ACTIVE METHODOLOGIES AND NEW TECHNOLOGIES: A WINNING COMBINATION FOR 21ST CENTURY SKILLS?

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Abstract

For some time now, the teaching-learning paradigm has been centered on the individual, the active author of his or her learning process. From this principle emerges the need, on the part of educational institutions, to use active methodologies, and clear expressions of innovative teaching practices, albeit largely already shared by illustrious exponents of the academic sciences such as Dewey, Freire, Bruner, and Vygotskij, to name but a few. However, which active methodologies are inclusive and innovative enough to develop and acquire life and soft skills today, and how do teachers perceive these? Furthermore, today, where technology is rampant in all its forms, can the so-called ICTs or ICTs be valid supports to the teaching-learning process? These are just some of the questions we have asked ourselves and which we have tried to answer in the exploratory study involving us in the training of primary and secondary school teachers. The aim of this study was primarily to investigate, including through semi-structured questionnaires:

- What are teachers' knowledge and beliefs regarding active and innovative methodologies supported by new media?
- How does the training course influence teachers' ability to implement the methodologies and utilize the tools and applications introduced during the training?
- How do teachers perceive the practical value of these methodologies and technological innovations in enhancing their daily teaching practices and supporting students' development of life and soft skills?

[1] The contribution is the result of the shared work of the authors. However, the "Introduction" is attributed to Mariella Tripaldi; "The research" to Alessandro Barca; "The results" to Alessandro Barca and Mariella Tripaldi; and the "Active Learning role", the "Students' Engagement", and the "Teachers' training" to Maria Concetta Carruba. The abstract and conclusions are to be equally attributed to all authors.

Introduction

Today, educational institutions are increasingly tasked with addressing the demands of digitalization, adhering to European standards and the objectives outlined in the 2030 Agenda (United Nations, 2015). Significant disparities have been identified at regional, institutional, and classroom levels regarding digital integration. The advancement of digital innovation in schools often depends on individual teachers who exhibