear common patterns. The coding process was carried out both manually and computationally, using NVivo, ChatGPT, and Python. Furthermore, the results were also displayed through mind-mapping (thematic codes) and dendrogram (clustering the interviewees), making the emerging patterns more accessible.

4 Results

This qualitative analysis offers practical repertoires on AI-driven formative assessment, while also highlighting shared insights from the interviews. Three common patterns emerged:

1. *AI use is already embedded* in everyday academic practice at our university, METU.
2. Nevertheless, the focus is not on "artificial intelligence" itself, but primarily on *the human element*; more specifically, reflection, creativity, and critical thinking remain central.
3. *Students must be trained to use AI consciously, critically, and creatively*. This aligns with our MyBrand program, Hungary's first portfolio-based higher education model, where students build personal portfolios through project-based learning and authentic outputs, later used to support their career pathways. In this framework, AI-driven formative assessment directly complements and enriches students' long-term development.

5 Conclusion

Learning support AI tools (e.g., chatbot, recommender system, feedback engine), automatic assessment systems (e.g., essay improvement using AI), and the development of reflective thinking (e.g., learning diary analysis using AI, career portfolio) will make the transformation process in higher education. The current phase of our ongoing research confirms that the integration of AI in formative assessment is not only a technological issue but an educational and cultural challenge, placing students' reflective and creative development at the centre.

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Adaptive Psychometric Design for Inclusive and Formative Online Assessment in Higher Education

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1. Introduction

The growing complexity and diversity of student populations in online higher education challenge traditional summative assessment approaches.

This situation calls for a reconceptualization of assessment as a formative, inclusive, and pedagogically embedded process [1–3]. This contribution presents a conceptual framework for the design of an adaptive psychometric tool that applies formative assessment principles within higher education digital learning environments.

2. Conceptual Framework

The framework advances the idea that psychometric tools—traditionally used for standardized measurement—can become pedagogical instruments that actively support formative feedback, learning, and critical reflection by both learners and educators. Grounded in a constructivist and inclusive vision of education, the tool structures and assesses key psychological and pedagogical constructs—such as learner engagement, cognitive flexibility, and feedback responsiveness—not as static traits but as dynamic elements in a co-constructed learning process.

Through Item Response Theory (IRT) and adaptive testing principles, the tool enables real-time, personalized feedback that helps educators monitor learner trajectories and adapt their teaching strategies in a formative and inclusive way. To reduce reliance on self-report instruments—often affected by social desirability bias—the model integrates behavioural and interactional data [4,5], enhancing ecological validity and learner authenticity.

3. Methodological Approach

This process promotes a virtuous cycle of formative thinking, in which educators themselves gain greater awareness of their own evaluative practices, fostering critical reflection and pedagogical growth. Assessment thus becomes not only a tool for learners' development but also a trigger for instructors' professional learning.

Methodologically, the framework combines psychometric rigour with pedagogical relevance by integrating Bayesian reasoning [6–8] and NHST, alongside effect size interpretations, to validate constructs and support nuanced educational decision-making [9]. A mixed-methods approach—including qualitative input from instructors and learners—ensures that the tool remains responsive to real educational contexts [10].

Learning analytics and network analysis expand the model's interpretive power by revealing patterns and connections among constructs such as self-efficacy, motivation, and perceived competence [11].

4. Conclusion

Looking ahead, integration with immersive, ecologically valid environments [12] opens new paths for authentic, personalised assessment that respects learner diversity.

These innovations reinforce the growing call for transparency and clarity in assessment design—not only as technical requirements, but as essential pedagogical conditions that enable learner engagement and foster reflective teaching practices—in both clinical and educational domains [13].

By reframing assessment as a developmental and empowering process, this framework contributes to the creation of transparent, inclusive, and reflective digital assessment ecosystems. It positions psychometric tools as catalysts for pedagogical awareness, enabling a deeper understanding of learning processes for all participants in the educational dialogue.

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“Moving Breaks”: Perceptions of the Effectiveness of Active Breaks in University Teaching.

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1 Introduction

The integration of active breaks in university teaching represents an innovative practice that can contribute to the cognitive, emotional and relational well-being of students. Previous studies [1,2] highlight how short intervals of teaching activity characterized by physical activity can improve students’ attention, mood and participation. In academic contexts, even simple low-intensity physical exercises, such as standing, can interrupt prolonged sedentary behavior, providing perceived benefits on both a physical and mental level [3,4]. However, most research on active breaks focuses on school contexts and few studies investigated the application of this methodology within university contexts [5]. This paper presents the results of a preliminary exploratory research aimed at investigating the perceived effectiveness of active breaks in university teaching, with a particular focus to their impact on attention, mood and stress management, even in proximity to high cognitive load evaluation moments. The study is part of the contemporary debate on formative assessment and the promotion of well-being in adult students.

2 Methodology, Data Analysis and Results

The sample consists of 99 university students enrolled in the annual specialization course for support teaching (TFA) of the University of Salento, predominantly women (average age: 28-40 years). The data were collected through an anonymous structured ad hoc questionnaire administered online. It was composed of 40 questions divided into 22 thematic sections, of which 4 aimed at collecting demographic data, 6 aimed at analysing the effectiveness of active breaks. The additional sections have re-proposed some items of the Global Physical Activity Questionnaire [6] not covered in this paper.

Section 5 included 18 items on a Likert scale (1–5) related to perceptions of attention, mood, usefulness, applicability; section 6 proposed an open-ended question on the most appreciated aspects; section 7 instead investigated the least appreciated aspects. In sections 8, 9, and 10 of the questionnaire, participants were asked to indicate, respectively, the type of active break they preferred, the one perceived as most effective in supporting concentration, and the one deemed most useful in improving mood. The available options were: teacher-led breaks, free breaks, both, or none. Each respondent selected a single answer per question, and therefore the categories were treated as mutually exclusive in the data analysis.

Section 5 data reveal a broadly positive perception of active breaks. Specifically, 74% reported improved attention and 79% improved mood during lessons; even before exams, 61% noted enhanced concentration and 63% better emotional state. Most participants (76%) reported no difficulty following the exercises, and 71% had no trouble refocusing afterward. Non-parametric tests (Mann–Whitney U and Kruskal–Wallis) showed no statistically significant differences by gender or age (e.g., $U = 409.5$, $p > .05$; $H = 6.72$, $p = .081$). Mean scores remained similar across groups, though a slight decline was observed in older participants.

The qualitative content analysis [7] of the open-ended responses of sections 6 and 7 revealed that active breaks were perceived as beneficial for relaxation (n=21), concentration (n=17), mood (n=13), physical activation (n=10), and social interaction (n=9). Few critical aspects emerged: limited duration (n=9), physical discomfort (n=10), and contextual barriers (e.g., space or evaluation setting).

In Sections 8-9-10, the mixed model (guided + free breaks) received the highest ratings for satisfaction ($M = 4.46$), concentration ($M = 4.35$), and mood ($M = 4.48$), with a statistically significant difference for mood ($p = .048$). Guided-only breaks followed, while free breaks were least effective. Women and students aged 25–30 showed consistently higher scores across all domains.

3 Conclusion and future directions

The findings of this study highlight a broadly positive perception of active breaks in university teaching, particularly in their capacity to enhance attention, mood, and overall well-being, even during high-stress assessment phases. The mixed procedure (guided + free breaks) emerged as the most appreciated, confirming the importance of flexibility and structured facilitation in promoting student engagement. The consistency of results across gender and age groups suggests the inclusiveness of the methodology, though younger participants tended to report slightly higher benefits. The qualitative data support these outcomes, showing that students value active breaks as regenerative moments that support emotional regulation, concentration, and social cohesion. Despite these encouraging results, some limitations must be acknowledged. The sample was limited to students enrolled in a specialization course for support teaching, making it difficult to generalize findings to broader university populations. The reliance on self-reported data, without a control group, introduces potential biases such as social desirability effects. To strengthen the evidence base, future studies should include more diverse samples across disciplines, implement experimental or quasi-experimental designs, and adopt objective indicators such as cognitive performance measures. In practical terms, this study suggests that the regular and thoughtful integration of active breaks can represent a low-cost didactic tool to improve the quality of teaching and student experience, especially in cognitively demanding courses promoting concentration, good mood and a human-centered educational climate.

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Special Track 3

AI-enhanced E-learning for 'Augmented' Mathematics Education at University Level

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The Integration of ChatGPT in Teaching Calculus*

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Educational technologies can profoundly transform student and teacher learning environments in mathematics education (e.g., Pepin et al. 2024). In this evolving landscape, Large Language Models (LLMs), such as GPT, Gemini, or Claude, are trained on composite datasets that integrate mathematical libraries, and school and university textbooks (Yang et al., 2023), enabling LLMs to interact effectively with mathematical content, though they show evident limitations in formal reasoning and deductive processes. A recent special issue (Pepin et al., 2025) explores the integration and use of LLMs, such as ChatGPT, across different educational levels. The studies have reported several benefits, including support for understanding basic mathematical concepts, designing personalized tasks, lesson planning, and promoting collaborative and self-regulated learning. Teachers can use ChatGPT to generate differentiated instructional materials, and optimize lesson preparation, while students benefit from interactive and individualized learning pathways. However, these tools also show significant limitations: difficulties with advanced content, complex reasoning, and visual mathematical representations; and the risk of passive dependence that can hinder the development of critical thinking. Pepin et al. (2025) claim for the importance of the introduction of guided and structured classroom activities to prevent uncritical use of AI and to maximize its educational potential. Contel and Cusi (2025) show that spontaneous use of ChatGPT by students often leads to skipping crucial planning and reflection stages, focusing instead on immediate task execution. Kock et al. (2025) identify three main use of these tools: passive use (obtaining answers), diagnostic use (verifying and correcting), and elaborative use (developing and transforming). Pepin et al. (2025) argue that to ensure a sustainable and educationally sound integration, it is essential that educational institutions invest in AI literacy training, equipping students with tools to decode, evaluate, and critically contextualize outputs generated by LLMs. Our work explores the integration of ChatGPT in the teaching of Mathematical analysis, one of the fundamental courses in all science-based degree programs, but it is also one where students often face major difficulties, especially at the beginning of their studies (Gómez-Chacón et al., 2015). Built on two pilot experiences conducted in 2023 and 2025, we present a teaching proposal for the guided integration of ChatGPT in the instruction of calculus topics within two first-year mathematics courses

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at the School of Architecture, Politecnico di Milano. In the first pilot, ChatGPT was introduced in a Calculus and Linear Algebra course for Civil Engineering students in extracurricular tasks designed to stimulate intrinsic motivation and foster metacognitive reflection: formulating questions, self-assessment, exam simulations, and revision using ChatGPT support. Students created prompts, discussed the chatbot's answers collectively, identified errors, and reflected on the underlying mathematical processes. The second pilot was conducted during the workshop "Generative AI for Empowering Education" as part of the "11th International Conference on Higher Education Advances (HEAd'25)." During the workshop, the chatbot was used as a digital artifact to explore concepts such as the derivative and differentiability. The 20 workshop participants - academic staff and technical-administrative personnel interested in using GenAI in STEM education - organized in groups, interacted with ChatGPT to solve problems, challenge incorrect statements, and discuss alternatives, with the instructor acting as a facilitator. In this paper, using holistic and categorical approaches (Lieblich, Tuval-Mashiach & Zilber, 1998), we analyze the data (ChatGPT conversations, discussions with participants, and classroom observations) from both pilots. The results highlight increased metacognitive awareness, the development of critical and communication skills, and a more responsible and active attitude toward learning, along with the need for careful guidance to prevent passive or uncritical use of the tool. Finally, we present a teaching proposal following the didactic tetrahedron model for e-learning (Albano, Faggiano & Mammana, 2013).

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Integrating DESMOS in the primary school for a more effective approach to mathematics education

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1 Introduction

The integration of digital technologies in education has produced significant transformations in mathematics education. In primary school, in particular, integration of hands-on activities and digital learning represents a promising paradigm for active, participatory learning that fosters the development of solid intuition and a sense of familiarity with abstract concepts.
Concrete manipulation –understood as the use of physical objects– to explore mathematical concepts has deep roots in Piaget's constructivist pedagogy [5]. It enables children to develop intuitions and construct meanings through direct experience, facilitating the transition from concrete to abstract knowledge. However, this methodology may be limited in terms of scalability and the ability to represent more complex concepts. Integration with digital learning, through digital tools and multimedia resources, expands the potential of manipulation by offering interactive and customisable environments. According to Papert [4], the use of technologies such as computers and digital applications can foster more dynamic and engaging learning, stimulating creativity and problem-solving skills. The combination of physical and digital manipulatives enables the creation of more flexible and adaptive educational learning pathways, capable of addressing the diverse needs of pupils.
The research literature highlights how the integrated approach enables children to manipulate, explore, and visualise mathematical concepts in direct and tangible ways.
For example, Clements and Sarama [6] emphasise that the use of digital manipulatives, such as interactive applications, can facilitate visualisation and exploration of mathematical concepts, thereby making even the most abstract ones more accessible.
In addition, the integrated use of concrete and digital manipulatives fosters the development of metacognitive skills, as pupils learn to reflect on their own learning processes and transfer knowledge across different contexts.
A practical example of this integration, in the primary school, is mathematics labs that use both traditional manipulative materials (blocks, geometric figures, dice) and interactive digital platforms such as GeoGebra or DESMOS [1]. These tools allow mathematical concepts to be explored in a dynamic and engaging way, stimulating pupils' interest and motivation [7].

1.1 Research question

Effective implementation of integrated learning pathways requires that teachers be adequately trained and supported in the use of these technologies. Merely having access to technology does not necessarily ensure its optimal use in mathematics education. Teachers should be able to determine when and how technology can enhance pupils' opportunities to engage positively with mathematics.

Teacher training, both initial and in-service, must include strategies for integrating manipulatives and digital learning in a coherent and meaningful way, preventing technologies from becoming mere support tools without real pedagogical value [2].

This paper focuses on the integration of DESMOS in primary schools.

Specifically, it explores whether the use of DESMOS within the course of Mathematics Education I - in the Master's Degree in Primary Teacher Education, enables students (future teachers) to design interactive learning activities based on the 5E instructional model [3], and whether their effectiveness can be assessed.

An embedded mixed-methods design is employed to examine learning from multiple perspectives, providing a holistic picture of the implementation of DESMOS.

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Hybrid learning environments for mathematics education at university level: objectification and subjectification in communities of practice with plugin Quick Chat

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1 Introduction

Offering students opportunities to engage deeply with mathematics, as well as fostering their critical participation in this knowledge, are central aspects of mathematics education. In this research, the concept of co-positioning refers to the conscious path taken by university students - future teachers of mathematics - in the process of constructing disciplinary knowledge and defining their own role as active subjects in their professional training.

This work is part of a broader strand of research whose aim is to examine how mathematics education courses for future teachers are influenced by a blended, in-presence and online learning environment. The online environment is Moodle. In such an environment, students - future teachers - communicate with each other in small groups, with the whole class and with the teacher through chats. In particular, they use the Moodle Quick Chat plugin. This plugin was created as part of the LIME (Learning Interface for Mathematics Education) project at the University of Campania "L. Vanvitelli" [1]. Once it is activated, the browser window is divided into two parts: the left part shows the current Moodle page, allowing the user to continue their experience; the right part shows all the chats in which the student is involved according to their role and group. In this way, students can manage both the task and all the chats on a single browser page and interact with each other on several levels and in parallel, and the teacher is able to monitor the activity in real time.

Dello Iacono and Fiorentino [2] have shown how the Quick Chat plugin augments the educational impact of both students' and teachers' mathematical practice and communication. The use of the plugin simplifies the interface and thus increases the acceptance and usability of the digital environment by users who can cognitively focus on the task. This improves their experience and the effectiveness of online collaboration. Dello Iacono and Santi [3] framed the use of the Quick Chat plugin within the Theory of Objectification [4, 5] and pointed out how the introduction of the plugin modifies the structure of activity introduced by the theory. Such a new structure fosters the emergence of dynamic and fluid systems that enable new forms of joint labor in the socio-cultural context of teacher training at the university level.

2 The study

This work fits into the context described above. In this paper, we present a study conducted with 15 undergraduate mathematics students participating in the Mathematics Education course at the University of Campania "L. Vanvitelli". The students - future teachers - took part in a face-to-face activity designed to stimulate reflection on misconceptions related to the straight-line tangent at the points of non-derivability [6] and on the ensuing teaching approaches. Working in small groups and in plenary, they discussed among themselves and with the teacher, initially through the Moodle platform, using the Quick Chat plugin, and later in person. At the end of the activity, they answered a reflection questionnaire on their role as future teachers. Finally, at the end of the course, they answered a metacognitive questionnaire on the entire training course and the moments they considered most significant.

We collected their conversations in Moodle chats using the Quick Chat plugin, the audio recordings of the teacher-mediated plenary discussion, their answers to the questionnaire at the end of the activities and the metacognitive questionnaire administered at the end of the entire course.

3 Results and conclusions

We discussed the dialectic between objectification and subjectification in accordance with the Theory of Objectification by showing the positioning of students in their training as future mathematics teachers with respect to the concept of a straight line tangent to a curve at points of non-derivability [6].

Data analysis highlights the dynamics between objectification and subjectification processes, in relation to the way in which students co-position themselves in their training as future mathematics teachers, with reference to the concept of the tangent line. The configuration of the joint labor, made possible by the use of the Quick Chat plugin, is crucial in shaping how students and the teacher interact during the activity. Data highlights that this didactical configuration triggers prospective mathematics teachers' positioning towards their specialized knowledge, both subject matter knowledge and pedagogical content knowledge. The hybrid learning environment built around the Quick Chat plugin can be enhanced by the introduction of chatbots (e.g., ChatGPT) that, as communication and information agents, enlarge the affordances of the plugin. Further research is needed on this topic. Moreover, further research is needed to understand the extent to which the methodology used is suitable for contexts devoted to learning mathematics at the university level, not just teacher training.

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Combining a Large Language Model and an Advanced Computing Environment for Problem Solving in Mathematics: A Research Design for University-Level Investigation

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1 Introduction and Background

While Large Language Models (LLMs) such as ChatGPT [1] are being increasingly adopted in higher education, controversy surrounds their potential to support mathematical learning. As these models can facilitate the development of problem-solving and computational thinking skills by offering instantaneous feedback and solutions [2], there is a concomitant risk that they will diminish students' engagement in fundamental cognitive processes, including modelling, generalisation, and argumentation [3]. Conversely, an Advanced Computing Environment (ACE), such as Maple [4], provide a rigorous context for mathematical exploration and visualisation, thus fostering computational thinking and problem-solving skills [5, 6]. However, effective use of these environments requires specific digital competencies and time-intensive learning, which often poses a barrier for students. The problem-solving process in the field of mathematics is of paramount importance for the development of modelling abilities, argumentation skills and critical thinking. The nature of the exercises typically involves resolving mathematical problems or engaging with scenarios presented in written or verbal form. The process requires interpreting the provided information, identifying the pertinent mathematical principles, and constructing the relevant equations or expressions to determine a solution. Such tasks frequently reflect real-world scenarios, thereby prompting students to apply mathematical reasoning to practical and significant contexts. The successful resolution of problems requires technical proficiency, logical thinking, creativity and the ability to make and justify decisions. According to the classical model proposed by George Pólya [7], problem solving is a structured process involving four stages: understanding the problem, devising a plan, carrying it out and reflecting on the solution. Using an ACE in mathematical problem solving offers several pedagogical advantages: it supports the development of problem-solving skills through dynamic visualisation, symbolic computation, and interactive components, enabling students to explore, test, and generalise mathematical models in meaningful, context-rich ways [6]. An ACE enables students to visualise and manipulate mathematical models, create dynamic graphs, test hypotheses and ultimately generalise their reasoning [8]. Recent approaches emphasise that LLMs should primarily be used in mathematics education as learning supports rather than problem-solving tools. They can foster critical thinking and engagement by providing step-by-step explanations and conversational feedback. Nevertheless, there are still issues to be addressed. These include the risk of reinforcing misconceptions, limited adaptability to diverse learning styles, and concerns about data privacy and responsible use [9, 10].

2 Research Questions and Design

The study addresses the following research questions:

1. Can LLMs support students in effectively using an ACE to solve complex mathematical problems?
2. How does the interaction between an LLM and an ACE influence students' problem-solving processes, argumentation, and collaboration?
3. What are students' perceptions regarding digital competence, mathematical thinking, and learning satisfaction in AI-enhanced environments?

This paper presents the design of an exploratory study investigating the educational potential of combining an LLM and an ACE in university-level mathematics courses. The central hypothesis is that, if used intentionally, the two tools can complement each other: the LLM can act as a responsive tutor and linguistic mediator, while the ACE can function as a computational and visual space for modelling, experimenting and generalising. To answer the research questions, a research activity divided into 4 phases was designed:

1. Introduction and training: Students are introduced to the study's context and receive guided training on the use of both ACE and LLM.
2. Individual problem solving: Students solve a contextualized mathematical problem using both tools independently. Interactions with an LLM are logged; students' resolutions with an ACE are collected.
3. Collaborative problem solving: Students are assigned to small groups and work together to solve a new problem using both tools. Collaborative behaviour is observed and recorded.
4. Group reflection and discussion: A guided discussion encourages students to reflect on the experience, their problem-solving strategies, the perceived strengths and limitations of each tool, and their preferences.

3 Methodology and Expected Contributions

The research methodology incorporates various approaches: initial and final questionnaires to collect data on students' perceptions of their digital, mathematical, and problem-solving competences, affective attitudes toward mathematics, and tool-specific feedback; evaluation rubrics for assessing the quality of individual and group problem-solving outputs (correctness, generalization, graphical reasoning, argumentation); observation grids to analyze group dynamics and collaboration strategies during phase 3;

analysis of LLM conversations in terms of typology of support (e.g., conceptual explanation, ACE syntax, procedural help), role in the problem-solving process, use of language and discourse markers. This study contributes to AI-enhanced mathematics education by proposing a structured model that integrates LLMs and ACEs in a complementary manner to support competence development and student agency. In this hybrid environment, LLMs are not used to provide answers, but rather as dialogic scaffolds that support students' cognitive and metacognitive processes. By facilitating the process of conceptual clarification, debugging and reflective thinking, they reduce technical barriers and encourage learning. The research also provides a framework for evaluating not only the solutions themselves, but also the reasoning and interactions behind them, to strike a balance between automation and meaningful learning.

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AI and Formative Feedback in University Mathematics Education: Open-Ended Problems

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1 Introduction

The integration of Artificial Intelligence (AI) in higher education is increasingly reshaping teaching and assessment practices, opening opportunities for more personalized and scalable forms of feedback. In university mathematics courses, where large enrolments often prevent timely individual support, formative assessment represents a critical challenge. As emphasized by Black and Wiliam (2009), feedback is most effective when it is prompt, individualized, and oriented toward improving learning processes rather than simply judging outcomes.

This paper presents an experimental study within the PRIN project *"AI&F – Artificial Intelligence & Feedback for Effective Learning"* (Foschi et al., 2024). The project investigates the integration of AI-based tools into formative assessment in Mathematics Education, with a particular focus on open-ended problems. These problems demand reasoning, creativity, and justification, and thus pose specific challenges for automated systems that go beyond the evaluation of correct answers.

2 Theoretical references

Open-ended problems are here understood in the sense proposed by Pehkonen (1997), as mathematical situations allowing for multiple solutions, approaches, and argumentative strategies. Their educational value lies in promoting students' reasoning, problem-solving flexibility, and capacity to justify claims. Yet, such tasks are also demanding to assess: unlike closed questions, they require attention to the process, not just the product.

Formative assessment, conceptualized as a lever for learning (Black & Wiliam, 2009), provides a useful framework for understanding the role of AI in this context. AI-driven analysis of written solutions may enhance formative processes by supporting teachers in identifying reasoning strategies, misconceptions, or promising directions. In this sense, AI does not replace the teacher but complements human mediation, fostering iterative cycles of feedback and revision that are central to effective learning.

The project explores how language models and machine learning techniques can analyze students' responses to open-ended tasks, offering immediate, individualized feedback. Such an approach holds potential to create fairer, more transparent, and scalable assessment systems, bridging the gap between automation and human interaction. Recent literature on AI in education (e.g., Holmes et al., 2019; Luckin, 2021) highlights both opportunities and risks, stressing the importance of aligning technological affordances with pedagogical principles.

3 The problems

Two problems were central to the experiment. The first of a geometric nature, asks two siblings to divide a rectangular plot of land equally by connecting an interior point to the rectangle's vertices, creating four triangles. Students must evaluate the fairness of the division and justify their conclusions. The second, in the arithmetic domain, involves a "hundred chart"—a 10×10 grid filled with numbers from 1 to 100. Students are asked to explore and explain numerical patterns in the diagonals of a selected 2×2 square, identifying and justifying properties related to the sums and products of the diagonal numbers. Both tasks aim to stimulate critical thinking, generalization, and autonomous construction of meaning.

4 Conclusion and preliminary results

Preliminary findings suggest that the AI-supported system can detect central elements of students' mathematical reasoning and deliver personalized insights in a short time. Students reported that the feedback supported reflection and encouraged revision of their solutions, while teachers valued the system's capacity to highlight key features across large numbers of responses.

Nevertheless, the study remains exploratory and limited to two tasks. Broader validation across diverse mathematical domains is needed to confirm the generalizability of the approach. Future research will address the integration of AI feedback within broader teaching practices, examining its impact on learning outcomes and teacher workload.

By aligning automated analysis with formative assessment principles, this line of work contributes to the design of innovative feedback systems capable of fostering deeper learning in mathematics education.

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AI and Feedback: Human-Artificial Agent Interaction and Standardized Assessment Questionnaires in Physics Education

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1 Introduction

Artificial Intelligence (AI) is increasingly considered a transformative force in higher education, especially in STEM disciplines where large enrolments make it difficult to provide timely and personalized feedback. Feedback, as highlighted by Wiliam (2011), is not only corrective but a central element in learning, supporting metacognition, self-regulation, and conceptual change. Within this perspective, AI can be envisioned as a partner in generating interactive and adaptive learning pathways, amplifying teachers' ability to respond to diverse learning needs.

This contribution draws on the early phases of the PRIN project AI&F – Artificial Intelligence and Feedback (Foschi et al., 2025), which investigates the integration of human–artificial agent interaction in assessment practices. In particular, we report on the use of standardized assessment questionnaires in physics education to train and calibrate AI-supported feedback systems capable of detecting conceptual misunderstandings and fostering dialogic feedback processes.

2 Conceptual background

The integration of AI in STEM education requires moving beyond the automation of grading to a richer vision of assessment as a dialogic and formative process. In this view, feedback is conceived as a dynamic interaction among student, teacher, and intelligent system, where meaning is co-constructed (Luckin et al., 2016; Holmes et al., 2019).

Physics education research has long recognized the persistence of alternative conceptions and misconceptions (Hestenes, Wells & Swackhamer, 1992). Standardized conceptual inventories, such as the Force Concept Inventory (FCI), have proven useful in diagnosing these misunderstandings and monitoring conceptual development. Embedding such instruments into AI-enhanced systems opens the possibility of scaling formative assessment, while still attending to the depth of students' reasoning.

Recent scholarship emphasizes the importance of aligning AI systems with pedagogical principles, ensuring that algorithms are not only technically effective but also educationally meaningful (Luckin, 2021). Our work responds to this call by embedding diagnostic tools into AI systems that are sensitive to the epistemological and dialogic dimensions of learning.

3 Methodological approach and preliminary results

The study was carried out within the Primary Teacher Education program during the Physics Education course. Students completed the FCI (Hestenes et al., 1992), whose items were analyzed both quantitatively and through AI-enhanced platforms. The AI models were trained to identify recurring answer patterns, distinguish correct from partially correct reasoning, and detect common conceptual misunderstandings (e.g., force as an internal property of objects, confusion between velocity and acceleration).

Preliminary analyses suggest that AI can recognize clusters of responses associated with specific misconceptions and generate individualized prompts that encourage students to reflect, compare, and revise their reasoning. For example, instead of merely flagging an incorrect choice, the system suggests targeted reflection ("What happens if the net force is zero?") and invites comparison with similar problems.

Teachers reported that AI-generated insights helped them to prioritize classroom discussion around widespread difficulties. This supports the notion of dialogic feedback loops, where AI highlights patterns, students engage in metacognitive reflection, and instructors integrate findings into their teaching strategies.

4 Perspectives and conclusion

While preliminary, these results point toward the potential of combining standardized conceptual assessments with AI-driven analysis to enhance feedback in physics education. Future developments will refine the algorithms' ability to recognize subtle reasoning patterns and integrate multimodal data (e.g., written explanations, problem-solving steps).

From a professional development perspective, the effective use of AI feedback tools requires teacher training in interpreting algorithmic outputs and aligning them with pedagogical intentions. Rather than replacing the educator, AI acts as a mediator, enabling a more inclusive, student-centered assessment culture (Wiliam, 2011).

By embedding diagnostic instruments like the FCI into AI-enhanced feedback systems, this study contributes to the design of hybrid learning environments where human and artificial agents collaborate to foster conceptual understanding and reflective learning.

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ChatGPT in University Education: how does the tool perform on mathematical questions with a specific structure?

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1 Background

The integration of generative artificial intelligence into education has rapidly transformed the ways students and teachers engage with knowledge, tools, and learning environments [1]. Among these technologies, ChatGPT has emerged as a widely adopted resource across disciplines. This requires a deepening about how students and teachers are appropriating the tool to enhance their knowledge. A recent systematic review highlights the limited integration of theoretical pedagogical frameworks [2]; moreover, it is necessary to consider the challenges that arise and the pedagogical implications of its growing use [3].

In some cases, ChatGPT becomes part of a hybrid learning ecosystem in which students, peers, artificial intelligence, and possibly teachers collaboratively interact to improve their knowledge [4]. This co-agency reconfigures the traditional relationship among teacher, learner, and tool, and calls for a reconsideration of what constitutes "help," "understanding," and "authorship" in educational contexts.

The students' engagement with ChatGPT reveals a progressive process of instrumental appropriation. As learners experiment with and reflect upon their interactions, they develop personalized usage schemes: internalized routines, strategies, and critical heuristics that determine how, when, and why to use the tool [5]. These schemes often evolve from uncritical adoption to more discerning use, as students become increasingly aware of the model's strengths and limitations.

From an instructional perspective, universities face the challenge of balancing the empowering aspects of generative artificial intelligence with the need to preserve academic integrity and foster independent thought. From this perspective, teachers need to increase their knowledge and awareness of the way ChatGPT replies to the students' prompts.

This study explores the evolving role of ChatGPT as an educational instrument, in particular for what concerns its accuracy [6] in answering mathematical questions with a specific structure. Since students often ask ChatGPT about the main difficulties they face, we chose to investigate how the tool performs on some kinds of questions that turn out to be challenging for students.

2 Methodology

Relying on the classification of mathematical questions due to [7], we formulated and submitted to ChatGPT open-ended and closed-ended questions concerning Linear Algebra. The set of questions has been extracted from the ones used in formative or summative assessment in our Linear Algebra courses for engineering freshmen. In order to answer the questions, students are expected to activate not only the cognitive level of learning (i.e., pure knowledge), but also competencies (e.g., links between pieces of knowledge, coordination of semiotic systems, etc).

For this study, we submitted the questions to ChatGPT (based on the model GPT-4o) in different ways, e.g. by providing a photo with the task (like a student would do), by integrating the photo with a specific question (formulated by an expert), or by progressively improving the prompts on the basis of the answers given by ChatGPT. We collected and analyzed the answers of the tool on the basis of their soundness, correctness, and completeness, and some categories emerged.

3 Preliminary results and conclusions

Two main remarks can be drawn by preliminary results, both of them very relevant to mathematics education: a) ChatGPT seems to move along an instrumental approach to mathematics understanding (i.e. use of overneeded mathematical operations versus use of relational theoretical-driven shortcuts); b) ChatGPT seems to use a fragmented approach to answers of the type “A because B”, giving the logical connective ‘because’ a secondary value (i.e. it does not assign a truth value to the complex proposition but only to the simpler propositions making it up).

This study should have both theoretical and practical implications. On the one hand, it should increase the knowledge about the strengths and limitations of ChatGPT in answering mathematical questions with a specific logical structure. On the other hand, this could be used in teaching-learning practices to involve students in evaluating and possibly improving (either wrong) answers by the tool, in order to increase their critical thinking and metacognitive reflection on the mathematical contents.

Further research is needed to understand the possible dependence of ChatGPT’s performance on the mathematical content of the questions. Moreover, based on the obtained results, it would be crucial to involve students in educational experiments to understand how they use the feedback from ChatGPT on their prompts. In particular, we plan to explore to what extent such practices promote metacognition and self-regulated learning when students are active evaluators of the tool’s suggestions [8].

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Evaluating the Application of the SPIRAL Model: Mapping Learning Outcomes to ESCO Skills for Enhanced Personalization and Design Validation of Learning Paths

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1 Introduction and background

The SPIRAL model [1] - Student-centered Personalization of Individual education through Reusable and Autonomous Learning units - was developed to structure the macro and micro design of online and hybrid learning courses through a graph-based articulation of Learning Outcomes (LOs), where each outcome is represented as a granular node connected to modular Learning Units (LUs) within a relational learning network. While the model focuses on formalizing and personalizing digital learning pathways, its applicability has not yet been tested in a concrete curriculum context with real-world alignment to established competence frameworks. This perspective is consistent with broader findings on the opportunities and challenges of educational technology integration, which underline both the potential for personalization and the need for thoughtful implementation [2]. This paper presents an application of the SPIRAL model to a set of existing modules, with the goal of evaluating how the model can represent and refine the existing relationships between competences for the same modules. Usually, the connection between - learning activities and skills are typically mediated by high-level competences - macro learning outcomes - which lack granularity and hinder the precise evaluation of content coverage and progression logic [3]. In contrast, the SPIRAL model introduces a structured representation of both macro and micro learning outcomes, connected through parent-child relationships and associated with specific LUs. This hierarchical and formalized approach enables a finer-grained analysis of the learning design, including prerequisite structure, Bloom taxonomy levels, and thematic clustering. The central hypothesis of this study is that applying the SPIRAL model to modules can validate their alignment and connections with competences defined and, at the same time, also improve the interpretability, adaptability, and quality of the learning pathways by refining the underlying network of connections between outcomes.

2 Research Questions and Design

To test this hypothesis, we selected a sample of modules from different disciplinary domains each explicitly referencing one or more competences. The evaluation process involved three phases: (1) encoding the macro learning outcomes of each course into the SPIRAL model using the Bloom-based LO schema; (2) decomposing each macro LO into child outcomes and linking them to specific learning units (real or hypothetically designed); (3) analyzing the alignment between these micro LOs and the original competences. This decomposition and structuring process resonates with previous research on integrated content modeling approaches for educational modules, which emphasize modular representation and explicit linkage between outcomes and instructional components [4]. A key innovation of this study lies in treating competences as validation anchors for a network of intermediate learning outcomes. Leveraging competences as validation anchors reflects approaches that use competency frameworks to strengthen course design and alignment [3]. For example, if a macro learning outcome (LO) in a data analysis course aims to "apply data cleaning procedures using spreadsheets," and this is linked to the competence "use spreadsheet software," a design process following the model involves breaking down this macro LO into micro outcomes such as "identify inconsistent data entries," "formulate logical conditions for filtering," or "use built-in functions for transformation." Each of these micro LOs is associated with a learning unit and evaluated for cognitive level, prerequisites, and potential redundancy.

3 Methodology and Expected Contributions

As a preliminary step, this decomposition process could be supported by a Large Language Model (LLM), which can assist in analysing course descriptions, identifying candidate learning outcomes, and proposing micro-level reformulations based on Bloom's taxonomy and semantic context. Moreover, the formal descriptors introduced by SPIRAL (e.g., topic tags, estimated study time, interactivity level) allow for the introduction of personalization logic, such as adapting LPs based on learners' prior knowledge or learning styles. By calculating semantic and structural similarity between LOs, the model supports the generation of alternative learning paths that still fulfill the same competence, thus enhancing learner choice and flexibility.

A further contribution of this study is the introduction of a metric for evaluating the refinement power of the model: that is, the degree to which the SPIRAL representation increases the density and coherence of the LO–LU–skill network. We define refinement as the ability to (a) disambiguate high-level skills into distinct pedagogical steps; (b) expose inconsistencies between intended and actual learning paths; and (c) suggest actionable design improvements.

This case study-based evaluation leads to several conclusions:

1. The decomposition of macro learning outcomes into measurable micro outcomes, grounded in Bloom's taxonomy, makes teaching more transparent and gives learners more control over their learning journey.
2. A graph-based representation of learning units and outcomes, enriched with semantic metadata, offers a powerful foundation for future AI-enhanced features such as recommender systems and adaptive navigation.

In future work, we aim to expand the module sample and develop an automated pipeline to extract learning outcomes, align them with ESCO skills, and support decompositions within the SPIRAL framework. Since research on competency-based education highlights challenges in outcome decomposition and assessment, such automation can enhance scalable implementation [5]. The integration of ontologies for topic hierarchy and the use of graph neural networks for similarity estimation are also foreseen as promising directions. In summary, this study offers a first application of the SPIRAL model to real curricula, showing its potential to structure and personalize learning pathways aligned with European competence standards.

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Special Track 4

The Art of Learning Online: Creative Practices in Digital Higher Education

Organizers:
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The Impact of Preparatory Phases on Immersive Learning Experiences in Art Didactics: A Mixed-Methods Study

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1 Introduction

The integration of Virtual Reality (VR) technologies into educational paradigms is increasingly acknowledged for its transformative potential, offering significant benefits across a range of disciplines [1] and specific areas of knowledge [2]. A critical aspect for the effective deployment of immersive experiences within any didactic pathway is the preparatory phase [3], which plays a crucial role in facilitating student familiarization with the immersive environment [4, 5]. This paper presents the main results of an exploratory mixed-method research study designed to understand how different preparatory approaches impact the immersive experience. The primary objective was to investigate the influence of these preparatory phases on learning outcomes, student engagement, and the perceived sense of presence among a cohort of university students enrolled in a Master's degree in Philosophy, attending an educational workshop in the field of art. This research aims to contribute to the growing body of literature on the pedagogical applications of VR, particularly within artistic and humanities contexts.

2 Materials and methods

The study, approved by the university ethics committee, was conducted following an Explanatory Sequential Mixed Methods Design (QUANT > qual) [6], using a quasi-experimental approach. In this initial exploratory phase, 12 university students voluntarily participated in the experiment and were randomly assigned to two groups. Each group was invited to participate in an immersive art experience, carefully selected by the research team. However, the introductory phase preceding the experience differed between the groups, as it was designed to vary in terms of modality of pre-exposure. The experimental group engaged in a VR-supported preparatory session, specifically developed by the author of the immersive experience. In contrast, the control group received a traditional preparation, based on the same content but conveyed through conventional, non-immersive materials such as textual descriptions and static images. The duration, supporting instructions, and guided procedures were standardized across both conditions to ensure comparability.

Data collection was conducted using a mixed approach, integrating both quantitative and qualitative measures. Quantitative data were gathered through established psychometric scales [7-11] and complemented by content-specific questions. Qualitative data were collected through semi-structured interviews with a subset of participants from both groups following the immersive experience, aiming to gain deeper insight into their perceptions and meaningful learning moments. Quantitative data were analysed using statistical methods, while qualitative data underwent thematic analysis.

3 Results

The findings show that participants particularly enjoyed the immersive experience, reporting very high scores, particularly in terms of curiosity about how the activity would unfold and the perceived sense of involvement. A sense of fun and interest also emerges from the interviews. Comparing the results from the two different groups important differences emerge. Students in the VR group found the preparation session useful for gathering information about the immersive experience especially concerning to the visual and spatial aspects of the environment. Students reported an improvement in their ability to navigate the immersive space and, conversely, the group using printed materials showed better results in memorising and understanding theoretical content, thus improving their theoretical knowledge. These preliminary data suggest that students tended to perceive traditional media (such as printed paper) as more effective for assimilating and memorising information, whereas VR was considered more suitable for exploring the visual aspects of a learning object.

4 Conclusions

For the field of art, these results offer a transformative pedagogical model. The study shows that VR is an invaluable tool for facilitating complex artistic experiences. By enabling pre-emptive virtual exploration, students can develop a foundational understanding of an artwork's spatial, formal and conceptual elements prior to experiencing its full immersive scale [12]. This approach can demystify intricate art installations, fostering a more informed aesthetic appreciation and encouraging deeper critical analysis that moves beyond passive observation. This is particularly relevant for contemporary art forms that increasingly utilise immersive and interactive technologies.

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TAG: Territory, Art, Youth. Designing a Pedagogical Device Between Participatory Art and Media Education

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1 Introduction

In an era in which school dropout manifests not only as a physical abandonment of educational paths, but as a deep disconnection from the very meaning of the educational experience [1], it becomes urgent to question which practices can regenerate belonging, motivation, and meaning, especially in the most vulnerable contexts.

The TAG project - Territory, Art, Youth - was born from this need and proposes a research model centered on art as a space of mediation and repositioning of the individual in relation [2] to oneself, to others, and to one's own territory.

2 Research

This research supports the perspectives of Embodied Cognition [3] and the phenomenology of perception [4], both of which challenge the idea of a mind detached from the body, showing how knowledge emerges from the living interaction [5] between body, environment, and culture.

These perspectives recognize the body as a mediating element in educational processes and the plurality of languages [6] as a resource for educational inclusion. From this standpoint, learning is rooted in a situated, embodied, and relational [2] process, in which sensory, bodily, and emotional experiences play a structural role in meaning-making. Within this framework, education cannot be limited to the transmission of content but must activate narrative [7] and symbolic devices that allow students to redefine their place in the world. In particular, non-linear languages [6] prove fundamental in reaching subjectivities that do not recognize themselves in the logical-deductive registers of traditional teaching [6].

TAG is inspired by an approach that considers the learning environment as a dynamic ecosystem, composed of interactions among content, media, actions, and individuals. In line with Diana Laurillard's framework, teaching here is conceived as a design process that integrates digital media, narration [7], and collaboration to support cycles of reflection and application [8].

The objective was to investigate the effectiveness of artistic experience in engaging and motivating at-risk youth to participate in collective and educational pathways, particularly those at risk of school dropout and social exclusion. The experimental projects were structured around participatory art and media education, involving the use of podcasts, interactive posters, and social media. The educational use of these digital tools does not follow a merely technological logic but represents a pedagogical and relational strategy aimed at repositioning young people as authors and mediators of meaning within their own life contexts.

The TAG project was carried out between May 2024 and December 2024 in the eastern outskirts of Naples, specifically in the neighborhoods of Ponticelli and San Giovanni a Teduccio, areas marked by social marginalization, educational poverty, and high dropout rates. The participants were twenty adolescents aged 15 to 18, already engaged in informal educational programs promoted by the Maestri di Strada association. All the young participants faced educational vulnerability, irregular school attendance, and limited access to structured expressive spaces.

The program was divided into nine weekly workshop phases, co-designed by educators and artists. Following an initial phase of circle time and collective brainstorming to identify meaningful existential themes (freedom, love, transformation, and dreams), multidisciplinary expressive workshops were activated - including theater, visual arts, urban collage, music, and rap writing - allowing the youth to explore and symbolically translate these themes through multiple languages [6].

In a subsequent phase, the generated content was collectively reworked to create four original poetic podcasts. The dramaturgical structure of these podcasts was built by integrating autobiographical texts, musical pieces, images, and narrative elements drawn from previous project archives. The podcasts were recorded and edited with the direct involvement of the participants and then paired with artistic posters displayed throughout the neighborhoods and schools, each equipped with a QR code to access the digital content. The project concluded with public events, exhibitions, and dissemination actions through social media and streaming platforms.

TAG represented an integrated pedagogical device, where educational design, participatory art, and media education were intertwined in an intentional process of reactivating the desire for learning. The qualitative documentation collected during the process - through observations, narrative feedback, and informal interviews - showed a tangible change in the participants' relationship with the educational context: an increase in attendance, greater openness to dialogue, and a progressive appropriation of expressive language as a means of mediating oneself in the world were observed.

3 Conclusion

In conclusion, the TAG project suggests an approach to countering school dropout that does not operate in compensatory or corrective terms, but is instead based on redefining the educational environment as an aesthetic, relational, and transformative space [9].

In this context, the performing arts emerge as powerful tools of educational mediation, drawing inspiration from transformative practices such as the Theatre of the Oppressed [10] and postdramatic theatre [11], which are capable of dismantling communicative hierarchies and restoring agency to marginalized educational subjects [12]. From this perspective, theatre functions as a performative pedagogical device [13], capable of generating processes of symbolic and relational transformation within the most complex educational contexts. The experience shows that, in highly vulnerable territories, the combination of art, participation, and digital media can give young people voice, visibility, and a sense of agency, activating meaningful and lasting learning dynamics.

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The potential interconnection between simplexity and the six hats for thinking for inclusive teaching: results of exploratory research

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1 Introduction and theoretical framework

Learning environments are increasingly shaped by multidimensional dynamics involving cognitive, emotional and social aspects (Aiello et al., 2023). Engagement is fondamental for educational success, as it leads to deeper learning and more lasting outcomes (Sugden et al., 2021; Bevan et al., 2014). Yet, the instability of school contexts, amplified by distance learning (Sun, 2016; Martin et al., 2020), calls for new pedagogical models capable of managing complexity and non-linearity (Sibilio et al., 2023). Innovative methodologies and creative processes thus become essential to customize teaching across different delivery modes. In this perspective, the simplexity approach (Berthoz, 2009; Sibilio, 2014, 2023) and De Bono's six hats method (1985) emerge as particularly relevant. The former supports innovative teaching based on complexity management, while the latter enhances recognition of one's own action through multiple "*cognitive positions*," fostering participatory and inclusive learning. This debate is central to addressing diverse Educational Needs (Aiello, 2016; Aiello et al., 2023). The simplexity model helps teachers adapt to "protean" contexts by modulating interventions according to environmental complexity and learners' characteristics (Sibilio, 2020). At the same time, virtual settings increase motivational challenges (Martin et al., 2020), making it necessary to adopt novelty-oriented approaches. The integration of simplexity with the six hats fosters active participation and deeper engagement beyond mere online presence. Finally, both models converge on metacognitive awareness. Simplicity enables adaptive responses to complexity (Sibilio, 2023), while the six hats encourage flexible thinking through symbolic roles, white (facts), red (emotions), black (criticism), yellow (positivity), green (creativity), blue (organization) (Zollo et al., 2015). Their integration supports authentic and sustainable engagement, resilient in both distance and face-to-face contexts (Sibilio, 2020).

2 Methodology

Starting from the above-mentioned theoretical premises, the exploratory research conducted aimed to investigate how the integration of the paradigm of simplicity with De Bono's six hats methodology can enhance the engagement of teachers in training in hybrid teaching contexts. Such approaches in such a context represent a fertile ground for experimenting with new *moda operandi* capable of supporting interaction, motivation and active participation, in the presence or not of the technological medium (Martin et al., 2020). Starting from the multidimensional definition of engagement, which includes behavioral (attention, active participation), emotional (interest, motivation) and cognitive (commitment to understanding and problem solving) aspects (Hookham and Nesbitt, 2019; Fredricks, 2014) the Questionnaire Engagement (Abbasi et al., 2024) was chosen for theoretical consistency, which was adapted into the Italian language for the sample participating in the present research (La Manna et al., in press).
The survey involved a sample of 365 future teachers attending specialization courses for teaching activities on support at the University of Salerno, trained through a 30-hour course, of which 20 were dedicated to theory and practical exercises relating to the simplicity and methodology of the six hats. The teachers had the opportunity to attend the courses with a percentage of ten hours remotely, during which they had the opportunity to reflect on the paradigms, theoretical frameworks of the study, actively experimenting with them through individual and group activities. The training course adopted a metacognitive and cooperative approach, aimed at stimulating in participants the ability to use the principles and properties of simplicity in teaching action, using the six hats to think as a tool for orientation and monitoring of thought. The data, collected before and after the intervention, were analyzed by means of t-tests aimed at validating the effectiveness of the intervention and verifying which are the areas of most empowering engagement following the didactic intervention through the two approaches highlighted. The study showed a significant increase in engagement levels across all areas.

3 Conclusions

From the study results, the integration between the paradigm of simplicity and De Bono’s six hats theory emerges as both a theoretical and practical innovation, through approaches that interconnect creativity, metacognitive awareness and complexity management. These prove particularly effective in responding to the needs of increasingly heterogeneous and dynamic learning environments, both in person and remotely. Findings highlight a significant increase across the three areas of engagement, suggesting that the combined adoption of the two approaches fosters active, conscious and sustainable participation. This is particularly relevant given the growing need in education to promote authentic involvement beyond physical or virtual presence, in favor of reflective, inclusive and adaptive teaching. Evidence thus supports the hypothesis that models centered on simplexity, and the strategic use of lateral thinking are valid tools to address the complexity of educational processes, stimulating cognitive, emotional and relational skills in future teachers. The research, still in progress, aims at longitudinal analyses to further validate the effectiveness of this integration across different engagement dimensions and educational contexts.

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The body beyond the screen: motor-expressive activities and online learning

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1 The challenge of corporeality in digital education

The implementation of teaching practices within immersive environments [1] is producing a substantive paradigm shift in pedagogy, reconfiguring the relationship with oneself and with others. The emergence of the digital Self [2] entails the constitution of new forms of community [3] and compels a reconceptualization of identity as *presence* [4], conceived as situated, conscious, and ecologically grounded participation [5]. Within the post-media educational context, and particularly in both pre-service and in-service teacher education at the secondary level, it becomes essential to interrogate which pedagogical strategies may foster a critical and reflexive engagement with immersive technologies. Such strategies must safeguard an expressive, situated, and relational corporeality, thereby avoiding the reduction of embodied experience to the digital confines of a pixelated self, stripped of its spatio-temporal dimensions [6]. When virtual environments, whether in augmented reality (AR) or mixed reality (MR), interact convincingly with the body and the physical world, the immersive experience transcends the boundaries of three-dimensional digital simulation. It encompasses the body in its entirety, together with emotions and relational dynamics, eliciting an authentic response from the participants in the educational process [5,7,8].

2 Objective: new learning scenarios for teachers

In light of these considerations, the present study advances a training programme for secondary school teachers, with explicit implications for university-based initial teacher education (pre-service teacher education) [9,10]. This perspective calls for the integration, within teacher education courses, of both theoretical and practical components grounded in the construct of motor-expressive activities, with the aim of valorizing physicality as a pedagogical lever. The objective is to provide both a theoretical and an operational framework capable of activating and fostering situated presence, affective engagement, and empathic communication within digital educational environments. In this way, it seeks to sustain an *on-life* professional teaching identity [11] that integrates physical and virtual dimensions [2,10]. The proposed training approach unfolds in three phases. The first, an exploratory phase, focuses on cultivating motor-expressive awareness and sensitivity. This is followed by an immersive phase, in which activities are transposed into AR/MR digital environments to stimulate reflection on the interplay between the physical body and its virtual representation. Finally, a reflective phase is envisaged, designed to promote conscious elaboration of the experience from a pedagogical perspective, with the purpose of generating potential scenarios for educational application. This structure is intended to foster the acquisition of professional skills oriented toward the critical appropriation of immersive technologies, while simultaneously consolidating a pedagogical awareness "filtered" by the body and transposed into the digital dimension. In this respect, the proposal constitutes a targeted contribution to the scholarly debate on educational innovation in higher education, with specific reference to pre-service teacher education.

3 Conclusions and future prospects

The complexity of digital learning demands an educational approach that acknowledges the role of the body as a vehicle of experience, expression, and relationality [12]. This vision entails that teachers cultivate functional vicariousness [9], drawing upon alternative and complementary pedagogical strategies that integrate sensory, bodily, and cognitive dimensions. Future research will need to be accompanied by experimental investigations designed to assess both the effectiveness and the concrete educational impact of the proposed approach. The overall objective is to foster the construction of meaningful immersive environments capable of ensuring attention, motivation, and active participation within educational processes. From this perspective, the present work seeks to contribute to the debate on pre-service teacher education by delineating the constitutive elements of an innovative approach that may be replicated and adapted within university curricula. Such an approach enables pedagogical experimentation while remaining grounded in embodied pedagogical reflection.

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Connected Bodies: Theatre and Digital Technologies in the Training of Future Teachers

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1 Introduction

This study, grounded in the Theory of Embodied Cognition [1] which posits that the body, alongside the mind, plays a pivotal role in learning processes aims to investigate how theatre-based practices oriented toward bodily and emotional awareness can be integrated with digital tools [2] to enhance the sensory perception of prospective educators. By emphasizing the pedagogical value of theatre as a space for active listening, presence across both physical and virtual environments [2] and embodied interaction [3], the research seeks to examine whether, and in what ways, technology may facilitate and/or hinder the development of bodily, emotional, and environmental perception [4], all considered fundamental dimensions of the educational relationship.

2 Research

The theoretical framework underlying this exploratory research is based on the assumption that the body is not merely an instrument at the service of the mind, but rather a site of knowledge and meaning-making [5]. Within this phenomenological perspective, perception is not a disembodied function, but a situated act that engages the subject in their entirety. It is through the body that individuals inhabit and give meaning to their perceptual space [4; 6], generating forms of knowledge that emerge from lived experience. In this context, learning is conceived as an embodied and situated process [7], in which perception and action dynamically intertwine.
Theatre, as an aesthetic and experiential practice [8], thus represents a privileged space that favors non-linear languages [9] to activate a form of knowing that simultaneously engages emotions and bodily presence [10]. In this sense, "theatre cannot exist without the actor/spectator relationship, without the communion of direct, living perception" [11]. The practice of theatrical training stimulates the sensory, relational, and cognitive dimensions of each student. In particular, this study based on a hybrid format employed digital theatre training guided by the teacher's voice [12], enabling participants to construct their own *Umwelt* [4]: a relational bubble defined by an organic-perceptual field in which each subject shapes their own world of meaning, modulated by lived sensorimotor dispositions. In this regard, digital tools functioned as a magnifying lens for students' bodily awareness, activating a specific form of auditory perception in which sound [13] was not merely an informational channel but became an experience of relationality [14]. The research involved approximately 300 students at Suor Orsola Benincasa University of Naples who, during the 2024/2025 academic year, attended the *Drammaturgia Didattica Performativa* laboratory (Bachelor's Degree in Primary Education Sciences) and *Giocando s'impara: tecniche per l'animazione e la comunicazione teatrale* (Bachelor's Degree in Education Sciences). The activities were

structured around a guided sensory training designed to foster awareness of the body and surrounding environment, alternating between in-person and online interaction [15]. During remote sessions, students connected via the Meet platform, using personal headphones, and were able to engage in training in an outdoor education context [16], moving freely within university spaces particularly in the garden while continuously listening to the teacher's voice [12]. The core of the laboratory was dedicated to experiential theatrical exercises focused on the body, voice, interaction, and play. Data collection was conducted through a questionnaire administered at the beginning and end of the experience, as well as through reflective journals compiled by students after each session. Analysis of the data revealed that the digital dimension, rather than diminishing the effectiveness of the training, in many cases amplified its sensory and perceptual intensity. The combination of vocal guidance, auditory elements, open space, and the group isolation made possible by technology fostered deeper self-connection. Working on micro-actions and liminal perceptions served as a cognitive threshold, intensifying listening, altering balance, and deconstructing automatic gestures. Perceptual quality was further enhanced in unconventional contexts, such as those offered by outdoor education [16], where the landscape did not merely serve as a backdrop but actively intervened in the educational dynamic, functioning as a matrix of meaning [16]. Thus, the use of technology proved functional in creating a setting in which the experience was intensified through the interplay of physical presence, mediated voice, and perceived space [4]. In line with Dewey's pragmatist aesthetics [17], the educational experience took on a transformative role, capable of reorganizing lived experience and generating meaningful learning [18].

3 Conclusion

The research conducted through the laboratory-based experience aimed to highlight how educational and communicative technologies [19] can support and, in some cases, amplify the perception of the corporeal and emotional self, offering students a deeper and more intimate space for exploration and awareness. Within this perspective, theatre emerges as a privileged pathway for the training of future educators, including in its interaction with technology, which "represents a network of relationships [15]" that mediates between the human being and the environment [20]. As it evolves, technology "generates and produces new relationships among people, among things, and between people and things" [21].

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Special Track 5

AI in Higher Education: Empowering Design

Leader Organizer:
Annamaria Miranda – University of Salerno

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Fostering Reflective Teaching and AI Literacy in Pre-service Teachers: A Comprehensive Laboratory Approach

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1 Introduction and Theoretical Framework

This paper presents a comprehensive laboratory experience conducted within the General Didactics course (2024/2025) for first-year Primary Education students at the University of Palermo, Trapani campus. The objective of the study was to enhance pre-service teachers' professional awareness by simultaneously fostering reflective teaching competencies and AI literacy. The approach integrates three complementary dimensions of AI in higher education: a design partner supporting instructional design, a critical friend stimulating reflection, and a collaborative participant proposing solutions to be critically evaluated [2,5,6]. The theoretical framework combines Schön's reflective practitioner model [5], Dewey's conception of reflective thinking [2], and recent approaches to AI literacy in teacher education [6].

2 Methodology and Laboratory Activities

The experience involved 85 first-year students (90% female, average age 20.8 years). The laboratory pathway was articulated into sequential phases. Initially, students engaged in narrative reflection on personal school experiences of success and failure, which were discussed in small groups and plenary sessions to build foundational reflective competencies. These activities served as a bridge toward the integration of AI-based tasks, including: adaptive text design using ChatGPT for inclusive education; historical character simulations enabling dialogue with poets and cultural figures to deepen curricular content; automated assessment creation through AI-generated quizzes aligned with learning objectives; and lesson planning integrating AI with traditional pedagogy. Complementary role-play simulations placed students in the role of teachers, developing infographics with Canva and visual metacognitive guides to support classroom discussion. Data collection employed a multi-method approach: structured reflection questionnaires, AI competency self-assessment scales adapted from established frameworks [6], and perception surveys exploring attitudes toward AI integration [3].

3 Conclusion

The laboratory experience demonstrates how narrative reflection activities, when combined with practical AI applications, can effectively develop both reflective teaching and AI literacy in future teachers. The results suggest that different levels of AI competence influence perceptions of AI's educational potential and the related implementation challenges and limitations [1,4]. The results contribute to the design of integrated frameworks that balance technical skills with critical pedagogical reflection, supporting curricular strategies for the responsible and ethical use of AI in higher teacher education.

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The Impact of Non-Formal Education on the Understanding and Perception of AI

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1 Introduction

Until the 1960s, the educational environment was mainly understood as consisting solely of formal and informal education. Non-formal education emerged as a concept that lies "somewhere in between", designed to meet specific national and local needs [1; 2]. The need to learn throughout life and the ability to learn independently using technology and resources has become not a requirement but a necessity [3].

The COVID-19 pandemic and the associated closures of educational institutions have significantly highlighted gaps in learning in formal, informal, and non-formal educational settings [4]. In addition, the pandemic has also highlighted the critical relevance of social and emotional skills, which informal education develops particularly well, for people to cope with increased uncertainty and adapt to new realities [5]. Nowadays, AI and AI-based systems have become a new reality.

Scientists define AI literacy as more than just the ability to use ChatGPT. It is a complex competence that includes: understanding the basic concepts of AI, the ability to critically evaluate AI, the ethical application of AI, and the ability to interact with AI [6; 7]. Research shows that the lack of such literacy leads to the spread of myths about AI (from "magical technology to "terminator") [8], uncritical use, and the inability to detect errors or manipulation [9].

2 Methods and results

That is why, in 2025, students of the Lutsk National Technical University (LNTU) (Ukraine), who are not specialists in the field of AI, were offered to take a thematic course as an informal education. The distance course Elements of AI from the University of Helsinki and MinnaLearn was chosen [10]. Access to the course and certification are entirely free, and since the end of 2024, with the support of Google.org and INCO Group, the course has been available in Ukrainian. It should be noted that students who took the course were not limited in their choice of language, but chose it freely from the list of available languages. However, 86.0% chose the Ukrainian version of the course, while the rest took the course in English. The article analyzes the results of an anonymous survey of students who took the course and those who did not.

The survey involved 450 bachelor's students from LNTU, of whom 211 (46.9%) had completed the “Elements of AI” course as part of informal education and received a certificate. In contrast, the others had no such experience. The results of the comparison of key indicators are shown in Table 1.

Table 1. Comparison of key indicators between surveyed students who took the “Elements of AI” course and those who did not.

Indicator	**Took the course, points**	**Did not take the course, points**
Understanding of AI system architecture	3.89	2.77
Ability to use AI tools	3.83	3.48
Trust in generative AI responses	3.22	3.17
Knowledge of AI terminology	3.06	2.27
Assessment of own AI competencies	3.28	2.59
Awareness of the “filter bubble”	2.89	1.55

The survey results revealed two key areas where taking the course had a significant positive impact. Understanding the structure of AI systems showed the most pronounced difference between the groups. Students who took the course had an average score of 3.89 out of 5, while those who did not rated their understanding at 2.77. The difference of 1.12 points is statistically significant (p=0.004) with a large effect size (Cohen's d=0.98). Knowledge of the “filter bubble” phenomenon also showed substantial improvement. Course participants rated their awareness at 2.89 points compared to 1.55 points for those who did not take the course. This difference of 1.34 points is statistically significant (p=0.005) and has a large effect size (Cohen's d=0.94).

The need for formal education in AI among respondents is rated relatively high, 3.62 points out of 5. At the same time, 220 respondents (48.9%) rate this need at 4-5 points. Of these, exactly half (50%) took the “Elements of AI” course, which indicates an awareness of the limitations of non-formal education, the need to introduce specialized disciplines on AI, and the specifics of its application in various fields.

3 Conclusion

Theoretical training gives future specialists confidence in working with existing AI systems and the ability to quickly and effectively master new solutions, critically evaluate them, and apply them in their professional activities. Students demonstrate a pragmatic, moderately optimistic, and critical attitude toward AI and actively use modern tools in their studies and daily life. At the same time, they feel the need for systematic education and a deeper understanding of the principles of AI.

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Using an LLM as design partner for authentic problems in service calculus classes

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1 Sci-problems

Maths is hard! For life science students, Mathematics is even harder. Disengagement is known to be a primary factor of students *giving up*, leading to students dropping out of STEM programmes, or adding a considerable time to degree completion. To avoid this, we want students to increase their perceived utility-value of Mathematics through modelling, i.e., through a "process consisting of structuring, generating real world facts and data, mathematising, working mathematically and interpreting/validating" [1].

[2] introduces the concept of hard and soft sci-problems: "a *hard sci-problem* will be a sci-problem where science provides the illusion of realism, the setting should not compromise fidelity to scientific facts for didactical purposes or, if it does, this should happen in such a way that the student does not much notice" (see Fig. 1); while a "*soft sci-problem* will be one in which the science is irrelevant to the story" (see Fig. 2).

> Driving across Nevada, you count 97 dead but still easily recognizable jackrabbits on a 20 km stretch of Highway 500. Along the same stretch of highway, 28 vehicles passed you going the opposite way. What is the approximate density of the rabbit population to which the killed ones belonged?

Fig. 1. An example of hard sci-problem [3]

> The concentration $C(t)$ of a drug in the bloodstream (measured in mg/L) as a function of time t (in hours) after administration is given by the formula:
>
> $$C(t) = 50te^{-0.2t}, \qquad t \geq 0.$$
>
> 1. Find the time $t_{\max}$ at which the drug concentration reaches its maximum value.
> 2. Compute the maximum concentration $C_{\max}$.
> 3. Discuss the practical meaning of $t_{\max}$ and $C_{\max}$ in the context of drug administration.

Fig. 2. An example of a (ChatGPT generated) soft sci-problem [2]

Suspension of sense making [4] will appear often in soft sci-problems, thus hindering the students' ability to map from the mathematics to the science in which the problem *appears* to be framed.

2 Building words

The design of a hard sci-problem requires knowledge not only of the mathematical content and of its pedagogy, but also of the science in which the problem is framed; in most cases, this requires an interdisciplinary team [5]. In the absence of such a team, browsing the relevant scientific literature in the search of a fruitful example, and being able to understand the example, might be too time consuming even for the most dedicated teacher.

2.1 The research question

Can an LLM (Large Language Model) be used as design partner in a such a scenario?

The answer is yes, if the instructor can *convince* the LLM to be of any use. This brings the issue from one of learning enough of the science content knowledge to one of developing a sufficient level of Technological Pedagogical Content Knowledge (TPACK).

3 Conclusion

A first round of interviews with students shows that the use of hard sci-problem is effective in creating engagement with the mathematical content; at the same time, LLMs appear to be useful as design partners, given that the Math instructor has at least a scientific content knowledge at the level of a (good) high school student and has developed an appropriate TPACK.

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Critical co-creation with Artificial Intelligence for educational content development: a Human-in-the-Loop approach to MOOC production

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1 Introduction: The New Frontier of Human-AI Co-Creation in Education

Generative Artificial Intelligence (GenAI) is rapidly being integrated into higher education, shifting the paradigm from simple tool usage to complex human-AI co-creation of educational content (Bond et al., 2024). This evolution offers transformative potential for developing personalized and scalable Open Educational Resources (OER), yet it is accompanied by significant systemic risks that challenge academic integrity, equity, and the principles of Open Science. The discourse has matured from focusing on academic dishonesty to exploring sophisticated human-AI collaboration in teaching, learning, and research (Bewersdorff et al., 2023). This transition compels a re-evaluation of authorship and expertise, transforming the educator's role from a content provider to a "learning architect" who critically and ethically manages this collaborative process (Rascoff, 2025). However, the uncritical adoption of GenAI is fraught with risks inherent to the underlying Large Language Models (LLMs), including the generation of factually incorrect information (hallucinations), the perpetuation of dominant cultural and linguistic norms (hegemonic bias), and a fundamental lack of transparency in proprietary models (Ji et al., 2023). These are not superficial flaws but deep-seated characteristics that threaten academic rigor and equity. This paper argues that to responsibly harness GenAI's potential, higher education institutions must adopt a proactive and critical mitigation framework. We propose a framework built on three synergistic pillars: (1) Technical Grounding using Retrieval-Augmented Generation (RAG) to anchor AI outputs in verifiable data; (2) Critical Human Oversight via a Human-in-the-Loop (HITL) model; and (3) a Commitment to Openness by leveraging both proprietary and open-source models to create transparent and adaptable OER. As a practical instantiation, we present a case study from the University of Florence, demonstrating an innovative workflow for producing educational video content that strategically employs GenAI tools while embedding expert human review at critical junctures.

2 Pilot Study at the University of Florence

We conducted a pilot study between January and July 2025 with 10 faculty members to co-create educational video content. The workflow was developed within the "Digital Education Hub (DEH) - ALMA" project, funded by the Italian Ministry of Universities and Research (MUR). Using a participatory action research approach, the workflow integrated GenAI tools with mandatory human review checkpoints: 1) Source-Grounded Synthesis (RAG): Professors' articles were uploaded to NotebookLM to synthesize key concepts exclusively from the provided texts, 2) Structured Draft Generation: Gamma.App efficiently generated a draft presentation structure, 3) Critical Expert Review (HITL): Faculty members rigorously reviewed the draft, correcting facts, adding nuance, and mitigating bias, 4) Constrained Scripting: GPT-4/Gemini wrote descriptive text for the verified slide content, 5) Scalable Video Production: The final content was assembled into a video using HeyGen.
The pilot demonstrated significant efficiency gains while maintaining academic quality in 1) Time Reduction: total production time per video was reduced from an estimated 12 hours to approximately 2 hours (an 83% reduction), with 45 minutes dedicated to human review, 2) Quality Control: the RAG implementation resulted in **zero fabricated references**. The HITL review identified and corrected factual errors in approximately 8% of the initial AI-generated material. Constrained scripting further reduced new errors to approximately 3%.

The University of Florence pilot demonstrates that a deliberate, human-centered workflow can effectively manage GenAI's risks. This model has profound implications for the educator's role, shifting it toward that of a "learning architect" (Rascoff, 2025). This transformation requires institutional investment in new specialized roles to manage complex human-AI workflows. The future of AI in education is not one of full automation but of thoughtful, critical co-creation. Our pilot shows that strategic use of proprietary tools, coupled with rigorous human oversight and a commitment to open outputs, offers a practical pathway for responsible innovation.

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Artificial Intelligence in higher education: educational challenges and opportunities. A scoping review

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1 Introduction

Both European institutions and the scientific literature highlight how Artificial Intelligence (AI) is increasingly integrated into various sectors, including academia, offering significant opportunities for personalized learning, assessment support, and the optimization of teaching and administrative processes [1,2].

However, its adoption in European higher education contexts raises issues that remain insufficiently systematized, particularly regarding pedagogical, ethical, and regulatory implications [3,4,5], highlighting the need for a more comprehensive and critical understanding of AI's impact on educational practices.

2 Objectives

This scoping review, conducted in accordance with the PRISMA-ScR extension [6], maps and analyses the most recent secondary literature (2019-2024) to identify key educational challenges, emerging opportunities, and operational recommendations for AI adoption in higher education, with particular attention to pedagogical and regulatory dimensions.

3 Methods

The review followed a two-phase process consistent with PRISMA-ScR guidelines: (1) systematic identification and selection of sources from major academic databases (including Scopus, ERIC, and EBSCO), using defined eligibility criteria; and (2) thematic synthesis of the selected studies, focusing on pedagogical challenges, ethical concerns, and operational recommendations. Eligible works were peer-reviewed, written in English, published between 2019 and 2024, and classified as systematic reviews (with or without meta-analysis) centered on AI in university contexts. Excluded were primary empirical studies, interim reports, ongoing research, non-relevant contexts (e.g., secondary education), non-peer-reviewed contributions, works prior to 2019, and studies in languages other than English.

4 Results

The review highlights AI's significant potential to enhance teaching, personalized learning, and administrative efficiency in higher education. Nonetheless, critical issues persist, including ethical concerns, data privacy, and resistance to change. Despite its transformative potential, AI integration demands careful planning and appropriate regulation. The review offers valuable insights for developing institutional guidelines and for directing future research toward a conscious, inclusive, and sustainable educational transformation supported by AI in higher education.

The findings reveal a constellation of recurring themes that reflect both the potential and the vulnerabilities of integrating AI into higher education. On the one hand, numerous studies highlight AI's capacity to support personalized learning pathways, intelligent tutoring, content analysis, and inclusive teaching practices [7,8,9,10]. On the other hand, they underscore a persistent conceptual ambiguity, coupled with an overall lack of critical reflection on the pedagogical and ethical implications of its adoption [3,1,4]. In particular, key issues such as data security, algorithmic transparency, and equitable access to technology remain largely overlooked or addressed only in a fragmented manner [11,12,9].

Another critical concern lies in the uneven distribution of AI applications across academic disciplines: a clear predominance is observed in STEM and medical fields, with comparatively limited presence in the humanities and social sciences [7]. This imbalance risks reinforcing existing epistemological asymmetries and promoting a technocentric vision of education that may marginalize critical and reflective approaches [5].

5 Conclusions

Nevertheless, despite these challenges, the reviewed literature reveals a growing awareness of the need to reconsider the role of the educator. The teacher is no longer viewed as a passive user of technology but as an active mediator of meaningful, participatory learning processes grounded in principles of equity and ethical-educational responsibility [5,12].

This redefinition of the professional role of the educator emerges as essential to ensure that AI integration in university settings is not only technically effective, but also pedagogically sustainable and inclusive in terms of values. Building upon the synthesis of the results emerging from the analyzed literature, the contribution proposes a thematic reorganization of the main recommendations, offering a framework oriented toward the definition of four strategic directions that reflect emerging needs in terms of governance, teacher training, intersectoral policies, and ethical-pedagogical regulation.

This approach allows for the formulation of a coherent and applicable proposal to guide the responsible adoption of AI in university contexts, representing an added value for academic reflection and the orientation of educational policy.

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Unpacking Gender Bias in AI STEM Education: A Pilot Study on Student Perceptions of MetaHuman Tutors in University Physics

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1 Introduction

Artificial Intelligence (AI) is becoming pervasive in learning and educational practices by bringing more consistently personalized learning pathways, intelligent feedback, and adaptive content delivery [1, 2]. The majority of the available tools are designed to support students in concept understanding and skill development, however they often overlook important dimensions of the learning experience, such as social factors' influence with gender representation [3, 4]. Furthermore, the educational context plays a crucial role in shaping students' initial sense of belonging to a discipline [5, 6] and representational elements are pivotal in shaping perceptions of inclusion or identity in fields like physics or engineering [7, 8]. Current literature emphasize the subtle and valuable impact of gender representation in STEM educational context for fostering the educational belonging [3]. This pilot study addresses the following research question: *How the gender of a virtual tutor for physics university education can affect the students' perceptions of the tool's competence, clarity and empathy?*

2 Methods

The experiment envisioned the manipulation of gender in a MetaHuman (MH) [9] technology, by creating three virtual tutors: one male, one female, and one non-binary (Figure 1). All tutors shared identical instructional scripts, behaviors, voices, and interaction flow; only the visual appearance varied. A fourth interaction was included as a control condition, featuring a text-based chatbot with the same instructional content. The pilot study's sample included 12 students (mean age = 20.1 years; SD = 2.19) enrolled in a physics-related course, who interacted with all four tutor conditions in a randomized sequence to control for order effects. After each interaction, participants completed standardized questionnaires to estimate usability (UMUX-Lite), the perceived gender and attributes of the tutor, and their own self-efficacy in physics. Additional information on educational background and other demographics were collected to monitor the variables of prior experience and competence. Observational logs were also collected to capture spontaneous reactions, interaction length, and behavioral cues.

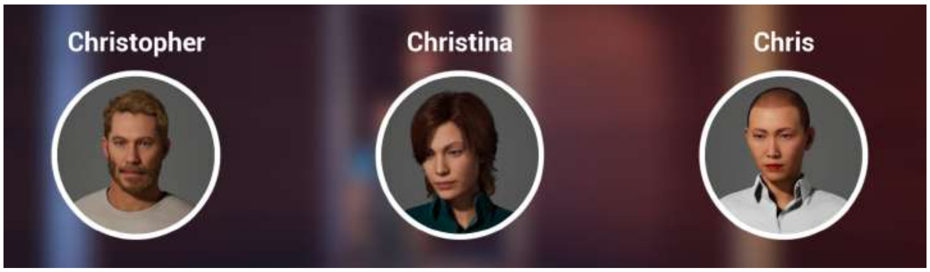

Fig. 1. Tutor's genders choice interface in MetaHuman's platform.

3 Results

Overall, the female tutor was perceived as the most competent and the one who provided the most clear explanations, although her behavior was identical to that of the other tutors. In addition, students reported some differences in the empathy and warmth they attributed to the tutor stemming solely from physical appearance. This pattern emerged even though all tutors shared the same content and behaviors, hinting that the visual representation of gender influences user perceptions. With regard to background variables, students' previous educational background seems to influence their answers, although not in a linear fashion. Participants with more experience of being tutored by male teachers did not consistently favor the male MH tutor, and some of them expressed surprise in preferring the female tutor. As a result, this suggests that MH tutors can serve as tools to improve equity by challenging implicit biases and offering alternative role models in STEM education.

4 Conclusions

These findings suggest that the perceived gender of an AI tutor may have an important influence on the perception of the tutor. This can reinforce existing assumptions and prejudices in society. Although the sample size is small, the results underline the potential of AI to not only be utilized for teaching, but also to represent all people in a more equitable way. Future work will explore how virtual tutors can help build a more inclusive and equitable learning spaces in STEM fields.

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Hattie&TimperlAI: an AI-Based feedback coach for math teacher training

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1 Introduction

Generative AI is rapidly transforming everyday digital tasks like writing, translation, and design. Among its most promising developments is the ability to create AI *agents*–customizable chatbots with tailored behaviors and domain-specific knowledge. In platforms such as ChatGPT (via GPTs) and Google Gemini (via Gems), these agents can simulate expert roles by integrating pre-set instructions and curated knowledge bases.

Recent research highlights the educational potential of AI agents to support both pre-service and in-service teacher development [1,7]. In mathematics education, their use is still emerging. Notably, Schorcht et al. proposed a network of cooperating pedagogical agents for collaborative task design [9].

Among the various areas in which teacher development is most needed, formative feedback stands out as particularly important. Effective feedback is a cornerstone of high-quality mathematics teaching [4,3], yet remains difficult to master. While well-crafted, improvement-oriented feedback can significantly enhance student learning [5], research also shows that feedback can be counterproductive when vague, overly evaluative, or misaligned with learning goals [6,4]. This underscores the need for teacher training to support structured, theory-based feedback practices. AI agents can help by offering pre-service teachers interactive, low-risk environments to explore and refine their strategies.

Building on this vision, we present Hattie&TimperlAI (H&TAI), a prototype AI agent that acts as a feedback coach for pre-service or novice teachers. Grounded in the influential framework by Hattie and Timperley [4], H&TAI is designed not for student interaction, but to support teacher education by fostering effective feedback practices. This paper contributes (1) a theory-informed design of H&TAI as a pedagogical agent, and (2) its evaluation through feedback from in-service teachers and mathematics education researchers, by investigating two research questions:

1. To what extent H&TAI generate feedback consistent with Hattie & Timperley's four feedback levels?
2. Focusing on middle school, how do teachers and mathematics education researchers assess its usefulness and usability?

2 Approach

The development of H&TAI has followed a four-phase research process.
Phase 0 - Identity Definition We created a prompt embedding the key traits of effective feedback, drawing on the framework by Hattie & Timperley [4] and aligning it with the national learning goals for Italian middle schools. The prompt was designed to guide the AI to act as a structured pedagogical advisor, specifying a clear and explicit role for the agent, behavioral constraints to reduce verbosity and enforce focus, and interaction protocols tailored to common challenges faced by novice teachers. In addition to the prompt, we uploaded key reference documents to enrich the agent's contextual awareness and responsiveness: the full text of Hattie & Timperley [4] and the official national curriculum guidelines for lower secondary education in Italy [8].
Phase 1 – Feedback to Student To evaluate whether H&TAI internalized its theoretical identity, we simulated a dialogue between the agent and a "student" prompted by a middle school math task. The student was itself simulated via prompt engineering, allowing us to control responses and elicit realistic misconceptions. This controlled setting enabled us to fine-tune the agent's behavior and assess whether its feedback aligned with Hattie & Timperley's four levels—directly addressing Research Question (1).
Phase 2 – Teacher–Coach–Student Simulation We simulated a realistic classroom scenario inspired by Cusi et al. [2], involving three roles: a teacher (played by a human), a student (simulated via chatbot), and the AI coach. In this setting, the teacher interacts with the student and leverages H&TAI to refine and improve the feedback provided, allowing us to observe the agent's support in a dynamic, practice-oriented context.
Phase 3 – Field Evaluation We will involve in-service middle school teachers in interacting with H&TAI using examples drawn from their own classroom practice. Their feedback will inform the refinement of the agent's configuration and provide insight into its perceived usefulness and usability in authentic teaching contexts, addressing Reasearch Question (2).

All tests were conducted using both ChatGPT (model o3) and Gemini (model 2.5 Flash) to compare behaviors across platforms. Temporary chat settings were used to avoid contamination from prior interactions. Each phase provided insights to iteratively refine H&TAI 's identity and performance.

3 Conclusion and Future Work

Preliminary results from interactions with in-service teachers and researchers suggest that H&TAI, with its approach in line with Hattie&Timperley [4], holds promise as both a feedback coach and a metacognitive tool for supporting teachers' reflective practices. This enables teachers to develop strategies for constructing, assessing, and refining feedback. Future work will involve a field evaluation with pre-service teachers and further exploration of how to balance pedagogical and disciplinary dimensions within the agent's identity and reasoning.

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Artificial Intelligence and Instructional Design: A Systematic Review in Higher Education

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1 Introduction

In recent decades, the scientific community has shown a marked increase in interest in Artificial Intelligence in Education (AIED), as evidenced by the growing number of studies addressing various dimensions of the teaching and learning process in relation to the affordances of AI technologies [1]. Findings from a recent review [2] highlight key topics discussed both in domain-specific contexts and in more general instructional settings, including support for personalized and adaptive instruction, assessment and feedback, and the prediction of learner performance. While much of the existing literature focuses on enhancing the student learning experience, there is a parallel effort to identify strategies that support faculty in developing and refining course design and curriculum, a domain that remains relatively underexplored and warrants further investigation.

2 Methodology

The present systematic review was conducted following the PRISMA guidelines [3] and adopted a qualitative, descriptive approach to address the following research questions: (1) Which aspects of instructional design are affected by the use of AI in university settings, including both micro-level course design and broader curriculum-level design? and (2) What perceptions, experiences, and attitudes do faculty members express regarding the use of AI-based tools, with particular attention to perceived opportunities and challenges?

The search process was conducted across the Web of Science, Scopus, and ERIC databases using the string: ("artificial intelligence" OR "AI") AND ("learning design" OR "instructional design" OR "course design") AND ("higher education" OR "universit*"). Peer-reviewed contributions (journal articles, book chapters, and conference proceedings) published between 2015 and 2025 in either English or Italian were included, provided they were available in full text, referred to the university context, and presented a theoretical or empirical focus on the use of AI in instructional design (whether face-to-face, blended, or online).

Excluded were works published prior to 2015; those concerning other educational levels; studies focusing exclusively on student outcomes or fully automated AI systems without teacher involvement; non-peer-reviewed materials; and texts not available in full. The selection process took place between April and May 2025. Two independent reviewers conducted a blind screening of abstracts and full texts. Discrepancies were resolved through discussion. Of the 453 records identified, 154 were removed as duplicates. The remaining 299 were screened by abstract, with 263 contributions excluded for lack of relevance. The main reasons for exclusion included thematic misalignment, unsuitable publication type, or unavailability of the full text. Of the 36 articles screened in the final stage, 18 studies were ultimately included in the review: 14 journal articles, 2 book chapters, and 2 conference proceedings, published between 2023 and 2025. A content analysis [4] was conducted by the two researchers to develop and share interpretative categories emerging from the coding process, which identified three main dimensions of interest: conceptual, organizational, and experiential.

3 Discussion

AI is frequently seen as a valuable support in designing content, learning objectives, learning activities, and assessment tools, in alignment with structured approaches such as Constructive Alignment and Universal Design for Learning. In addition, benefits in terms of efficiency and time savings in course design, especially in online contexts, were reported. However, significant limitations were also identified, including the unreliability or generic nature of AI-generated content, its limited contextual relevance, the risk of technological dependency, and the ongoing need for human oversight and validation. A gap was also noted between the recognition of AI's potential and its actual adoption, often hindered by low levels of digital literacy, insufficient training provision, and institutional constraints. Moreover, the introduction of AI prompts a redefinition of the faculty didactical roles, increasingly oriented towards critical mediation and guidance in the interpretation of information.

The review highlights that AI is having a growing impact on instructional design in higher education, offering opportunities in terms of efficiency, personalization, and innovation. However, its actual integration into teaching practices remains uneven and is conditioned by several enabling factors, including faculty competencies, pedagogical vision, and appropriate institutional support.

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Covariational Instruction and MWS-AI Integration: Modeling Teacher-AI Interactions in Math Education

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1 Introduction and Theoretical Framework

In the era of Artificial Intelligence, mathematics education requires a profound rethinking [1,2] from an academic and ethical integrity perspective [3]. This research is grounded in the theoretical framework of Mathematical Working Space (MWS), which considers mathematical learning as a multidimensional process occurring between epistemological and cognitive planes [4]. It is also based on constructive alignment theory in technology-rich environments and on understanding AI not as a mere support tool but as an agent capable of promoting the development of critical thinking and metacognitive competencies [5].

We analyse not only how AI moves within the MWS components but also how AI participation in mathematical activities covaries with human participation through task-induced covariational instructions generating predictable patterns of group-AI covariation. The introduction of the MWS-AI framework represents a first step for a specific theoretical-methodological framework to understand and design covariational interactions in AI-integrated mathematics education.

We aim to: (1) develop a theoretical framework of constructive alignment for AI-integrated teaching environments within MWS [6,7]; (2) identify covariational patterns between student-AI interactions that foster meaningful learning across MWS components [8]; and (3) create and evaluate guidelines for modelling teacher-AI interactions in mathematics education [9].

2 Methodology

A 12-hour experimental workshop, engaging 30 prospective mathematics teachers, working in small groups, was entirely conducted online via the Teams platform, and structured in three sequential tasks designed to elicit different covariational instructions. The challenging tasks required to work on a geometric definition, such as that of a segment's axis or a circle, by shifting from Euclidean to taxicab geometry. The first task involved exploring taxi geometry through real-world problems [10,11] using CANVA digital whiteboards integrated with GeoGebra, followed by critical comparison between human solutions and AI-generated proposals. The second task required interpretation and evaluation of other groups' work according to the MWS model [12], integrating AI evaluation. The third task involved AI-guided instructional design in tutorial mode. The entire process was supported by an integrated digital ecosystem that included Google Docs for collaborative document editing and Padlet for material sharing among groups.

Data Collection and Methods of Data Analyses. Data were collected through participant observations, analysis of group productions, digital interaction recordings, and structured final interviews. Data analysis employed a Hybrid Thematic Analysis with the MWS-AI framework, combining deductive coding based on MWS components with inductive coding to capture emerging covariational patterns.

The analysis operated on three levels: (1) MWS-AI mapping to examine how AI integrates within each MWS component; (2) covariational coding using an MWS-AI matrix to identify task-dependent interaction patterns; (3) cross-component analysis to reveal AI-mediated transitions between MWS dimensions. The MWS-AI framework provided the theoretical structure while maintaining openness to discovering novel covariational patterns of participation that emerged from the specific context of AI-integrated mathematics.

3 Preliminary Results

The analysis revealed that covariational instructions activate three distinct but complementary dimensions of AI-human covariation within Mathematical Working Spaces: (1) *Social Dimension*: AI as a group work participant that proposes alternative solutions, stimulating critical comparison [13], and developing evaluative capacities while enhancing the epistemological component of MWS; (2) *Weak Instrumental Dimension*: AI as a "critical friend" that provides constructive feedback and supports metacognitive reflection, primarily influencing the cognitive component of MWS; (3) *Instrumental Dimension*: AI as a design partner that guides prospective teachers in developing innovative instructional activities, operating within the instrumental component of MWS. Each dimension corresponds to specific task-designed covariational instructions, creating predictable patterns of AI-human interaction.

4 Conclusions and implications

The research show how covariational instructions can systematically activate different AI participation modes, contributing to the development of critical thinking, evaluation competencies, and instructional design capabilities in prospective teachers across all MWS components. They not only determine how AI participates in mathematical work, but also how groups of prospective teachers modulate their interaction with AI in response to these task-induced stimuli. The three identified dimensions offer MWS-AI covariational framework for designing innovative educational pathways that prepare prospective teachers to use AI as an advanced pedagogical resource rather than a simple support tool, as it is noted in the recommendations of Sgreccia and Dominguez [14].

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Culturally Inclusive AI Tutoring in Higher Education: A Multi-Dimensional Framework for Developing Critical Thinking and Metacognitive Skills

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1 Introduction

Higher Education institutions face considerable cultural diversity, yet AI tutoring systems adopt such as ChatGPT-based tutors, Claude for education, Socratic by Google, and Khan Academy's AI assistant implement "one-size-fits-all" approaches that overlook sociocultural backgrounds [1]. Current AI tutoring systems personalize content based primarily on performance metrics while neglecting cultural values and learning preferences that significantly influence knowledge construction [2]. This contributes to educational inequalities and risks alienating diverse learners. Many AI tutors fail to implement Universal Design for Learning (UDL) principles and reflect developers' cultural assumptions [3].

How can AI tutoring systems integrate cultural inclusivity across three complementary dimensions (AI as design partner, critical friend, and work participant) to support critical thinking and metacognitive skills in Higher Education?

This paper proposes a theoretical framework for Culturally Inclusive AI Tutoring that seeks to transform cultural diversity from implementation barriers into pedagogical assets for improved learning outcomes [4].

2 Theoretical framework

2.1 Three-Dimensional Architecture

Dimension 1: AI as Design Partner. The system supports educators through cultural context mapping, inclusive content generation with diverse examples, bias detection algorithms, and UDL integration that considers cultural contexts [5].

Dimension 2: AI as Critical Friend. Provides culturally-aware feedback that adapts communication styles to student backgrounds, multi-perspective scaffolding that presents solutions from diverse cultural frameworks, and culturally-informed reflection questions designed to facilitate critical thinking [6].

Dimension 3: AI as Work Participant. The system generates solutions based on different cultural methodologies such as collaborative versus hierarchical versus individualistic approaches, with each reflecting different cultural value systems. Additionally, it moderates cross-cultural discussions, and supports the development of assessment skills through exposure to diverse thinking patterns [7].

2.2 Integration Mechanisms

The dimensions operate through continuous cultural adaptation algorithms that adjust interactions based on real-time student analysis. Learning analytics track cultural inclusivity metrics while dynamic personalization combines academic performance with detailed cultural context [8].

2.3 Theoretical Contributions

This framework offers a systematic integration of cultural theory with multi-dimensional AI tutoring, shifting from reactive bias correction to proactive cultural diversity design. It positions cultural perspective comparison as one mechanism for metacognitive development [9].

3 Implications and future directions

The framework represents a shift from performance-only to culturally-inclusive personalization in AI education. For educators, it offers guidelines for culturally inclusive design and bias detection tools. Students may benefit from increased engagement and potentially improved critical thinking through diverse problem-solving approaches. Institutions gain systematic approaches for equitable AI implementation [10].

Empirical validation across diverse contexts requires cultural sensitivity measurement instruments and cross-institutional studies. Research priorities include long-term impact studies on critical thinking development, scalability investigation, and exploration of applicability beyond Higher Education [11].

4 Conclusion

This paper presents a systematic framework for Culturally Inclusive AI Tutoring, addressing important gaps in AI education systems. The three-dimensional model aims to transform cultural differences into pedagogical assets for improved critical thinking and metacognitive development. The contribution lies in proactive cultural sensitivity integration across all AI tutoring functions, moving beyond content adaptation to fundamental system design changes. Future research should focus on empirical validation to ensure AI-mediated learning serves all students effectively regardless of cultural backgrounds [12].

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Active Online Assessment in Higher Education: an experimental framework

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1 Introduction

The development and spread of Generative Artificial Intelligence open up a range of possibilities in universities, particularly in design, feedback and assessment [1]. Scientific literature is investigating how Generative AI is transforming both summative and formative assessment in Higher Education, and this implies the need for universities to implement Faculty Development programmes to enable the adoption of new assessment models that are consistent with the potential of AI and able to support educational innovation in a critical and reflective way [2-3].

As part of the PRIN project 'Active Online Assessment in Higher Education' (AcOnHE), an innovative framework for online formative assessment has been designed to support effective assessment of learning outcomes in online, blended and traditional contexts. The project's initial hypothesis is that can be enabled through an automated system that integrates AI. This framework aims to replace online proctoring systems with a sustainable learning design that improve student engagement and supports e-tivities based on formative assessment [4-5]. An experimental study was conducted within the Docimology course at eCampus University (LM-85, 9 ECTS), in which the e-tivities carried out by students compose an e-portfolio. The target is the development of an AI automated system for these e-tivities assessment. To train the AI, a knowledge base was created using selected student exercises, providing the specific theoretical context, student responses, and the type of evaluation required.

2 Methodology

The designed system is a Proof of Concept (PoC) aimed at automating the assessment of written tests within the online university course. At this stage, the system is accessible via a frontend web interface, but it is already set up for future backend-to-backend integration with the LMS. The architecture allows for the selection of the type of exercise, the uploading of theoretical material (in PDF, DOCX, PPTX format), the student's response, an option for a correct example answer, and the choice of the desired AI model. The system interfaces with models such as ChatGPT, Nova (Micro/Light/Pro) and Sonnet 3.5, via OpenAI and Amazon Bedrock APIs, allowing the selection of the model. The content extracted from the documents is structured in a prompt with dedicated sections (context, question, answer, example). The prompt includes specific instructions for each type of exercise and explicit evaluation requests based on structured criteria (e.g. length, thematic consistency, linguistic correctness, presence of keywords). The design chose a single prompt containing all relevant material, taking advantage of the growing ability of AI models to handle broad contexts, to achieve greater portability, ease of audit and reduction of failure points compared to an indexed Knowledge Base.

For each exercise, the AI system provides the lecturer with a summary assessment (unsatisfactory/satisfactory/good) and a detailed assessment based on the various criteria identified (unsatisfactory/basic/intermediate/advanced).

The research group, composed of teachers of the course and/or related courses, evaluated the exercises to verify the consistency between the AI assessment and the human assessment. The corpus of exercises analysed includes over 300 papers. The data collected from the experiment so far show substantial consistency (over 85%) between the assessments generated by AI and those assigned by lecturers, confirming the potential reliability of the tool. This allows lecturers to make an initial assessment and screening of students' activities.

3 Conclusion

Some critical issues have emerged, such as the greater difficulty in managing unconventional languages or divergent approaches, the complexity of assessing e-tivities such as concept maps, and the difficulty in using intermediate assessments (tendency towards “simplified” assessment).

Aspects to be improved include standardising formats, clarifying operating instructions, ensuring consistency with the expected assessment criteria and continuous monitoring and “training” of the system. The limitations of this type of model concern the possibility of completely replacing online assessment based on proctoring systems with a sustainable learning design framework capable of improving student engagement and monitoring their learning outcomes. The perception of using AI to support self-regulated learning is still strongly linked to students' preference for human support, particularly with regard to motivation, which highlights the importance of building trusting relationships in teaching, especially in distance learning [6-7]. In the future, the system will be able to support teachers in the design of formative assessment and help students with self-assessment and self-regulation processes [8]. Future strategies include implementing guided exercises for students and providing teachers with training on the responsible use of AI.

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Re-examining constructionism in the age of GenAI: from "learning by making" to "learning by prompting"

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1 Rationale and Theoretical Foundations

The integration of Generative AI (GenAI) into learning environments requires a critical reexamination of foundational theories such as Papert's constructionism [1] within mathematics education. This paper theoretically proposes and empirically investigates how constructionism is being transformed through student interaction with a specific GenAI tool, namely ChatGPT, widely adopted across various educational contexts, particularly in mathematics education [2]. We ground these theoretical reflections in a qualitative study with upper-secondary students, aimed at exploring how interaction with GenAI supports or challenges constructionist dynamics in mathematics tasks. In line with constructionist perspectives, we consider foundational ideas such as "learning by making" and the use of "objects to think with", as introduced by Papert, to be central to how students construct knowledge. These ideas are incorporated into practices, such as "debugging", which become particularly relevant in ChatGPT-supported mathematical learning environments. Specifically, we hypothesize that these established ideas undergo significant changes. Our central theoretical argument concerns the transformation of "learning by making", positing a shift toward prompt as a key cognitive artefact, complemented by critical evaluation of the AI response. This shift invites a reconceptualization of computational thinking itself, as students engage not in coding per se, but in orchestrating AI behavior through abstraction, iterative prompt refinement, and analysis of generated logic. We further theorize that: "debugging" becomes multilevel, targeting the mathematical formulation of the prompt, the logic generated by AI, or the student's own conceptual understanding; ChatGPT interaction acts as a new "object to think with", fostering reflection on mathematics and communication; student agency shifts from direct manipulation to critical supervision, involving strategic orchestration, metacognitive awareness, and reflective evaluation of powerful digital tools. Rather than treating GenAI as a mere technological tool, we frame it as a transformative agent that reshapes the epistemic conditions under which mathematical meaning is constructed. This perspective builds on Papert's legacy and is informed by contemporary interpretations of digital constructionism and AI literacy [3], [4], [5].

2 Methodology and Insights from a Pilot Study

We empirically explored these propositions through a qualitative pilot study involving Grade 13 students. Participants engaged in a sequence of structured activities that required them to formulate prompts in natural language that would elicit algorithmic behavior from the AI, emulating the logic of turtle geometry. The tasks were designed to foreground constructionist dynamics, such as iterative refinement, error exploration, and conceptual articulation, in a GenAI-supported context. A key task, inspired by Logo explorations [6], involved creating ChatGPT prompts to generate animated GIFs using Python's Turtle graphics. The collected materials, including prompt versions, generated output and reflective notes from the students, were qualitatively analyzed to identify patterns of reasoning and learning. The data reveal a recurring cycle of hypothesis–generation–evaluation, where students adjust their prompts not only to correct functional errors but to express mathematical ideas better. In particular, students participated in layered debugging: modifying prompt syntax, interpreting AI visual or code outputs, and re-evaluating the underlying mathematical structure of their tasks. This suggests that constructionism is enacted differently with GenAI, with students taking on the role of designers and evaluators of intelligent system responses.

3 Conclusions

We conclude that engaging with a GenAI tool like ChatGPT through intentional prompting and critical reflection can lead to a transformed version of constructionist learning, where language serves as a medium for shaping mathematical thinking, and prompting acts as a form of design-based epistemic action. Rather than focusing on procedural syntax, students are encouraged to develop abstraction, strategic reasoning, and critical evaluation, the core components of mathematical and computational thinking [7]. Furthermore, we should recognize the risks of overreliance, in which students may uncritically accept AI results, and AI hallucinations, in which seemingly plausible answers may actually be incorrect or misleading. Educators must explicitly support students' ability to critically evaluate AI responses, verify them with mathematical reasoning, and use them as opportunities to identify errors and clarify concepts. In this sense, the integration of GenAI requires a pedagogical emphasis on critical supervision, ensuring that the tool enhances rather than replaces students' cognitive and creative efforts. Finally, our findings suggest that "learning by prompting" may serve as a contemporary evolution -rather than a replacement- of "learning by making", capable of fostering reflective agency and conceptual understanding in GenAI supported environments.

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From Reflection to Regulation: A Pilot Study on Metacognitive Awareness Inventory and the Use of Generative AI Tools in Higher Education

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1 Theoretical Framework

The present work stems from the sharing of interdisciplinary and concentric research experiences of several researchers and teachers with the intention of identifying some operational paths aimed at identifying ways, curricula, and processes of critical integration of Artificial Intelligence in the university setting. The aim is to develop 'intelligent' tactics that enable AIs to play a supportive, evolving, and non-mandatory role in students' academic engagement through their critical, conscious, reasoned, and responsible use.

The process of learning involves the use of both implicit and explicit sensory stimuli in perceptions and concepts. Synaptic germination processes that guarantee human cognitive evolution are based on essential moments between subjects and environments [1][2][3]. The environments outside the subject can transform individuals in both direct and indirect ways, and can be classified as environmental, social, real, digital, or virtual. [4].

The evolutionary potential of subjective formation can be realized through the encounter and creation of knowledge, which is mediated and realized through the Digital and its ultimate physiognomy like Generative Artificial Intelligences [5]. It is important to ensure that this knowledge, operational skills, and competences are functional and interoperable when applied in new contexts.

It is a matter of realizing training processes that do not reduce Artificial Intelligences to tools aimed at performance, at the product, at the result, at the single response and at the single elaboration, but that can be constituted as new evolutionary perspectives of the human being. Processes that are influenced by the metacognitive dimension of each individual can lead to training that increases their complexity, critical thinking, and awareness [6][7][8].

The idea is to act on cognitive, metacognitive processes and domains of knowledge that are hierarchically superior to the mere input of prompts in LLMs.

We should therefore act on areas of the cognitive system that act as an organizational background to the action of obtaining information.

These domains, which we would classify as superior hierarchically, offer a significant possibility for modification; however, they necessitate a longer, deeper, and finely organized time for medium-term learning objectives [9].
Working, investing educationally in this dimension means recognizing a double dimension to all learning processes: an explicit one, made up of declared, clear, evident knowledge; the other deeper, meta-level, hierarchically superior dimension that concerns the implicit capacity to organize knowledge, to be aware of how to manage it, of its general complexity, of its dominion.

2 Pilot Study and Preliminary Findings

This pilot study adopts a qualitative-quantitative exploratory design to test a revised version of the Metacognitive Awareness Inventory (MAI) [10][11], adapted to the use of Artificial Intelligence in learning contexts [12][13][14], and referred to as MAI-C, where "C" stands for "Critical." The questionnaire consists of 30 yes/no self-assessment items addressing students' reflective and responsible use of AI tools across academic and professional settings, covering awareness of AI capabilities and limitations, critical evaluation of outputs, ethical implications, bias detection, and transfer of AI-related skills across tasks and domains. Administered to a random sample of Mathematics Didactics students at the University of Salerno, to verify its effectiveness in intercepting processes of awareness and cognitive regulation [15] during interaction with AI tools [16]. It revealed high levels of metacognitive reflection, with over 90% affirming awareness of AI limitations, 98.7% checking alignment with goals, and 97.4% identifying and correcting errors. Critical gaps emerged, however, as only 47.4% planned AI use in advance and fewer than 70% adapted strategies to new contexts, suggesting strong ex post evaluation but weaker strategic planning and adaptability. The study highlights the need to foster intentional and flexible AI use and sets the ground for validating MAI-C with larger and more diverse samples to assess internal consistency, educational applicability, and its potential as feedback on students' critical reflection.

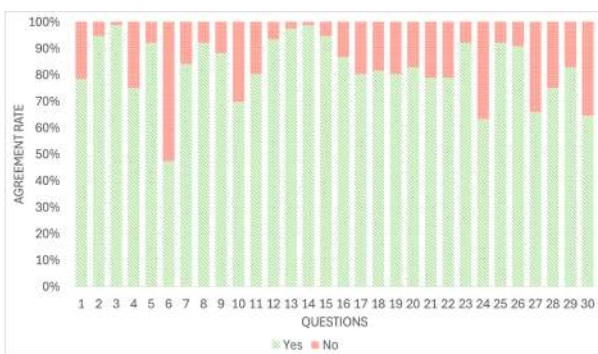

Fig. 1. Agreement rates for the 30 items of the adapted Metacognitive Awareness Inventory for Critical AI Use..

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Reflective Communication in Medical Education through AI: A Pedagogical Approach Using ChatGPT

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1 Introduction

This paper presents a pedagogical proposal that uses artificial intelligence – specifically, ChatGPT – to foster critical thinking, reflective learning, and communication skills in fourth-year medical students. Recent studies have emphasized the growing role of generative AI in supporting reflective learning and dialogic reasoning in professional education. In a meta-analysis of AI-supported health education, Wei et al. (2025) report that language models like ChatGPT can enhance both knowledge acquisition and interpersonal competencies when integrated into problem-based and case-based learning formats. For example, Hui et al. (2025) demonstrate that ChatGPT-assisted instruction significantly improves clinical communication skills, while Shalong et al. (2024) show that AI-facilitated environments strengthen self-directed learning and diagnostic reasoning. These perspectives align with a broader trend of rehumanizing education through intelligent technologies.

The initiative is embedded within the “Didactics and Special Pedagogy” module at the University of Genoa and aims to integrate theoretical knowledge and clinical practice through a structured, dialogic engagement with AI tools. By simulating patient-doctor interactions and promoting metacognitive reflection on communicative practices, the proposal emphasizes the value of pedagogical care as a complementary dimension to clinical training.

2 Care and AI

While traditional medical education often emphasizes the technical and diagnostic components of patient care, this intervention seeks to foreground the educational and relational aspects of medical practice. Drawing on theoretical contributions from pedagogical ethics (Mortari, 2006) and narrative medicine (Charon, 2006), the program conceptualizes care as a complex interaction involving empathy, listening, cultural sensitivity, and emotional presence. The instructional design is based on an inclusive pedagogical model, promoting equity of access and personalization of support for diverse learners.

The course was structured in five sessions of two hours each, combining theoretical input, AI-assisted simulation, and interactive reflection. Table 1 outlines the sequence, content, and methodology adopted during the module.

Table 1. Structure of the AI-supported training

	Content	Method	Tools/Supports
1	Introduction to narrative medicine and pedagogical care	Lecture + discussion	Slides, readings (Charon, Mortari)
2	Presentation of the ME-CO questionnaire and key dimensions of communication	Interactive workshop	ME-CO questionnaire
3	AI-assisted simulations: prompt creation and ChatGPT response analysis	Small group work + guided reflection	ChatGPT, clinical scenarios
4	Critical discussion of AI responses and relational strategies	Group debrief + peer feedback	ChatGPT transcripts, moderator facilitation
5	Role-playing activities and consolidation of competencies	Simulated consultation + observation	Observer grid, video/audio recording (optional)

During the ten-hour course, students engage in simulated medical consultations with the aid of ChatGPT. Structured prompts guide them through three essential dimensions of medical communication—gathering information, delivering information, and maintaining the patient relationship—drawing on established models in clinical education. Students consult ChatGPT to generate communication strategies and example formulations, which are then critically evaluated through peer discussion and guided reflection. This process is supported by the ME-CO questionnaire (Lewkonia, 1991), which assesses students' self-perception of their communicative competence across multiple relational and emotional domains, as discussed in the original course documentation.

For example, when simulating the case of a 78-year-old patient with multiple chronic conditions, students use ChatGPT to explore how to initiate the consultation in an open and empathetic way. One prompt was: “How could I start this conversation with empathy and respect for the patient’s situation?” ChatGPT responded: “Good morning, I understand you've been dealing with several health issues lately, and that must be challenging. I’m here to listen and work together with you to find the best possible approach for your care.”

Students are then invited to analyze this formulation, reflect on the balance between empathy and clarity, and discuss how such a message might be perceived by a real patient.

These interactions are followed by group debriefings where students assess the relevance and limitations of the AI’s suggestions and consider how to translate them into real clinical encounters. This hybrid learning environment—AI-supported and human-reflective—encourages a form of distributed cognition in which knowledge is constructed collaboratively with the tool, rather than passively received.

The course culminates in role-play activities in which students alternate between the roles of doctor, patient, and observer. This experience consolidates their communicative competencies, enhances emotional awareness, and supports the internalization of effective relational behaviors. The ME-CO questionnaire is administered before and after the course to track changes in students’ self-perceived communication efficacy.

3 Anticipated outcomes

Anticipated outcomes hypothesize that ChatGPT can act not merely as a source of information but as a co-reflective partner—a dialogic presence that stimulates students to question assumptions, articulate their reasoning processes, and consider alternative strategies for effective communication. Rather than providing prescriptive answers, the AI facilitates the emergence of self-awareness, empathy, and critical analysis in clinical dialogue. Importantly, ChatGPT is not positioned as a substitute for interpersonal interaction, but as a pedagogical catalyst: a tool that provokes deeper engagement with complex relational dynamics and supports the development of professional identity in a reflective, ethically grounded manner.

While the project is still in an early phase of implementation, it offers a model of AI integration that enhances—not replaces—human-centered medical education. By embedding AI within a framework of pedagogical care, the course supports a rehumanized vision of medical practice where technical competence and ethical sensitivity are mutually reinforcing.

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Exploring Student Engagement and Perceptions in EFL Using AI-Powered Chatbots

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1 Introduction

The widespread adoption of artificial intelligence (AI), particularly through generative tools such as chatbots, has led the international scientific community to explore new educational opportunities. Among these, natural language processing systems enable conversational interactions between users and machines, offering personalized feedback by adapting to user input.

In particular, the affordances of Chatbots are being investigated in the field of foreign language acquisition [1], with a focus on designing learning environments and strategies that promote student autonomy, self-efficacy, and self-regulation. Special attention is being paid to the potential benefits for students with disabilities and learning difficulties.

The emerging line of research on dialog systems (DS) for language learning [2] is the focus of the UNITe project (Universally Inclusive Technologies to practice English), a three-year initiative funded under the Italian PRIN 2022 (Research Project of National Interest) program. The project aims to conduct a comprehensive analysis of existing tools and literature, engage university students in pilot sessions, and ultimately develop evidence-based resources to support the integration of DS into learning practices within Italian universities.

UNITe is coordinated by the University of Bologna, in partnership with the University of Macerata and the University of Naples “L’Orientale”.

2 Research overview

The overall objective of the UNITE project is to promote the use of chatbots in the university context as accessible and inclusive technologies for learning English as a Foreign Language (EFL). To develop a comprehensive understanding of the tools, methods, and affordances of AI-based dialog systems (DS), the research team conducted a preliminary in-depth analysis of selected chatbots. These were categorized by domain (general or restricted), platform (e.g., web-based, mobile application), type of conversation (e.g., small talk, roleplay), and key features (e.g., accessibility, feedback, and conversation prompts).

The analysis led to the selection of ChatGPT and Pi.ai as the chatbots to be piloted with a sample of university students from the three partner institutions. The participants consisted of first-year students, aged 19 to 25, enrolled in non-foreign language degree programs.

To ensure the inclusion of students with learning difficulties (DSA) or disabilities, the project collaborated with university support centers to facilitate communication and outreach to students with special educational needs.

A protocol for the experimentation was developed to ensure consistency across the different sessions conducted at the three universities. The sessions were supported by researchers who, either in face-to-face settings or remotely, guided groups of 10–15 students through the piloting of either ChatGPT or Pi.ai. Each session involved two specific, sequential tasks, small talk and role play activities (in varying order), to be completed within a set time frame of approximately 25 minutes. Each session concluded with a questionnaire designed to gather students' opinions about their performance and overall experience during the interactions.

The present contribution focuses just on the analysis on the closed and open-ended responses collected through the post-hoc questionnaires to examine students' expectations and perceptions during their engagement with the AI tools. Through a content analysis approach [3] data were triangulated with variables such as participants' self-declared level of English proficiency and disability status. The coding process revealed two primary categories: immersion in the communication flow (engagement) and quality of interaction (consistency and comprehensiveness).

3 Conclusion

The aim of this study is to assess the potential of AI-powered chatbots to support diverse learners by offering accessible, flexible, and engaging opportunities for language practice. The piloting phase provided a foundation for understanding how AI can be integrated to foster engagement and motivation in EFL learning, especially within the framework of inclusive education.

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Beyond the Instrumental Use of AI to foster Mathematics students' Metacognitive Awareness and Critical Thinking

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1 Introduction and theoretical framework

The contemporary challenge of integrating Artificial Intelligence (AI) in education [1--5] highlights the need for a pedagogical approach that goes beyond mere instrumental use, focusing instead on fostering metacognitive and critical thinking skills [6]. Ennis's framework [7] and Flavell's theory [8] explain how learners develop self-regulation and critical evaluation of their own problem-solving strategies. In mathematics education, Schoenfeld's seminal work [9] further emphasizes the importance of metacognitive awareness in mathematical problem solving, highlighting the necessity for students to monitor and regulate their mathematical thinking processes. More recently, in mathematics education research, Contel and Cusi [10] and Miranda [11] have explored how ChatGPT supports metacognitive processes and contributes to shaping mathematical identity during university-level problem solving. The presence of AI as a collaborative "participant," sharing its solution after students complete their work, stimulates critical thinking, and aligns with Vygotsky's [12] view that interaction with external tools fosters knowledge construction and internalization of higher cognitive processes. This pilot study, as part of a broader interdisciplinary project investigating the metacognitive potential of AI in education, examines how structured AI integration in mathematical problem solving can foster: (1) metacognitive competencies in university mathematics students; (2) critical evaluation capabilities of problem-solving strategies; and (3) deeper conceptual understanding through comparison of human- and AI-generated solutions.

2 Methodology

The study involved 63 mathematics undergraduates enrolled in an introductory topology course at a university in southern Italy. Students completed four problem-solving activities focused on key topology concepts, each centered around a task designed to support understanding through AI-generated examples. Each activity's core involved a task designed to help students understand a specific definition, with AI participation through its own example generation, intervening in each working group only after the group had produced its response. A mixed-methods research approach was adopted. The experimental design comprised three phases: group-based problem solving, AI interrogation, and critical comparison to select the best strategy or to discuss potential AI inconsistencies and errors. Data were collected through students' and AI's problem-solving responses, semi-structured interviews regarding AI interaction, and a questionnaire based on the Metacognitive Awareness Inventory (MAI) [14] that quantitatively measured metacognitive competencies.

Qualitative data were analysed thematically [15] to identify patterns in students' experiences and comparison strategies, while quantitative data were examined through descriptive, inferential, and correlational analyses to assess changes in metacognitive competencies and their relationship to students' perceptions.

3 First data analyses and findings

Thematic analysis of the semi-structured interviews revealed three recurring themes: error detection, strategy comparison, and critical thinking, demonstrating that metacognitive awareness grows when students compare their solutions with AI outputs. Student 2 exemplifies metacognitive monitoring [9]: conflict between human and AI answers sparks deeper reflection, a pattern labeled "critical comparison" in [15]:

> *In contexts where AI's answers differed from those developed by the group, there was an opportunity to think about the reasons for those differences, which allowed us to better develop our critical thinking.*

Student 10 illustrates routine evaluative practice, treating AI as a metacognitive aid rather than an authority, aligning with Ennis-style critical evaluation:

> *In the various group activities, we carried out on different topics covered in the course, we always compared our ideas and answers with those that ChatGPT provided. Having another method that quickly generated an answer was certainly a great advantage: it allowed us to think critically when the generated ideas were potentially incorrect.*

MAI-based results corroborate these themes: 97.9% of students reported identifying and correcting AI errors (monitoring), while 88.5% reflected on what worked and what did not after using AI (comparison).

Due to the anonymous nature of individual data, to identify cross-cutting consistencies between different sources, the analysis enabled macroscopic triangulation by correlating group patterns emerging in the qualitative protocols with aggregate trends in the quantitative data. High scores in Monitoring and Evaluation correspond to students' reports of critically comparing AI and human solutions. Similarly, the Self-Regulation dimension reflects their insights on how AI prompted review, questioning, and deeper awareness.

4 Conclusion

Preliminary findings suggest that integrating AI in mathematical problem solving strengthens students' metacognitive awareness, evaluative skills, and critical thinking. Comparing human and AI solutions deepens reflection on problem-solving strategies. As the initial stage of a broader multidisciplinary project, this study contributes to research on pedagogically sound AI integration in higher education and offers a replicable model for its critical use across STEM disciplines and the humanities.

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Integrating Digital Technology in University Mathematics Education to enhance Teacher Training

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1 Background and Theoretical Framework

The integration of digital technology in the teaching and learning of mathematics represents an important area of study in mathematics education research [1--3], particularly at the university level, where traditional teaching methods remain common in pure mathematics courses. Our research is grounded in the theoretical framework of Technological Pedagogical Content Knowledge (TPACK), which emphasizes the complex interplay between content knowledge, pedagogical knowledge, and technological knowledge in effective teaching [4]. Additionally, we draw upon Ball et al.'s conceptualization of specialized content knowledge for teaching mathematics [5] and the documentational approach to understand how teachers create and use digital resources [6,7]. Recent research has highlighted the potential of digital experiences in enhancing mathematical cognitive functions [8] and in beginning to shape mathematics students' pedagogical knowledge through the students' creation of digital documents in pure mathematics learning contexts [9].

This study investigates how mathematics students who have completed a mathematics bachelor's degree and master's teacher education training conceptualize the use of digital technology, including AI, to enhance mathematical understanding and pedagogical practice. Specifically, we examine: (1) how students with prior experience in digital resource creation in pure mathematics courses, potentially with AI participation, differ from those without such experience in their perceptions of technology integration; (2) the development of students' technological pedagogical content knowledge through student-generated digital resources [10,11]; (3) the impact of these experiences on early mathematics teacher identity formation [12,13].

2 Methodology

This research employs a qualitative approach through thematic analysis [14] to examine data collected from master's degree mathematics students attending a mathematics education course at the University of Salerno. Participants include two distinct groups:

students who previously engaged in designing digital resources for topology concepts (including interactive lessons, problem-solving games, videos, and ChatGPT integration) and students without this prior experience. Semi-structured interviews investigating their self-perception regarding technology use and their views on how technology can develop pedagogical skills and mathematical understanding represent the primary data focus.

Data collection involves interviews, written reflections, and analysis of student-created digital resources [9] using the documentational genesis approach [6]. The analytical framework integrates thematic analysis [14] with the TPACK model to trace the perceived and expected role of technology in enhancing mathematics learning and teaching, and the Patterns of Participation framework [12] to trace the evolution of students' technological pedagogical reasoning and professional identity development through their experiences of being, becoming, and belonging within the mathematics teacher community.

We identify how students' perspectives on technology and AI use change based on different storylines (*Who am I and who would I like to be in relation to the use of technology and AI?*) and consider the broader context of developing pre-service teachers' knowledge for teaching mathematics with technology [15], even supported by AI.

3 Key Findings and Implications

Preliminary findings suggest that students who engaged in digital resource creation within pure mathematics courses demonstrate enhanced awareness of the pedagogical dimensions required for effective mathematics teaching. These students begin to develop what Borba terms "humans-with-media" perspectives [16], recognizing technology not merely as a tool but as an integral component of mathematical thinking and communication.

The experience of creating digital resources for peer learning appears to favour the development of teacher identity, as students transition from viewing themselves primarily as mathematics learners to recognizing their potential as mathematics educators. Evidence suggests that engagement in digital and geometric transitions contributes significantly to shaping mathematics students' teacher identity [17], while promoting undergraduate mathematics students' TPACK through digital resource production [18].

4 Conclusion and future research directions

This ongoing research will expand to investigate how digital communication, mathematical discourse, and technological thinking can be systematically integrated into university-level mathematics education. The study aims to provide evidence-based recommendations for incorporating technology meaningfully in pure mathematics courses while simultaneously fostering the development of future mathematics teachers' professional competencies.

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Special Track 6

UDL and AI in Higher Education and in Pre Service Teacher Education: strategies

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New educational horizons: maps, AR, and inclusion for a changing school system

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1 Introduction

The integration of digital technologies in schools is now a crucial issue for innovation in the education system, a challenge that has been recognized at national and international level by the main guidelines on inclusion [1] [2]. The rapid evolution of technological tools opens new possibilities for the personalization of learning paths and the dissemination of truly inclusive practices, capable of actively involving all students, regardless of their abilities or starting conditions. The growing complexity of teaching for students with Special Educational Needs (SEN) highlights, now more than ever, the need for effective tools that enhance the educational relationship, participation, and collaboration, placing the support teacher in a central role as a pedagogical and technological mediator. These requirements translate into the need to design highly adaptable digital learning materials and environments that are open to innovation, in line with the paradigm of the school as an educational and inclusive community.

2 Innovative tools and concept maps in augmented reality

Inclusive education is a priority objective of contemporary education policies and involves overcoming barriers to learning and participation for all students, promoting a vision of school as a place where diversity is valued and everyone's potential is developed [3]. In this context, digital technologies can act as powerful catalysts for innovation, enabling the differentiation of educational pathways, easier access to materials, and the possibility of adapting tools to the different needs of students. Digitally supported inclusive practices, such as the use of augmentative communication software, virtual learning environments, interactive whiteboards, and augmented reality tools, have shown promise in reducing the gap between students and promoting higher levels of participation [4]. However, critical issues remain related to the accessibility of resources, the continuous training of teachers, the availability of technology in schools, and adequate methodological support to effectively integrate innovation into ordinary teaching. This gives rise to the need to develop research and prototyping paths that focus on the real needs of the school context, with reference to inclusion.

As part of strategies to promote inclusion, concept maps are a recognized tool for supporting the construction, restructuring, and visualization of knowledge. They make it possible to clarify the connections between key ideas, facilitating meaningful learning as advocated by the theories of Novak, Ausubel, and social constructivism [5]. When enhanced by augmented reality—understood as the enrichment of the real environment through the integration of 3D digital elements, audio, video, or animations—their educational potential increases significantly: the map is no longer a static artifact but becomes a navigable, explorable, and manipulable environment, capable of providing multisensory stimuli and encouraging the engagement of students with different cognitive styles and educational needs. The experiences reported in the literature and the first pilot projects show that the use of augmented concept maps increases curiosity, motivation, and a sense of self-efficacy, as well as promoting teamwork, the co-construction of knowledge, and the enhancement of individual resources. However, the adoption of these tools requires a redesign of teaching models and specific training for teachers so that they can create learning environments that are truly interactive, collaborative, and accessible even to students with greater difficulties. [6]

3 Design concept maps in augmented reality according to the SMAPP prototype

The SMAPP prototype was created with the aim of offering an innovative and functional response to the needs of support teachers and the inclusive school community. The SMAPP prototype was developed using user-centered design principles, involving teachers and special education experts from the early stages to identify real operational needs, critical issues encountered in the use of traditional technologies, and expectations for new augmented interfaces. [7] The platform allows for the fluid creation of multimedia concept maps, their customization through AR modules, and sharing in virtual collaborative environments. Features such as automatic conversion of text into symbols or images, the integration of teaching suggestions, and the ability to access open resources have been designed to encourage the participation of students with different levels of autonomy and digital competence. Particular attention is paid to usability (ease, effectiveness, efficiency of the interface) and the subjective acceptability of the tool: training courses on its use, continuous feedback, and peer co-evaluation activities among teachers are therefore provided. The entire project is part of a broader reflection on the potential impact of AR-driven technologies in inclusive teaching practices, highlighting how advanced tools such as SMAPP can help transform schools into more equitable, flexible environments that are attentive to the needs of everyone.

4 Methods and materials

The participants are teacher enrolled in initial teacher training courses with a special focus on special education. The sample is composed of 75 participants that was trained in the use of the SMAPP application and authoring tools. Before the lessons the pre-service teachers replied to an ad hoc questionnaire on their knowledge of the augmented reality in education and the application of concept maps aimed at the inclusion of students with special needs.

In the second phase, the teachers had the opportunity to learn how to use SMAPP authoring tool in order to create a concept map empowered with AR paradigms. The design of the map and the digital artefact were applied using the Universal Design for Learning guidelines.

In the third phase the teachers presented their conceptual maps empowered by AR system and replied to a post test questionnaire with the scope to investigate the acceptability of the teachers and their beliefs in terms of inclusivity of the tools in their future work. In addition, the System Usability Scale is applied to check the usability of the tool. [8]

5 Results

The results show the teachers have a very poor knowledge of AR tools in education. Only a quarter of the participants provide examples of AR systems for inclusion, while their previous knowledge of UDL is relevant.

After the use of the application SMAPP, the participants considered as important the application and its potential in the inclusion in school for students with special needs. The usability with the SUS reported a good appreciation with more than the 70% of the participants that gave a results grater of 80 points, considered as a tool with an high usability (A class).

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Development in Pre-Service Teacher Training

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1 Introduction

Embodied cognition emphasizes that learning is grounded in action, perception, and emotional engagement [1]. From this perspective, meaningful knowledge construction depends on situated, lived experiences rather than decontextualized information processing. This perspective informs the design, use, and evaluation of serious games for developing transversal skills.

Building on this, we present a novel application of the SPA (Situated Psychological Agents) framework [2], framework focused on how embodied avatars in virtual role-play scenarios can foster the development of transversal soft skills. The SPA model conceptualizes learning as a situated process, where psychologically grounded avatars act within structured environments shaped by narrative, educational, and social feedback mechanisms. In pre-service teachers, embodied avatars mediate the development of transversal skills (conflict negotiation, assertive communication, and emotional regulation) through realistic, emotionally rich role-play.

2 Methods

This study introduces *Accord* and *Enact*, two serious games developed within the SPA framework to foster soft skills in pre-service teacher training through psychologically grounded role-play.

The design is based on theoretical models embedded in the SPA architecture, such as Rahim's conflict-handling styles [3] and assertive communication theory [4],[5] which guide learners' engagement in meaningful scenarios. Learners act through avatars modeled as situated psychological agents, whose behavior, based on psychological theories, is expressed via multimodal cues (e.g., voice, posture, gaze) to simulate real classroom dynamics [2]. Cultural scripts and social norms, shaped by institutional roles, are embedded to reflect authentic teacher-student interactions. Grounded in Activity Theory [6], the SPA model views learning as socially mediated through action and tools. Avatars function as mediators, enabling learners to engage in realistic interactions and reflect on professional behaviours. Integrating educational psychology and game studies, this design supports relational skill development through role-based simulation, now being implemented in Italian teacher training programs.

3 Expected outcomes

By embedding cognition, emotion, and behaviour into avatars, these environments foster engagement, empathy, and reflection. Learners actively participate in realistic scenarios, practicing communication, negotiation, and emotional regulation in safe settings.

We expect these environments to help learners become more engaged and reflective, while also supporting the transfer of soft skills such as communication, negotiation, and emotional regulation into real-world contexts. Practicing these competencies in safe, simulated settings can help future teachers feel more confident and better prepared for everyday interactions in classrooms and school settings.

This supports skill transfer to real classrooms and boosts teacher confidence. Prior research highlights how embodied role-play enhances perspective-taking, identity exploration, and learner agency, key for meaningful digital learning [7].

The feedback system is integrated into interaction in real time. This allows learners to receive immediate responses to their actions and better understand the consequences of their communicative and relational choices.

4 Conclusions

This study presents a scalable use of the SPA framework for soft skills training in teacher education. Through psychologically grounded avatars, learners engage in realistic role-play to practice communication, emotion regulation, and relational strategies. Grounded in embodied cognition and activity theory, this approach prioritizes meaningful learning over technology for its own sake. The next phase of the project will involve testing the games in real teacher training programs to better understand their educational value.

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AI Literacy and Universal Design for Learning in Secondary Schools: Teachers' Perceptions, Needs, and Perspectives for Inclusive and Intelligent Education

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1 Introduction

Artificial intelligence now permeates schools and demands a pedagogical, ethical and organisational reframing centred on human agency and learner variability as an educational asset [1]. Authorities acknowledge opportunities (personalisation, sharper feedback, genuinely accessible digital environments) and risks (data exposure, algorithmic opacity, systemic bias, technological dependence) [2], underscoring the need for a stable frame: the CAST UDL Guidelines for accessible, participatory, multimodal learning [3]. Despite advances in AIEd, a gap persists in pedagogical translation and secondary-teacher preparation [4], while AI literacy foregrounds the critical, conceptual and socio-ethical competencies required for inclusion-oriented use [5]. With K–12 standards, human–AI complementarity and system-level initiatives reshaping practice [6–7, 8–9], these strands converge on a key insight: AI literacy and UDL are mutually reinforcing axes enabling a paradigm of intelligent inclusion that couples didactic innovation with educational justice.

2 Objectives and Research Questions

This study has a dual aim: to understand secondary-school teachers' perceptions of AI and their training needs; to test whether UDL can translate these into accessible, personalised pedagogy; and to define a core set of AI-literacy competences for feasible professional learning. This raises three questions: What essential skills enable responsible use of AI? How do UDL principles guide tools, accessible materials, and assessment? What sustainable and scalable training architecture should be adopted, and what indicators should be used to measure its effectiveness?

3 Methodology

The study was developed in two phases. First, a systematic Scopus review (2015–2025) combined "AI" and "UDL" with descriptors for schools and teacher education, including only peer-reviewed studies explicitly linking AI, UDL and inclusion, and

excluding purely technical or non-educational works. The screening moved from title/abstract to full text, and reasons for exclusion were recorded. Data were extracted with a standard template (context, participants, AI tools, inclusive variables, UDL principles, teacher-education implications) and synthesised thematically regarding AIEd and UDL frameworks [4–6].
In parallel, an exploratory pre-test involved semi-structured interviews with Italian upper-secondary teachers, purposively sampled for variation in subject and seniority. The interview guide, derived from the review and AI-literacy/UDL constructs, explored representations, practices, opportunities and risks, UDL familiarity, and training needs. Interviews were collected with informed consent and anonymised, then examined using thematic analysis with an inductive–deductive coding approach; the codebook was refined to stabilisation, and analytic decisions were validated by consensus [10–13].

4 Discussion and Implications

Data and theory converge on two essentials: teachers' critical AI competence is a prerequisite for inclusion [1,2,5], and UDL turns intelligent tools into accessible, multimodal learning that lowers barriers and sustains motivation [3,6,14], with technology adding value when it amplifies rather than replaces teaching [7] amid a shift to personalised, UDL-oriented solutions [6,8,9,15]. Our pre-test shows uneven preparedness and limited UDL familiarity alongside a mature demand for training, supporting a targeted intervention. We therefore propose a scalable, modular pilot integrating AI literacy, UDL-informed design and human-AI complementarity to enable responsible, school-realistic adoption that aligns innovation with educational justice [1–3,7,10,14].

5 Conclusion

Combining AI literacy and Universal Design for Learning is a practical lever for turning technological innovation into educational equity [1–3]. Our exploratory pre-test with upper-secondary teachers shows willingness to learn but conceptual uncertainty and fragile UDL knowledge, pointing to targeted training that integrates critical, design and ethical AI competences within a UDL framework to steer accessible, personalised and evaluable practice [1–3]. Technology is most effective when it amplifies rather than replaces teachers' work—through timely analytics, intelligent tutors and calibrated adaptivity—in line with evidence on human–AI complementarity [7]. We therefore propose a modular, scalable pilot aligned with public standards to enable responsible adoption that couples learning-experience quality with protection of educational rights [1–3]. Limitations (sample size and context) guide next steps towards broader mixed-methods verification and impact evaluation on learning outcomes, accessibility, engagement and assessment; the ultimate aim is intelligent inclusion, with AI as a transparent, ethically supervised and pedagogically sound means that supports learner variability and strengthens teachers' professional responsibility [1–3,10–13].

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A Multidimensional Approach to Digital Inclusion: What Is the Impact of a UDL-Oriented ITS on Global Affect and Self-Efficacy?

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1 Introduction

This study investigates the effectiveness of a Universal Design for Learning (UDL) - oriented Intelligent Tutoring System (ITS) in comparison to a generic chatbot within a digital learning context. The focus is on how these systems influence users' global affect (emotional experience) and self-efficacy, with consideration given to users' digital competencies [1-2].

2 Methodology

2.1 Participants Experimental Design

The study employed a case/control experimental design with independent samples, involving 99 participants divided into the ITS group (n=44) and chatbot group (n=55).

2.2 System Architecture and Experimental Procedure

Two digital learning tools were developed for the study: a UDL-oriented ITS and a generic chatbot. Both systems leveraged recent natural language processing tools but differed in sophistication and adaptivity [3]. The ITS featured a modular structure (Student, Domain, Instruction Modules), designed to operationalize UDL principles and offer adaptive support. It incorporated customizable interfaces, language models for tailored explanations, and machine learning for dynamic content adaptation. The system ensured assistive technology compatibility and device-agnostic access [4-5].

In contrast, the chatbot provided standardized, non-adaptive interactions, acting as a control for evaluating the benefits of UDL-driven personalization. Its static architecture and lack of real-time adaptation highlighted any differential effects based on UDL implementation.

3 Results

Statistical analysis revealed that the ITS group experienced greater positive changes in emotional experience (global affect) compared to the control group, demonstrating the impact of adaptive, UDL-based design. Both systems received high usability ratings, but only the ITS showed differentiated effects in emotional response, particularly among those with lower digital competency.

4 Conclusion

The results have significant implications for designing Intelligent Tutoring Systems (ITS) grounded in the Universal Design for Learning (UDL) framework. The observed interaction between users' digital competencies and the effectiveness of the intervention underscores the importance of accounting for individual differences in technological proficiency.

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The Educational Role of Unplugged Computer Science Education: Approaches to Foster Active and Meaningful Learning, and New Perspectives for Teacher Training

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1 Introduction

In an era dominated by digital technologies, schools must adopt educational strategies that are both deliberate and culturally informed. Central to this is the teacher's role, evolving from content deliverer to cultural mediator who guides students in grasping core computer science concepts. Teaching computer science transcends technical skills, emphasizing thinking, communication, modeling, and critical reflection.

2 Reconceptualizing Primary CS Education

The aim of this training transcends mere operational skills, seeking instead to foster a paradigm shift: conceiving computer science as a discipline of thought and designing activities that cultivate transversal competencies—cognitive, cooperative, and emotional—in children. The unplugged activities proposed in this contribution support this shift by detaching computing education from exclusive dependence on digital devices, thereby restoring its autonomous and pedagogically meaningful nature.

3 Pedagogical Foundations and Efficacy of Unplugged Modalities

The proposed activities are conducted in unplugged and screenless modes, thus avoiding dependence on digital devices. This choice, grounded not only in practical considerations but also in sound pedagogical principles, supports embodied, manipulative, and social learning that stimulates logical reasoning through action [1]. In an era of increasing screen exposure, such activities constitute a healthy, inclusive, and sustainable educational alternative, consistent with international recommendations on children's health and development [2].

Given the strategic role of computer science in contemporary society, it is imperative that primary education offers meaningful opportunities for children to engage with its foundational concepts. The objective is to cultivate computational thinking skills—such as problem decomposition, pattern recognition, stepwise solution design, debugging, and strategy generalization—that transcend STEM disciplines and contribute to writing, logical reasoning, creative design, and civic education [3]. This contribution introduces educational activities that foster these principles through concrete, symbolic, and collaborative experiences, thereby highlighting the broader formative potential of computational thinking [4].

Furthermore, these learning activities are designed to promote active engagement by considering individual interests, learning rhythms, and emotional needs. Following Universal Design for Learning (UDL) guidelines, they allow wide operational freedom: once learning objectives are set, each child may choose the modes of engagement best suited to their personal characteristics. This approach fosters intrinsic motivation and autonomy, emphasizing choice optimization and self-determination, in alignment with the UDL framework [5].

4 Informal Learning and Cooperative Practices

The effectiveness of these strategies is amplified when implemented in informal settings such as robotics labs and computational thinking workshops, which foster cooperative, experiential learning through action and peer interaction, and shared meaning-making [6] [7] [8] [9].

Observations collected during screenless educational robotics activities held in summer camps with primary school children further support this, highlighting how such contexts naturally promote engagement, motivation, and collaboration.

While these preliminary findings areencouraging, rigorous empirical validation remains necessary. Future research should prioritize longitudinal, mixed-method studies combining quantitative assessments (e.g., pre/post-tests on computational thinking) with qualitative insights (e.g., interviews, observations).

Such long-term evaluations are crucial to assess the sustained cognitive, emotional, and social impact of unplugged activities, and to guide ongoing improvements in activity design and teacher training aligned with evolving educational needs.

5 Theoretical Perspectives and Emotional Dimensions

From a theoretical standpoint, the activities are inspired by a learning model that integrates semiotic mediation, situated didactics, and cognitive diversity. Reference to Sternberg's triarchic theory of intelligence [10] allows us to interpret these experiences as stimuli for all three dimensions of intelligence: analytical, creative, and practical. Unplugged activities are particularly effective in enhancing creative and practical intelligence, often overlooked in traditional settings.

Special attention is paid to the emotional and relational dimensions of the educational experience. The proposed activities encourage personal reflection and social awareness, promoting empathetic attitudes, respectful behavior, and restorative practices within the group (UDL 9). Consequently, they contribute to the construction of a safe, inclusive, and welcoming learning environment—an essential condition for deep, authentic, and lasting learning.

6 Teacher Training Implications

For teachers, this approach offers an opportunity to renew educational practices by promoting a vision of digital education that is not technocentric but culturally grounded, accessible, and thought-oriented. Teachers become pivotal figures in the educational process: through negotiation of meaning, verbalization of processes, analogies, and metacognitive reflection, they guide students in the active construction of knowledge. However, the successful implementation of this approach requires appropriate, well-structured training. It is essential to prepare educators to integrate computer science into everyday teaching in a sustainable, accessible, and pedagogically sound way.

7 Conclusion

Computer science plays a strategic role in contemporary education. Offering children the opportunity to explore its conceptual foundations from an early age means equipping them with powerful cognitive tools. Unplugged activities represent an inclusive and meaningful way to foster computational thinking, not only as a technical skill but as a broader educational approach that supports strategic, creative, and critical engagement with complexity.

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Embodied Cognition, Adaptive AI and *Universal Design for Learning*: Towards Hybrid Educational Models for Inclusive Learning

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1. Embodied Cognition and Inclusive Education

1.1 Cognition from sensorimotor processes

In the context of Universal Design for Learning (UDL) [1] and the increasing use of Artificial Intelligence (AI) in education, it is crucial to consider the embodied and motor foundations of human cognition. Evidence from neuroscience and cognitive science shows that cognition arises from sensorimotor processes: action and movement often precede and structure thought [2,3,4]. Human learning has evolved in complex physical and social contexts, where object manipulation, bodily interaction, and spatial exploration have shaped abstract thinking [5].

AI-based educational systems that neglect these embodied dimensions risk creating evolutionarily mismatched learning models [6], potentially undermining motivation, attention, well-being, and deep understanding. While adaptive feedback and cognitive personalization offer valuable tools, they often overlook the essential role of movement and physical engagement in concept formation. This mismatch may lead to learning experiences misaligned with the biological and cognitive architecture of the human mind.

1.2 Inclusive education

Research in neuroscience and cognitive science shows that cognition is not purely abstract or symbolic, but closely linked to perception, bodily action, and interaction with the environment. Studies on mirror neurons [2] and embodied cognition [5,7,8] highlight how learning and reasoning are grounded in sensorimotor experience. Theories like the "primacy of action over goal" [9], "thought as movement" [10], and the cognitive role of spatial structures [11] reinforce this view. Learning models that ignore these aspects may impair engagement, motivation, and depth of understanding [6]. Embodied cognition has also been applied to complex domains such as physics and numerical thinking [12].

These insights are especially relevant for inclusive education. Students with diverse cognitive profiles or disabilities often rely on bodily and spatial interaction to build meaning. If AI-based education focuses only on symbolic or cognitive levels, it risks marginalising these learners. On this basis, we propose an experimental model combining embodied cognition, conceptual engineering, and adaptive AI within the Universal Design for Learning framework. It supports concept acquisition by linking bodily experience with AI-assisted conceptual analysis, uniting sensorimotor grounding and metacognitive development.

2. Embodied cognition and adaptive AI in UDL framework

The model is organised into four phases: Embodied Exploration (EE); Conceptual Elaboration (CE); Central Interactive (CI); Emobodied Restitution (ER), which are fully described in Table 1.

Table 1. The four phases of the experimental educational model (1:EE; 2: CE; 3: CI; 4: ER) are grounded in embodied cognition, supported by AI technologies, and structured according to the principles of Universal Design for Learning [UDL, 13].

	Objective	Method	Conceptual Framework	UDL Principles
1	Introduce abstract concepts through physical exploration.	Students perform simple exercises activating sensorimotor metaphors. Focus on mathematical concepts [14].	Embodied cognition theory [4,15]. Sensorimotor experience supports abstract thinking.	Engagement: - Physical interaction promotes motivation overcoming cognitive/cultural barriers [16]
2	Refine students' conceptual understanding.	AI tools perform semantic analysis of student-generated definitions and reflections. Provide personalized feedback.	Promotes metacognition and conceptual clarity. Translates content into accessible formats.	Representation: Adapts materials to individuals' linguistic and cognitive abilities.
3	Deepen students' reflection providing dynamic support.	AI continues to offer semantic suggestions and alternative metaphors. The teacher is central: - Coordinates activities, interprets feedback, and guides student discussions.	3 way interaction: Student - Own Body Student - AI system Student - Teacher	Action & Expression: -Multiple means of action and expression through mediated interaction and reflection.
4	Consolidate learning through embodied representation.	Students physically or spatially represent revised conceptual structures, using gestures or physical models.	Reconnecting symbolic understanding to bodily experience strengthens memory processes [17].	This approach aligns with UDL: combining theory and practice, recognizing the importance of the embodied nature of knowledge.

3. Conclusion: a mixed environment approach

By integrating AI's analytical capabilities with embodied educational strategies, this model seeks to overcome the limits of disembodied digital learning. It promotes a more inclusive and cognitively grounded approach that reflects the dynamic interaction between mind, body, and environment. In conclusion, this proposal contributes to the debate on AI in education by advocating hybrid pedagogies that go beyond digital replication of traditional methods. It combines insights from cognitive science and technological innovation within the UDL framework. Rather than replacing teachers or embodiment, AI should enhance their interplay, supporting learning that engages the full spectrum of human cognition.

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Artificial Intelligence and Machine Learning in Physical Education and Sports

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1 Introduction

Artificial Intelligence (AI) and its subset, Machine Learning (ML), have transformed multiple sectors, from healthcare and finance to education. In recent years, university-level physical education (PE) and sports science have begun exploring AI's capacity to revolutionize pedagogical approaches, student monitoring, and performance evaluation.

Unlike traditional physical education, which often relies on observational assessments and uniform instruction, AI systems can process vast datasets from wearables, motion-capture systems, and learning management systems. These tools are particularly valuable in higher education, where student heterogeneity and class sizes challenge individualized attention. The COVID-19 pandemic further accelerated the adoption of AI-driven tools in physical education, with virtual learning environments and remote monitoring systems stepping in to sustain educational continuity.

Yet, this integration of AI in university PE is still emerging. Educators and researchers face critical questions: What pedagogical value do ML tools provide? Do they enhance student outcomes? How do they influence teaching practices, and what are their broader implications for health, motivation, and equity?

This study presents a systematic review of peer-reviewed literature from 2019 to 2024 on the application of ML in university-level PE and sports and aims to offer a comprehensive understanding of the current landscape and identify directions for future inquiry.

2 Materials and methods

This review follows the PRISMA 2020 guidelines to ensure methodological transparency and replicability. Electronic databases (Scopus, Web of Science, PubMed) were searched using keyword combinations: “machine learning,” “artificial intelligence,” “physical education,” “sport,” “university students,” and “higher education.” Searches were limited to peer-reviewed journal articles published between January 2019 and March 2024 in English.

Thirteen results met the inclusion criteria and were analyzed in depth.

A structured coding framework was used to extract data on study design, sample characteristics, ML algorithms, intervention contexts, and educational outcomes. A thematic synthesis was performed to identify common patterns across studies. No meta-analysis was conducted due to heterogeneity in design and measurement tools.

3 Results

The 13 included studies span various educational contexts across China, Korea, and parts of Europe. Sample sizes ranged from 100 to over 1,000 university students. Physical activities included fitness training, general PE classes, sport-specific programs, and virtual or remote activity modules.

Enhancing Student Engagement and Learning

Several studies leveraged ML to monitor and predict student engagement levels. Zhang et al. (2025) used ensemble ML models to evaluate how digital tools influence student motivation in physical education classes. The model identified key mediating variables such as perceived usefulness and self-efficacy. Shin et al. (2021) introduced a virtual PE environment where students participated in gamified motor tasks, with real-time movement recognition ensuring continued engagement during remote learning.

Personalizing Physical Training and Performance Optimization

Ge (2025) developed a multi-stage ML platform integrating wearable data, fitness diagnostics, and a reinforcement learning-based recommendation engine. This system generated customized training plans based on real-time performance data. Li & Li (2022) applied neural network algorithms to prescribe personalized exercise regimens for students with diverse physiological profiles, resulting in improved health outcomes and increased satisfaction.

Supporting Teaching Practices and Evaluation

Other studies emphasized ML’s potential to assist instructors. Wang et al. (2024) introduced a support vector machine (SVM) model within a VR classroom to assess motor performance. Cao et al. (2021) implemented a multi-modal IoT and ML system to provide real-time analytics and feedback for both students and educators, enhancing curriculum design and instructional responsiveness.

Cross-Study Outcomes

Reported educational benefits included: - Increased physical engagement and class participation - Improved motor skills and physical performance metrics - Enhanced data-driven instructional planning - More objective student assessment and real-time feedback. Challenges reported across studies included technology access barriers, user resistance, and the need for specialized training for instructors

4 Conclusion

The integration of machine learning (ML) into university physical education presents significant pedagogical opportunities, enabling personalized learning even in large classes. AI-driven tools support differentiated instruction through performance data analysis, enhancing both teaching effectiveness and student autonomy. However, ethical and practical concerns must be addressed. Current research is limited by small sample sizes, regional focus, and a lack of rigorous experimental design, highlighting the need for broader and more robust studies. With thoughtful integration, ML can contribute to a more effective, equitable, and innovative educational environment.

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Digital skills for inclusion: research with teachers in training

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1 Introduction

Creating inclusive environments is a priority in education to implement accessible and equitable teaching. It is also a fundamental objective for teachers, who must design learning experiences that enhance everyone's potential. Inclusion goes beyond responding to special educational needs; it is a pedagogical approach that values diversity, promotes active participation, and supports the educational success of all students [1]. Digital teaching methodologies are playing an increasingly central role in this scenario by offering tools and strategies that personalize learning, facilitate access to content, and stimulate peer collaboration [2,3]. Integrating technology into teaching is not merely an instrumental innovation but a structural element of educational design that can redefine educational practices to be more equitable, flexible, and student-centered. The growing complexity and diversity of classrooms require teachers to transform their practices profoundly, focusing on equity, accessibility, and valuing differences. From this perspective, inclusive environments cannot be created through compensatory or specialized interventions alone; they must be designed to be universally accessible to promote meaningful learning for all. The Universal Design for Learning (UDL) framework, developed by CAST (Center for Applied Special Technology), offers a well-established theoretical and methodological foundation based on three core principles: providing multiple modes of engagement, content representation, and expression/learning. The evolution of digital technologies, particularly the emergence of generative and predictive artificial intelligence, opens up new possibilities for personalizing learning paths, monitoring progress, automatically producing adaptive materials, and analyzing educational needs [4]. However, integrating these tools into academia requires critical pedagogical skills, ethical reflection, and awareness of their impact on inclusion.

2 Research

The research is part of the Special Education course in teacher training programs. A sample of 194 trainee teachers was divided between the humanities (85 participants) and science (109 participants). The aim was to explore teachers' representations and experiences of building inclusive contexts through the use of digital methodologies [5] Data were collected via a specially designed questionnaire shared on the Qualtrics platform to gather perceptions, experiences, and training needs regarding the use of educational technologies for inclusion. The qualitative, phenomenological hermeneutic methodological design, inspired by the work of Max van Manen (2007), allows for the investigation of lived experience and its meaning through the subjective interpretation of the participants. The narrative texts collected were analyzed using NVivo software, which allowed us to systematize reflections, identify recurring themes, and construct a conceptual map based on the core categories that emerged [6,7].

3 Conclusion and Results

The analysis revealed that digital teaching methodologies are perceived by teachers as an effective means of promoting inclusiveness in school settings. The results suggest that adopting such methodologies, guided by sound pedagogical reflection and accompanied by adequate training, can substantially contribute to creating equitable, motivating, and inclusive learning environments. Consequently, technology not only enhances teaching effectiveness, but also becomes a true pedagogical mediator capable of transforming educational practices and promoting a school that is attentive to students' individual needs while fostering an inclusive and participatory educational community.

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The school tutor to support teacher training

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1 Introduction

Initial teacher education is a pivotal phase for the construction of professional identity and preparation for complex school contexts. In Italy, the recent teacher qualification pathways of 60 and 36 ECTS credits (DPCM, 4 August 2023) offer an opportunity to reinforce the integration of pedagogical theory and teaching practice [1, 2]. Within these pathways, school placements play a central role, enabling prospective teachers to engage directly with the educational environment. The school tutor emerges as a key figure in supporting this process, facilitating the trainee's induction into the school community, and guiding them in the planning and reflection on teaching–learning processes [3-5]. In the Italian system, the school tutor is an experienced in-service teacher, appointed by the school principal, who directly supports trainees in the classroom by guiding their practice, monitoring their induction, and providing continuous feedback.

In increasingly heterogeneous school contexts – characterised by a growing presence of students with Special Educational Needs, Specific Learning Disorders and demands for inclusive teaching – the tutoring of newly qualified teachers calls for new competences and innovative tools. From this perspective, the integration of digital technologies [6], the principles of Universal Design for Learning [7] and the potential of Artificial Intelligence [8] can contribute to making the school placement experience more accessible, flexible, and effective.

2 Research aims

This study, building on previous research into teacher identity in initial training [9, 10], aims to explore the profile and practices of the school tutors engaged in the qualifying pathways offered by the e-Campus University. In particular, it seeks to: a) analyse the methods of mentoring used with trainees, the quality of the relationships established and the tools employed; b) identify the professional development needs perceived by tutors, with particular attention to inclusive pedagogy and the use of digital technologies; c) gather recommendations to enhance the tutoring system, also with a view to a more systematic adoption of strategies inspired by Universal Design for Learning and AI-based solutions.

3 Methodology

The study adopts an exploratory–descriptive design, centred on administering a structured digital questionnaire (QuestionPro) to school tutors. The instrument consists of 28 questions, of which 27 are closed items (multiple-choice and Likert scale questions) and 1 is open-ended, designed to elicit reflective observations. The questionnaire draws on established instruments already used in previous research, ensuring conceptual coherence with the existing literature. To strengthen its reliability, the instrument underwent expert review validation before administration. The target population consists of school tutors operating in secondary schools affiliated with e-Campus University. Data, currently being collected, will be analysed using statistical processing and text-analysis tools, with full guarantees of participant confidentiality and anonymity.

4 Expected results and implications

The study aims to provide an up-to-date overview of tutoring practices within the qualifying pathways, identifying recurring challenges and potential levers for improvement. It is anticipated that tutors will express specific professional development needs regarding the use of digital tools and inclusive strategies. In particular, the investigation will explore: a) levels of familiarity with UDL principles and the difficulties encountered in applying them within school contexts; b) interest in intelligent technologies capable of generating personalised feedback, supporting lesson design and adapting to trainees' needs; c) insights for the development of continuous professional development programmes for tutors, based on collaborative and adaptive digital environments.

From a theoretical perspective, the findings will enrich the discourse on the role of the school tutor as a facilitator of innovation and a promoter of inclusive practices in initial teacher education.

5 Conclusions and future directions

This contribution provides empirical evidence to characterise the tutor's role in the training of future teachers, promoting more effective mentoring models underpinned by inclusive technologies. The expected findings will form the basis for the design of interventions and the development of operational guidelines for the continuous professional development of tutors, with an emphasis on innovation and the capacity to respond to change.

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Design Experiences in Teaching Educational Technologies for Inclusion

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1 Introduction

Digital technologies play a crucial role in supporting teaching practices, particularly when integrated within an inclusive educational framework [1]. To foster a participatory and inclusive school environment, it is essential that teachers design instructional materials tailored to the needs of students with special educational needs (SEN). Digital tools represent a valuable resource for the development and implementation of adaptive teaching strategies [2]. Information and Communication Technologies (ICT), along with Artificial Intelligence (AI), are particularly effective in supporting SEN students. For example, AI-driven real-time captioning can support deaf students [3], text-to-speech systems help learners with reading difficulties [4], and automated image recognition and description tools facilitate access for visually impaired students [5]. Moreover, AI-based emotional recognition systems and intelligent tutoring technologies offer support to students with emotional, cognitive, or learning disabilities, as well as attention disorders. These tools can help manage stress and anxiety while providing cognitive and behavioural support in an accessible format [6, 7]. The literature also highlights the efficacy of serious games in improving learning outcomes and student engagement, particularly when their features are adapted to meet the needs of learners with disabilities [8]. Finally, AI-powered wearable devices and social robots are increasingly being used to assist students with physical disabilities and those on the autism spectrum, offering both educational and social support [9].

This paper aims to explore the use of technology in designing an inclusive learning unit (ILU) by analysing the final projects produced by students enroled in the course Educational Technologies for Inclusion, part of the Master's Degree in Primary Education at the University of Pisa. The ILU refers to a set of teaching activities, often transdisciplinary, organised around a common theme and carried out over a variable period using a range of tools and methods. As part of the course requirements, students must integrate one or more educational technologies (ET), including AI-based tools chosen from those introduced during the course. Although the choice of content, methods, and structure of the ILU is left to the students, each project must be designed for a class including at least one

SEN student. The course instructor provides each group with the Individualised Education Plan (IEP) of the assigned SEN student. The IEP, developed for each student, offers an in-depth analysis of key environmental and personal factors, such as relationships, socialisation, communication, and autonomy, which are essential for planning effective and inclusive educational interventions.

2 Methodology

This study investigates how university students use digital tools, particularly AI, to design ILUs tailored to specific SEN. The research is structured in two main phases, each guided by a specific question. In the first phase, a descriptive analysis is performed to explore how students integrated educational technologies in response to the assigned SEN profiles. Each group was required to design an ILU for a hypothetical classroom scenario that included at least one student with SEN. This phase is guided by the following research question. RQ1: How did student groups use educational technologies to design inclusive LUs in response to the specific SEN assigned to them? The second phase introduces a comparative dimension, focussing on student groups working with the same type of SEN. Specifically, it examines differences between groups that integrated AI tools and those that used only non-AI educational technologies. This phase is guided by RQ2: In what ways was AI used in the process of creating the ILU, primarily as a co-designer tool (e.g., using AI to structure inclusive and accessible activities) or a creative one (e.g., generating songs, stories, or other materials)?

3 Preliminary Results

In relation to RQ1, a preliminary analysis of 30 final projects submitted during the exam session reveals distinct patterns in the use of educational technologies based on the specific SEN. For students with visual impairments, the most frequently used tools were QR codes, Navilens, Book Creator, Makey Makey, and Wordwall. In cases of paraplegia, LearningApps and Wordwall were primarily used. For students on the autism spectrum, the preferred tools included LearningApps, Widgit, and Wordwall. These choices suggest a general tendency to rely on tools that support interactivity, personalization, and visual reinforcement, tailored to the type of SEN. With respect to RQ2, the initial findings indicate that AI was used primarily as a creative tool. Students used AI applications to generate songs, rhymes, images, and videos to enrich their ILU. However, the analysis suggests that AI remains largely underutilised, with its full potential as an educational resource yet to be explored. In most cases, AI was employed as a content generator. This suggests further investigation of the role of AI in inclusive educational design. Future research should explore the potential of AI as a co-designer in creating inclusive activities. Recent studies investigate this direction by experimenting with prompt engineering techniques to train teachers in more purposeful and effective uses of AI in educational settings [10].

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Integrating AI-Supported Strategies into Foster Inclusive Learning Environments in International Higher Education: A Conceptual Analysis

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1 Research Context and Objectives

The fast development of artificial intelligence (AI) offers a revolutionary prospect for overcoming educational barriers and achieving inclusive mobility in international higher education learning goals. While diverse student populations face challenges related to accessibility, cultural responsiveness, and personalized learning support, AI-driven approaches present innovative solutions to create more equitable educational experiences [1,2].

The given conceptual analysis is devoted to the field of AI technologies and inclusive education, and how AI-driven tools can be utilized to meet diverse learner needs due to linguistic, cultural, cognitive, and physical aspects [3,4].

2 Theoretical Framework and Three-Dimensional Model

Based on the interdisciplinary studies of literature in educational technology, accessibility studies, and global policy frameworks, this paper will develop a three-dimensional conceptual framework according to which AI is used as a tool and learning environment [5,6]. The framework highlights such features of inclusive practice as adaptive learning, the use of assistive technology, collaboration via AI, and immersion in digital environments [7].

The three-dimensional (3D) model, proposed here, will conceptualize the integration of AI in higher education, considering three interdependent dimensions, namely (1) Functional Dimension - using AI in pedagogical practice as a tool that promotes adaptive learning, assistive technologies, and AI aided collaboration; (2) Experiential Dimension - the use of AI as a learning environment that offers immersive experiences, interactive experiences, and culturally responsive digital space; (3) Equity Dimension - enhancing equity (inclusion) by meeting the systemic challenge to address algorithmic bias.

When united, the dimensions provide a comprehensive model with which to design globally equitable learning environments that are also technology-enhanced in international higher education.

3 Conclusion

This study addresses critical systematic issues including algorithmic bias, the digital divide, and ethical concerns, proposing targeted interventions such as faculty training, the implementation of Universal Design for Learning (UDL) principles, and equitable policy formation to support immersive and encompassing pedagogy [8]. The research provides significant theoretical and practical implications by offering a comprehensive framework that can guide institutional leaders, teachers, and policymakers in utilizing AI to develop equitable learning models responsive to diverse global challenges. Future research directions involve empirical examination of the proposed model across various global contexts, with particular emphasis on resource-constrained environments and underserved communities.

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Special Track 7

Human rights-based approach and practices for preventing and countering online hate speech: digital strategies

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Hatedemics: An AI-Enhanced Platform and Educational Toolkit to Counter Online Hate

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1 Hatedemics

This study presents the objectives, methodology, and preliminary outcomes of Hatedemics (2024–2026), a CERV project aimed at countering online hate speech and disinformation through the Hatedemics AI-powered digital platform and a participatory educational approach [1]. With 13 partners across five EU countries (Italy, Malta, Poland, and Spain, as well as Estonia and France), Hatedemics unites techno-logical innovation with human-rights and fact-checking based educational approach to foster digital literacy and civic engagement, particularly among young people and educators in both formal and non-formal educational settings.

This contribution focuses on the project's implications for Higher Education and how its methodologies and tools can enhance teaching, training, and counter-narrative strategies across the EU.

The main focus of the project is the Hatedemics Platform - an AI-driven tool that provides multilingual counter speech suggestions based on fact-checked and human rights-oriented content.

Through stakeholder focus groups, co-creation workshops, and expert interviews in the four pilot countries (Italy, Spain, Poland and Malta), the project has identified key pedagogical challenges, such as generational gaps between educators and students, lack of co-creation practices, limited media literacy focused activities, and low awareness of the real-world consequences of online harm.

This preparatory phase ensured platform usability across cultural and linguistic contexts and gathered innovative educational solutions (for e.g., joint learning path-ways for students and parents to analyze disinformation and hate speech narratives using the platform collaboratively).

The platform hence addresses both the needs of educators working with young people, as well as those of NGO/CSO operators, media professionals, public authorities, and young activists, as it allows them to monitor and analyze online content (by mapping Telegram channels), identify potential threats, and generate context-sensitive counter speech.

It currently supports five project languages (English, Italian, Maltese, Polish, and Spanish), with potential to expand to other languages. It is complemented by a tailored educational toolkit that aims to support educators who want to integrating counter-hate speech simulations and digital literacy modules into their educational curricula.

Hence, Hatedemics offers pedagogical guidelines for the incorporation of AI tools and activities into curricula to foster media literacy, digital ethics, civic education, and teacher training, as well as a possibility to research harmful narratives online and understand the connection between different channels that spread hate speech, disinformation and conspiracy theories.

The project embeds legal, ethical, and gender-sensitive assessments, complying with the EU AI Act [2], and is focused on cross-sector cooperation between NGOs/CSOs, universities, media, and public institutions, as recommended by the Council of Europe's Recommendation CM/Rec (2022)16 [3]. Subsequent paragraphs, however, are indented.

2 Conclusion

In summary, Hatedemics demonstrates how ethically designed AI technologies can be integrated into pedagogical process in order to empower educators and students to critically address online hate and disinformation, and into research process by mapping out the connections and main narratives of the channels on fringe social media platforms such as Telegram.

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The “Mappa dell’Intolleranza” Project

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1 Background and history of the "Mappa dell’Intolleranza" Project

The “Mappa dell’Intolleranza” project – conceived by Vox – Italian Observatory on Rights, in collaboration with the University of Milan (Department of Italian and Supranational Public Law), the University of Bari “Aldo Moro”, the Catholic University of Milan (sociology department "ITSTIME") and the University of Rome “La Sapienza” – aims to map online hate on social media, particularly on X (formerly Twitter). The goal of the project, now in its ninth edition, is to provide a tool for understanding the dynamics of online hate, to develop theoretical reflections on hate speech and the phenomenology of hatred, and to create effective prevention projects in terms of applied research.

2 The Eight Edition of the Project

2.1 Context

The eighth and most recent edition of the Map of Intolerance – which was supported by Vox Diritti, the University of Milan (Department of Italian and Supranational Public Law), the University of Bari “Aldo Moro” and saw the participation of new partners and research teams such as the “Giovanni Degli Antoni” Department of Computer Science at the University of Milan, the “Human Hall” research center (University of Milan), as well as support from “The Fool” – analyzes the spread of hate speech online through the extraction and geolocation of tweets on X containing sensitive keywords.

As in previous editions, tweets are divided into six categories: misogyny, antisemitism, Islamophobia, xenophobia, ableism, and homo-transphobia. This edition also made use of large language models (LLMs) to identify the impact of negative stereotypes on the formation and dissemination of hate speech. Beyond understanding how hate manifests across different Italian cities and how it affects the six target categories, the analysis also investigates the viral potential of discriminatory discourse on social media.

2.2 Results

Regarding the scale of hate phenomena, the data collected between January and November 2024 show a significant increase in antisemitism, along with a rise in xenophobia and Islamophobia. Women account for 50 percent those targeted by hate speech. In the case of misogyny, 20.81 percent of discriminatory content is produced by women themselves, suggesting instances of self-objectification. Thanks to this new edition of the Map, it was possible to study the factor of intersectionality, which is gaining increasing relevance in anti-discrimination policy studies. From a geolocation standpoint, the analysis confirms a greater incidence of hate in large cities: Milan stands out for misogyny and xenophobia, Rome for antisemitism and homo-transphobia.

For the first time, the project also revolves around the relationship between hate speech and stereotypes. The latest edition of the Map of Intolerance sheds light on both the definitions of hate speech and stereotypical language, and the tools that law or culture can deploy in response—encouraging reflection on the Council of Europe Recommendation CM/Rec(2022)16.

2.3 Discussion

In summary, several trends emerge from the latest edition of the Map of Intolerance:

- the central role of echo chambers on social media;
- the impact of negative stereotypes, and thus certain cultural configurations, on the formation and dissemination of hate speech.

a growing verticalization of online hate;

Following the mapping, there is an increasing need to:

- reflect on the link between stereotypes and hate speech;
- consider intersectional discrimination;
- envision, from a legal standpoint, new tools to counter hate speech beyond existing laws and policies;
- develop educational strategies (e.g., counter-narratives) for the use of social networks, rethinking the relationships between mass media, social platforms, and users, in order to prevent increasingly radical forms of hate. In this regard, in terms of practical and educational results, it should be noted that the project was the subject of work experience activities, teaching young people how to use social networks responsibly.
- reflect on the relationship between individual rights protection and techno- logical innovation, especially in light of AI.

With regard to the academic context, the project was presented at the University of Milan to students, professors, and civil society. In addition, students had the opportunity to learn about the project during classes and while writing their theses on the protection of fundamental rights.

3 Conclusion

In conclusion, the planned presentation will consist of a description of the Map of Intolerance project, the research directions just outlined, and the practical outputs derived from using the Map at the local and academic level.

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Critical Digital Literacy in Higher Education: Methods and Tools

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1 Introduction

In the current digital media ecosystem—where algorithms shape content curation and social platforms dominate the flow of information—young people, who increasingly rely on these platforms for news, learning, and social interaction, face a growing range of risks. Algorithmic personalization, filter bubbles, and echo chambers not only narrow their exposure to diverse perspectives but can also distort their understanding of social, political, and scientific realities. This distortion contributes to the formation of biased worldviews and reinforces stereotypes, often without users being fully aware of the underlying mechanisms. One of the most concerning consequences of this digital environment is the increased exposure to harmful content, including online hate speech, disinformation, and cyberbullying. Hate speech, in particular, has become a pervasive issue, amplified by the speed and reach of social media platforms. It targets individuals and groups based on race, gender, religion, sexual orientation, or migration background, fostering hostility, social division, and sometimes even offline violence. The normalization of such language online can desensitize younger users, gradually lowering their critical resistance to intolerance and discrimination.

Moreover, the lack of proper moderation and accountability mechanisms on many platforms allows hate-driven narratives to proliferate unchecked, often under the guise of freedom of expression. This creates digital environments that are not only unsafe but also detrimental to democratic dialogue and inclusive participation—values that educational institutions have a responsibility to uphold.

Given these challenges, it becomes increasingly urgent for higher education—particularly within the domains of media studies, digital humanities, and communication science—to implement structured pathways in critical digital literacy. These should not only address methodological and theoretical aspects, but also provide access to digital tools that enable students to critically examine the structures behind online information flows, as well as the technical skills required to use these tools effectively. Such programs are essential for empowering students to engage with digital content in informed, responsible, and analytically rigorous ways.

In this paper, we present a selection of tools which have proven to be particularly effective from an educational perspective and, when accompanied by appropriate technical training, can be successfully integrated into higher education to support the goals of critical digital literacy outlined above.

2 Theoretical and Pedagogical Foundations

This paper draws on multiple theoretical traditions. Critical digital pedagogy (Selwyn, 2016; Stommel, 2014) encourages educators to uncover and challenge the assumptions embedded in digital technologies. Data epistemologies (Kitchin, 2014) emphasize the need to understand how data is generated, structured, and interpreted. These perspectives align with the broader goals of media and information literacy (UNESCO, 2021), which seek to empower individuals to critically access, evaluate, and produce information in increasingly mediated environments. This critical stance also resonates with recent interdisciplinary inquiries into the evolving relationship between media trust, journalistic authority, and AI-driven content curation within platform-based media ecosystems, which highlight the urgent need to reframe algorithmic systems not only as technical infrastructures but as cultural and epistemic forces (Fulantelli et al., 2025).

Furthermore, digital citizenship frameworks argue that critical engagement with digital content is fundamental to democratic participation (Mihailidis & Thevenin, 2013). In this view, students are not merely consumers of content but actors capable of questioning, remixing, and reshaping digital narratives. Embedding such models into academic curricula enhances not only student skills but also the ethical and civic dimensions of digital literacy.

3 Methodologies and Tools to Support Critical Engagement

Several methodologies and technological tools can support the implementation of critical digital pedagogy in higher education. Project-based learning, inquiry-based learning, and experiential methods are particularly suitable. These approaches encourage learners to investigate real-world problems, develop research questions, and engage directly with digital environments. Educators can scaffold these activities using both digital and non-digital instruments. Among non-digital tools, traditional media literacy frameworks and debate-based pedagogies remain relevant, especially when combined with analysis of current events.

Digital tools, on the other hand, offer enhanced opportunities for active engagement. Examples include: data annotation platforms like Hypothes.is for collaborative textual analysis; browser-based tools such as CrowdTangle for social media monitoring; digital storytelling platforms like Twine and StoryMapJS; visualization tools such as Tableau Public and RAWGraphs; and code-free text mining platforms such as Orange or Voyant Tools.

Within this ecosystem of practices, the authors have developed a set of open-source tools designed to collect, structure, and analyze web data from multiple sources. These data pipelines, built by using different open source tools such as Miller, visdata, jq, and GDAL/OGR, were initially conceived as instruments for media analysis and research within the framework of the project TASKs - Trust and Authority in the Context of Knowledge and News. However, they have demonstrated significant educational potential in higher education settings, particularly in courses focused on digital methods, media analysis, and journalism.

In academic programs that aim to investigate digital media, journalism, and communication, these tools can serve as real-world infrastructures for hands-on exploration. Specific training programs on the use of these technologies would enable students to learn how to collect news and user data from different sources such as: RSS feeds, YouTube, Instagram, TikTok, and leveraging these pipelines to apply techniques like sentiment analysis and named entity recognition. Clearly, introducing technological concepts into disciplines that lean toward more humanistic themes is not a simple process. At the same time, as discussed in the introduction, the current digital media ecosystem can no longer overlook the need for these kinds of competencies. Pathways in critical digital pedagogy are essential for students, as they help strengthen their understanding of how digital content is shaped, manipulated, and consumed. The use of open-source software promotes transparency and skill transfer, enabling students to become autonomous analysts and critical readers of data.

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Detection Practices of Hate Speech: A University e-Tivity Case Study

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1 Hate speech: “ambiguous but useful” category

Contemporary forms of hatred (hate speech) encompass a broad spectrum of behaviours, yet common features unite them, particularly concerning the social and psychological dynamics that drive human hostility, which can vary individually. Understanding these dynamics is essential for a non-naïve or overly idealistic education that addresses and challenges these phenomena within their cultural, social, and political contexts [1]. In the social web various forms of hate speech and flame wars (flaming) are experienced, amplified, and sometimes countered. These flame wars are marked by the violent polarization of viewpoints, where personal attacks overshadow the content of debates, diverting attention from the issue at hand [2].

Within the field of Hate Studies [3], the definition and boundaries of "hate speech" remain contested, as various disciplinary approaches often diverge in their interpretations. It is an “ambiguous but useful category” [4]. This ambiguity also emerges in research employing algorithmic automation for hate speech detection [5].

A useful definitional framework is CM/Rec(2022)16 by the Committee of Ministers of the Council of Europe (132nd session), which categorises hate speech into three distinct categories, each requiring different responses and measures. The third level concerns cases that fall outside the scope of criminal or administrative liability, yet “can nevertheless cause or amplify prejudice, intolerance and hatred, raise concerns in terms of tolerance, civility, inclusion and respect for the rights of others, and threaten social cohesion and democratic stability” [6]. The decision to include this third level, which we might refer to as the ‘citizenship’ level, in the definition of the phenomenon has important implications for countering online hate and call for a media and educational approach [7]. Accordingly, higher education will be examined as a pedagogical space in which, consistent with the disciplinary orientations of academic programmes, this kind of sensitivity can be meaningfully cultivated.

2 Case Study: An e-Tivity Designed within an Information Literacy Course

The case study presented focuses on the e-tivity conducted during the academic years 2023–2024 and 2024–2025 within the *Information Literacy* course of the Master's

Degree in Media Education (LM-93) at the Catholic University of the Sacred Heart in Milan.

Students were asked to carry out a research and recognition task focused on identifying cases online hate speech on TikTok, within the broader polarised discursive landscape of the current conflict in Palestine (diverse groups targeted). In addition to a first-level evaluation of whether the content could be considered hateful or not, students were required to conduct a media analysis of TikTok videos and subsequently apply the "Online Hate Spectrum" – an interpretive framework developed through research conducted by the Mediavox Observatory at the Catholic University [8]. The purpose of this interpretive framework was to overcome the simplistic binary of "hate" versus "no hate," fostering a more nuanced understanding of online hostility.

Over the two academic years, the e-tivities led students to collect and analyse a total of 408 TikTok videos. The cases were examined using interpretive categories of hate speech studied during the course [9]. This process enabled students to critically engage with key phenomena such as the role of fast thinking in heuristics [10], the emergence of new authorship standards on social media, the banalisation of content in flame wars, the rhetoric linked to anonymity, the impact of the spiral of silence on social platforms, digital illiteracy, the cultural role of memes, the post-truth framework, and the concept of margin effect [11].

The most controversial cases were selected for in-class discussion, encouraging peer debate and critical reflection among students.

3 Conclusion

The e-tivity thus frames the university course as an opportunity to apply knowledge on online hate within a specific media context—namely, the discursive flows on TikTok related to the conflict in Palestine. More specifically, the individual-level detection activity followed by collective classroom discussion fostered media-educational awareness regarding the interpretation of online hate. This experience confirmed the pedagogical value of an interpretive tool such as the *Online Hate Spectrum*, precisely because it offers a more nuanced and multifaceted approach compared to a simplistic binary logic of yes/no.

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Generative AI in Data Journalism: Insights from Four Case Studies

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1 Introduction

Data journalism [1-4], a specialized branch of journalism focused on data analysis for narrative purposes, is distinguished by its ability to investigate complex phenomena through the identification, analysis, and visualization of relevant data. Starting from a specific research question, data journalism aims to extract insights, conduct territorial or temporal comparisons, and tell stories based on empirical evidence, often represented through charts and graphs. This approach is essential for several reasons: (a) it allows readers to verify the soundness of narratives through (a.1) access to the original data and (a.2) transparency of the analytical methodology; (b) it enables fact-checking and critical assessment; (c) it addresses journalistic topics with an analytical rigor that qualitatively enriches the narrative.

Bhaskaran's review [5] highlights that, although data journalism is gaining traction both as a journalistic practice and as a field of study, training remains a complex and still underdeveloped area, particularly from ethical and methodological perspectives. This contribution, which explores the integration of generative AI as a practical and reflective support, therefore fits within a necessary and timely research trajectory, with the potential to address some of the gaps identified in the review. Training in data journalism varies significantly depending on the national context, reflecting different media system models and journalistic cultures [3; 6-7]. This implies that there is no single training model, but rather a plurality of approaches that can coexist and contribute in a complementary way.

In the current context, marked by the rapid evolution of artificial intelligence (AI) technologies, it is crucial to examine how generative AI can be effectively integrated into data journalism workflows [8-10]. At the same time, the increasing use of AI-powered tools in educational environments, especially those involving data journalism, offers new opportunities for fostering media literacy, civic engagement, and critical reflection on digital content. This turns out to be particularly important in contexts where misinformation, bias, and hate speech proliferate. As online hate speech increasingly threatens social cohesion and democratic values, journalism education must promote not only technical competence but also ethical responsibility and critical awareness

This paper presents insights from four case studies conducted across different Higher Education contexts, in which generative AI (GenAI) was integrated into journalism education to enhance students' analytical and critical skills when engaging with digital information ecosystems.

2 Data Journal in Higher Education: four case studies

The educational settings analyzed include undergraduate and graduate programs in communication and journalism, as well as continuing education courses for professional journalists. The four case studies presented concern four distinct educational contexts, all aimed at introducing analytical techniques and methods in predominantly humanities-oriented environments:

- **Data Journalism Lab, University of Bologna:** a hands-on lab for third-year undergraduate students in Communication Studies.
- **Data Journalism Course, University of the Republic of San Marino:** an elective course for students enrolled in the Communication and Digital Media degree program.
- **Master in Journalism, University of Milan:** a course within a university master’s program, aimed at 27 students with a consolidated educational and professional background, not only in the humanities but also in statistics and economics.
- **Adult Course, Regional Order of Journalists of Lombardy:** a short 10-hour course for 18 professional journalists funded by the Erasmus KA1 program, focusing on the application of data journalism techniques in a professional setting.

In these courses, GenAI was used to support a range of activities, such as data extraction, information structuring, content simplification, and data visualization. These practices were embedded within project-based learning activities that tasked students with investigating real-world issues using data journalism methods.

In all cases, students and participants used standard tools such as open data portals (ISTAT, etc.), spreadsheets (Excel, Google Sheets), and data visualization software (Datawrapper, Flourish). In 2025, generative AI (Google Gemini, Mistral, ChatGPT) was introduced as a support tool.

3 Discussion and conclusions

The study emphasizes that integrating GenAI into educational practices goes beyond improving productivity. Instead, it offers a unique opportunity to teach students how algorithmic systems influence the production and dissemination of information.

Within this context, GenAI is positioned not merely as a tool for content generation but as a pedagogical ally in fostering digital civic competence. Through guided activities and critical reflection, students learn to evaluate the trustworthiness of sources, detect manipulation, and understand the epistemic and cultural implications of automated content curation. This approach aligns with media literacy and digital inclusion goals outlined by institutions such as UNESCO (2021) and the European Commission's Digital Education Action Plan (2021–2027).

Furthermore, by adopting a human rights-based educational perspective, these case studies underscore the need to design curricula that address AI's dual role in facilitating both access to knowledge and the risk of reinforcing polarization and disinformation. The pedagogical strategy proposed promotes a shift toward an ethics-aware and justice-oriented use of digital technologies in Higher Education, thereby contributing to institutional efforts to counteract online hate and promote inclusive, informed, and participatory digital cultures.

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Self-Regulation in Second Language Acquisition: Evaluating the Impact of Intelligent Tutoring Systems on Motivation and Affective Outcomes

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1 Introduction

This doctoral research explores the influence of adaptive learning technologies and self-regulation processes on Second Language Acquisition (SLA). Situated at the crossroad of cognitive, affective, and technological fields, the study investigates how innovative, dynamic instructional modalities can enhance both learning achievement and affective variables in language learners [1]. Adaptability in educational settings—which involves a learner's capacity to adjust behaviors, cognitions, and emotions in response to changing learning conditions—is considered fundamental for optimizing outcomes in SLA contexts [2].

The principal aim is to evaluate whether an adaptive, personalized learning environment, delivered via an Intelligent Tutoring System (ITS), leads to improved SLA outcomes and affective states compared to a traditional learning approach [3]. Specifically, the ITS (named "Albert") dynamically adapts to individual learner profiles, presenting content in a tailored, interactive manner, whereas the control protocol is based on conventional, logical-associative memorization techniques [4]. The research is theoretically grounded in the fields of Acquisitional Linguistics and is operationalized using a pseudolanguage, Vimmi, which mirrors the phonotactic structure of Italian.

2 Theoretical framework

The conceptual core of the study is the development of a learning model that foregrounds the critical roles of motivation and self-regulation in SLA. The model is anchored in the construct of Self-Regulated Learning (SRL), which integrates both cognitive and affective dimensions of learning. Within this framework, affective variables are more directly measurable, while cognitive variables are predominantly inferred through learners' performance and behaviors [5].

In the context of SLA, learning motivation (LM) emerges as a unifying variable, encompassing both cognitive and affective components. The investigation posits that the interplay of SRL and LM is central to understanding and improving language learning outcomes. SRL is defined as active management by learners of their cognitive, motivational, and behavioral processes towards achieving specified educational goals.

This framework emphasizes the agency of learners in setting objectives, monitoring progress, and iteratively adapting strategies to maximize learning [6].

A notable rationale for integrating SRL and motivational research is their bidirectional influence. Motivation is viewed as the catalyst for the initiation and maintenance of self-regulatory actions such as goal setting, effort regulation, and persistence. Conversely, successful deployment of SRL strategies reinforces learners' motivation by enhancing their sense of agency, control, and efficacy within the learning process [7].

3 Materials and Methods

3.1 Partecipants

The sample for this study was randomly selected from a population of students enrolled in a TFA (Tirocinio Formativo Attivo) course. The final dataset comprised 30 participants in the experimental group and 30 in the control group.

3.2 Experimental Design

A case-control design was employed, utilizing independent pre-test and post-test samples with two instructional modalities differing exclusively in degree of adaptability:

- **Experimental group**: Received instruction via the ITS, with interactions and content dynamically personalized.
- **Control group**: Engaged with a traditional, logical-associative learning protocol focused on memorization.

Participants were randomly selected from students enrolled in a Tirocinio Formativo Attivo (TFA) course. The final sample comprised 60 participants—30 in each group.

Affective states were measured employing the Self-Assessment Manikin (SAM), enabling a quantitative assessment of learners' emotional responses throughout the study.

4 Results

The preliminary analyses conducted, particularly the analysis of covariance (ANCOVA), revealed a statistically significant effect of group assignment on learning outcomes at both T1 and T2. Specifically, at T1, an F-value of $F(1, 56) = 4.886$ with $p = 0.031$ was observed, while at T2, the F-value was $F(1, 55) = 7.405$ with $p = 0.009$, thereby confirming the positive impact of the intervention.

Studies focusing on affective states and anxiety documented substantial changes within the learning environment. Notably, a significant reduction in anxiety was observed in the experimental group ($p < .001$). Furthermore, significant improvements were detected in the dimensions of arousal, perceived pleasure, and self-mastery, indicating an overall enhancement of the learning experience.

5 Conclusion

The present research articulates and empirically tests a comprehensive model synthesizing motivation, self-regulation, and adaptive technology in SLA [8]. The findings suggest that intelligent, personalized learning environments substantially augment both linguistic and affective learning domains [9]. These results underscore the value of multidimensional frameworks that consider cognitive, affective, and technological factors in optimizing language acquisition [10].

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From PDF to Pedagogy: How Multi-Agent AI Transforms Any Document into Adaptive Language Learning

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1 Context and Rationale of the Research

Language learning in the digital age requires a delicate balance between pedagogical customisation and authenticity of learning materials. Contemporary research in Intelligent Tutoring Systems shows that adaptive systems can significantly improve learning outcomes when calibrated to the individual needs of learners (Wang et al., 2020). In parallel, studies on language acquisition confirm that exposure to authentic and personally relevant materials increases both intrinsic motivation and long-term retention (Shadiev, Liu & Hwang, 2020). Recent advances in generative artificial intelligence and multi-agent architectures open up unprecedented possibilities for the creation of learning environments that can integrate these seemingly divergent elements (Chen et al., 2023).
However, a paradox emerges in contemporary language e-learning platforms that undermines pedagogical effectiveness: existing systems force learners to choose between professionally structured but generic content that lacks personal relevance, or authentic materials that interest them but lack adequate pedagogical support (Lavrysh, Saienko & Kyrychok, 2021; Jia, Sun & Looi, 2022; Meirbekov et al., 2024). This dichotomy is particularly problematic in higher education, where students need specialised language skills related to their subject areas. The lack of systems capable of transforming authentic documents chosen by the learner into structured and adaptive learning paths represents a critical gap that limits the effectiveness of digital language learning (Yan et al., 2023).
Therefore, this research proposes the development and validation of an intelligent agent-based architecture that transforms any user-loaded document into a comprehensive and pedagogically structured language learning curriculum through four specialised agents that collaborate to semantically analyse documents, dynamically model the learner's profile, generate contextualised exercises and implement evidence-based reinforcement strategies (Wang et al., 2024).

2 Objectives and Research Questions

The main objective of this research is to investigate how a multi-agent system can reconcile content authenticity and pedagogical structuring in digital language learning. The research questions guiding this study are:

R1. To what extent does the ability to use personally relevant documents influence the motivation and engagement of university learners?

R2. How can a multi-agent architecture dynamically balance the linguistic complexity of authentic materials with the level of individual competence?

R3. Which document features and which automated pedagogical strategies are most effective for different learner profiles?

3 Methodological Approach

The research adopts a Design-Based Research approach articulated in iterative cycles of design, implementation and evaluation: the first phase involves the development of the multi-agent architecture using Retrieval-Augmented Generation techniques for document analysis (Gopi et al., 2024), Bayesian Knowledge Tracing for learner modelling and Natural Language Generation for exercise creation (Cho et al., 2024). Empirical validation will follow a mixed-methods design that combines quantitative analyses of learning performance with qualitative investigations of user experience through think-aloud protocols and semi-structured interviews (Hoseini Ahangari et al., 2023). The study will involve university students from different language levels and subject areas to ensure the generalisability of the results.

4 Expected Results

This research is expected to produce several significant contributions to the scientific community. On the theoretical side, the work will propose a conceptual framework for the integration of authenticity and personalisation in AI-based language learning systems. On the technological side, the multi-agent architecture developed will provide reusable patterns for the orchestration of complex educational systems. From an empirical perspective, the study will generate evidence on the effectiveness of document-based personalised learning in the context of higher education (Claravall & Irey, 2022). Finally, the developed system will have immediate practical implications for university students in need of specialised language skills in their subject domains.

5 Current Status and Future Developments

The project is currently in the implementation phase, with the agent architecture completed and the first document analysis modules operational. Next steps will include the completion of the student modelling system, the integration of the exercise generation modules and the start of the first validation cycle with pilot users. The research aims to contribute to the broader debate on the ethical and effective use of artificial intelligence in higher education, exploring how technology can amplify rather than replace the human dimension of learning.

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Supporting Epistemic Agency in Personalized Learning Environments: Educational Requirements for Adaptive Systems

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The PhD project seeks to explore how risks associated with recommender algorithms might be mitigated by reframing them as a subclass of adaptive systems operating in decision-making environments. This document turns to a related subclass: personalized learning systems. These systems—tutoring platforms, dashboards, and recommenders—shape how users access, prioritize, and internalize information. While they promise personalization and engagement, they may also affect *epistemic agency*: the learner's capacity to interpret content critically, reflect on sources, and steer their own trajectory.

The project tentatively introduces the notion of *educational requirements* for adaptive systems: user-facing design principles that could support intelligibility, deliberation, and control. It draws on critical literature in educational technology and human–computer interaction, including work on algorithmic confounding, feedback loops, and epistemic injustice. Methodologically, it combines conceptual analysis with design-oriented inquiry, informed by philosophy of education and interface studies. Recommender systems serve as a central case to examine how adaptive systems may gradually shape epistemic environments—often without user awareness. The intended contribution is to outline design principles that might inform interface development and evaluation, supporting epistemic resilience and AI literacy. Preliminary conceptual analysis suggests that mechanisms such as explanatory overlays, diversity prompts, and reflective nudges could help sustain epistemic agency.

1 Introduction, Motivation, and Research Question

Concerns about adaptive systems in personalized learning—including tutoring platforms, AI-generated feedback tools, and learning analytics dashboards—highlight risks for epistemic agency. Chen and Zhu [3] show that learning analytics may reflect institutional priorities that diverge from learners' goals, while Tsai et al. [7] note that students are often expected to act on feedback they cannot interpret. Madaio et al. [5] extend this critique by framing such situations through the lens of structural (in)justice, where users lack the means to understand or contest how systems shape learning opportunities.

Taken together, these studies point to a deeper shift: many adaptive systems function less as neutral supports and more as persuasive environments. By guiding behavior and shaping attention, they introduce a subtle educational drift.

This motivates the introduction of *educational requirements*: design principles intended not to block personalization, but to render its mechanisms visible and interpretable so that learners can respond with informed judgment.

2 Use Case: Recommender Systems and Epistemic Drift

Recommender systems illustrate these issues clearly. By personalizing content in response to past interactions, they influence what users see, revisit, and regard as relevant. Studies describe this as algorithmic confounding or feedback-loop personalization [2]. Such dynamics may narrow exposure and entrench perspectives [6, 1]. Pedagogically, this mirrors adaptive tutoring: a slow drift away from self-directed learning, shaped by opaque feedback, often unnoticed.

3 Educational Requirements for Adaptive Systems

This use case suggests the potential value of *educational requirements*—interface-level design principles that render system adaptivity visible and actionable. Rather than preventing personalization, the goal is to support learners in understanding and modulating adaptation over time. Examples include explanatory overlays (why this, why now), behavioral feedback visualizations (how past actions shape outputs), diversity prompts (countering narrowing trends), and reflective nudges (inviting review or reframing of trajectories). These mechanisms aim to transform the interface into a site of epistemic engagement, fostering interpretive flexibility without prescribing user behavior.

4 Future Directions and Evaluation

A complementary avenue considers *traceability*: adapting infrastructures from educational certification and content management—potentially including distributed ledger technologies such as *blockchain*. While initially developed to secure artistic intellectual property, blockchain now offers a model for persistent, verifiable records that can document engagement with overlays, prompts, or nudges. Such records could provide systematic, quantitative evidence of effectiveness and enable comparison across institutions, resonating with discussions on durable educational data infrastructures [4].

5 Expected Outcomes

The project aims to contribute: (i) a provisional set of educational requirements that may help sustain epistemic agency; (ii) design patterns—overlays, prompts, nudges—that can be instantiated and tested in higher-education platforms; and (iii) an evaluation framework combining critical pedagogy with traceability infrastructures to measure effects on understanding, deliberation, and control. At this stage, the work remains exploratory, and feedback on framing and validation paths is welcome.

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Educator competencies in community technology projects: the DigEducati case as a model for professional development and digital inclusion

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1. Theoretical background

Within a "network society" where digital technologies constitute interconnected environments that shape social, cultural, and economic dynamics [1], community technologies can be defined as socio-technical systems in which tools and digital infrastructures are designed, implemented, and used with an explicit community orientation [2], becoming catalysts for educational processes and social inclusion [3] [4]. This approach —rooted in media ecology [5] [6], social constructivism of technology [7], situated learning [8] and participatory cultures [9]— considers media education as a cultural practice that transcends technical literacy [10]. Scientific literature highlights how the digital divide manifest in complex forms related to active participation in digital society [11]. Within this context, community technology projects emerge as strategic interventions to promote educational equity.

The *DigEducati* project, launched in 2021 in the province of Bergamo (Northern Italy) in response to challenges of digital exclusion, aims to create an inclusive educational ecosystem, where various social actors (educators, families, territorial entities) collaborate to reduce the digital divide and foster pedagogical innovation for children [12]. Amid the ongoing digital transformation of educational contexts [13], the role of the digital educator is increasingly emerging in youth work [14] as a distinctive professional profile, characterized by a hybrid set of competencies that integrate technological, cultural, relational and pedagogical dimensions, from the perspective of community tutors [2]. While the European framework DigCompEdu has attempted to systematize these competencies [15], further exploration is needed to understand how they evolve, particularly in light of the rapid proliferation of AI systems, which raise new challenges and questions for the field of education [16] [17] [18] [19] [20].

2. Research Hypothesis

The general objective of the research is to explore how community technology projects – with particular reference to *DigEducati* – contribute to the development of a new professional profile of the educator. The main hypothesis is that educators who possess pedagogical, relational and cultural competencies, in addition to digital ones, are more capable of orchestrating learning ecosystems and obtain more effective results in digital inclusion processes. Moreover, the integration of AI tools determines an evolution of the competencies required of educators, orienting them toward more complex functions of personalized learning and ethical mediation.

Specific Objectives: *a) Map educator competencies in community technology projects; b) Build a competency model for the digital community educator; c) Evaluate the impact of introducing AI tools on educational practices; d) Develop guidelines and training tools.*

3. Research Methodology: Mixed Methods

A mixed methods research approach [21], combining qualitative and quantitative techniques, are used to construct, test and validate an exportable and scalable model. The research explores various dimensions of the educator profile [22], along with contextual and organizational factors, across three main phases:
1. Competency and operational context construction. Development of a conceptual map outlining emerging competencies and influencing factors through focus groups, participant observation, and document analysis.
2. Model construction and validation. Design of a validated competency model and a preliminary version of the training toolkit, through surveys to educators, construction of a composite index of "digital community competency", comparative statistical analysis with data from families and users surveys across different territorial areas, expert panel input, co-design activities.
3. Artificial intelligence integration experimentation. Empirical evaluation of how AI integration influences roles and competencies. This phase includes guided implementation of AI tools, comparison with a control group, longitudinal assessment of evolving practices and skills, and a guide for ethical AI integration in education.

4. Expected Results and Research Relevance

The research sits at the intersection of educational innovation, professional training and social inclusion. The analysis of the *DigEducati* case represents a unique opportunity to explore in depth the transformations occurring in the role of educators and the impact of AI in inclusive educational contexts. The research aims to produce a professional development model that is scalable and transferable to other territorial contexts. Here are the foreseen project deliverables:

- a comprehensive research report including detailed results, methodologies and recommendations for improving digital educator training;
- a competency framework for educators involved in community technology projects, structured in competency domains, proficiency levels and KPIs;
- a training toolkit for digital educators professional development, co-designed with educators involved in the project.

On a theoretical level, the study intends to advance the conceptual understanding of community technologies and proposes an updated theoretical-operational model for the digital community educator profile, filling a gap in the literature regarding educational mediation of AI in non-formal and territorial contexts.

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Playing with Digital Technologies in Preschool: Strategies and Opportunities for Learning. The results of the systematic review.

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1. Introduction

This study aims to conduct a literature review on the topic of play with digital devices and technologies in order to investigate the possible effects of media play on the learning processes of 3- to 6-year-old pre-school children.

For these reasons, it is considered important to explore forms and ways of using digital tools during play activities in pre-school, considering that these tools are now a fundamental part of children's world and experiences [1].

2. Objectives, research questions and methodology

In order to contextualize the line of research, it should be pointed out that the study develops from three interrelated key dimensions.

First, *play* always activates a range of languages, such as cognitive, relational, social, creative and recreational [2]. Secondly, nowadays every child encounters and is confronted with the *media*, both as a spectator and as an actor [3]. Thirdly, the preschool that has the task of accompanying children to become familiar with the experience of digital media, renouncing two temptations: idealising these technologies and demonising them [4].

In the light of this scenario, the research objectives can be summarised as follows: - to identify types of play with the use of digital technologies; - to recognise teaching and learning practices based on digital technologies; - to identify the potential of digital technologies according to the "play to learn" approach.

The Population, Contest, Outcome (PCO) tool in the version of Butler, Hall & Copnell [5] was used to bring out the initial question. Specifically, the following question was formulated: "What interaction can we consider between play with the use of digital technologies and learning with pre-school children (3-6 years)?".

At this point, first the following search string "*Learning AND Game AND Digital AND (Nursery OR Early AND Years)*" was created and then placed within two international databases: Scopus and Web of Science (WOS).

The query of the two databases returned the following output: (n = 137) records in Scopus and (n = 123) records in WOS.

The PRISMA 2020 statement: an updated guideline for reporting systematic reviews [6] was used to conduct the review.

The identified studies were filtered through three working blocks involving the processes of Document Identification-Screening-Inclusion.

At the end of the process, the flowchart returned a corpus of 24 documents (7 = Scopus; 17 = WOS).

3. Results

Starting with the examination of each document and the consideration, in particular, of the abstracts and keywords included in the extraction framework, a series of emerging themes were identified, based on the assumption that «a theme captures something important in the data, in relation to the review question, and possesses a certain level of recursiveness» [7].

Following this, the themes identified were aggregated into categories, based on their correspondence to the topic under study. Thus, six main categories were formed, as follows: 1) Digital games, learning, neuroscience; 2) Pedagogical implementations from children's ideas on digital media; 3) Effectiveness of educational interventions based on digital games; 4) Use of digital media in the family environment; 5) Design and evaluation of computer games and children's videos on the YouTube platform; 6) Repertoire of digital games.

Consequently, the categories identified allow us to: - appreciate the richness and complexity of the phenomenon under examination; - provide guidance for the interpretation and conceptualisation of studies; - outline horizons and perspectives for further investigation.

4. Conclusion

The studies considered reveal how children through play experiences with the use of various digital devices «succeeded in achieving precise educational-didactic goals and not just pursuing generically educational goals» [8].

In addition to this, within the corpus of analysed documents we are able to trace and specify some "seeds" that can be traced back to the "play to learn": - the teacher's involvement in playing with children in several operational areas (game creator, tutoring guide, support and scaffolding) [9]; - the design of a didactic-curricular framework for digital competences, responsive to the children's cultural-cognitive context [10]; - the attention to each child through the implementation of high quality digital learning resources [11]; - the organisation of the learning context that normalises the presence of digital [12]; - the workshop approach that focuses on learning by discovery and the involvement of the mind-body-brain [13]; - the balanced duration of use of digital devices [14]; - the reflection and discussion on the play experience with the children (debriefing) aimed at helping them «to verbalise and reformulate a series of emotional experiences and on what happened in the play» [15]; - the children's gratification on both the learning processes and the concrete play products/results [16].

In view of the very rapid and pervasive technological development, we are able to assert that the media, as allies of the contemporary pre-school, «are not only tools, which must be used in the classroom, but are also a necessary basic competence» [17]. For these considerations, it is reasonable to employ them in the field of "play to learn", since they require from each child a cognitive, emotional and social commitment that jointly mobilises mind-body-brain.

The pedagogical insights presented above provide a framework that teachers and educators working in preschools can implement during play activities using digital devices. These basic methodological approaches therefore represent a valuable working tool useful both for the academic training of future teachers and for the reflection and professional development of teachers already in service.

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Generative AI as a teaching approach for Faculty Development: the case study of the eCampus University

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1 Research objectives and questions

The goal is to develop a teaching model for lecturers that want to use generative AI (GAI) to personalize learning experience.

To reach this objective we need gradual steps and answer some questions. The first one is to investigate the position of higher education teacher towards Artificial Intelligence Literacy (AIL) and Artificial Intelligence in Higher Education (AIHED), the second one is to understand when and in how it is actually used, the third one is to analyze the training needs and expectation of lecturers, and the last thing we have to do is hypothesize and design training courses for teachers to support them in building learning environment even using GAI but keeping a relationship with students.

Framework and research shows that both students and teachers need to be guided into AI understanding, applying and use for creation [1][2][3]. This is important because sometimes there's a lack of technical reliability of AI to support decision making in educational and teaching contexts [4]. Furthermore research shows that AIL must concern not only operative dimensions but also ethical and critical aspects of using AI [5]. For this reason we have also to understand if and how students trust to work with AI [6].

2 Context and motivation for your research project

eCampus is an Italian online university that has increased exponentially the number of students in the last ten years and consequently the number of teachers. Actually in eCampus there are about 750 lecturers (250 structured and 500 contract lecturers). This fact brings the University to implement a path of Faculty Development realized especially inside eCampus Academy web portal. In this context many researcher have GAI in their research interests. Being an online university makes eCampus a strategic place to deepen AIHED studies because it allows to develop and test teaching tools and didactic strategies with a large number of students.

Moreover, the fact that in a university there are a large number of teachers who work via the internet and personal computer makes this place perfect for an action-research on this topic. Artificial Intelligence Literacy helps us understanding how GAI can support teachers providing many benefits to their work. Reviews show that the most prominent benefits are personalized learning, greater insight into student understanding, positive influence on learn-ing outcomes, reduced planning and administration time for teachers, greater equity in education and precise assessment &

feedback [7]. Common use of AI in education is in intelligent tutoring system, recommendation of educational content, monitoring of learning and automatic assessment [8].

3 State of the art and/or key related work that frames your research

In the last few years we passed from a lack of researchers from departments of education about GAI to a lot of research on this subject. Today 29% of research about AIED is from the educational field [9]. Many reviews show that we have only a few research conducted with students at the graduate level because most of them are conducted with undergraduate students [7]. The topic of using digital technologies in Faculty development is relevant and the scientific community have interest about the impact of digital technologies on academic work but there is a need for new research supported by a robust information culture and inspired by an ethic of responsibility, collaboration and rigor [7][10][11].

4 Methodological approach

This type of research requires a mixed approach due to the complexity of the process [12]. We will start with a scoping review, trying to map existing literature and recognize which focus for research is necessary in the future.

In the second step a survey will be created to understand what lecturers know about AIL and how teachers use GAI in their work with students, the survey will also map their training needs.

In the third step we have to shape a tool and a training inside eCampus Academy for lecturers who want to improve their using of GAI to promote personalization of the learning experience that can make use, for example, for intelligent tutoring systems, recommendation of educational content, monitoring of learning and automated assessment [5]. This work will be carried out using the action research method.

It's important also to identify ways to prevent the risk of a loss of personal relationship with students, of an opaqueness of the learning process and a loss of trust in the teacher-student relationship [8].

5 Expected outcomes

The priority of the research is to design and test a training course for lectures in eCampus Academy to support them in experiment with teaching strategies to integrate GAI in teaching practice. We also want to create a community of practice between teachers to promote the exchange of experiences. Participation in conferences will help to disseminate the first research results and have feedback on the continuation of the work.

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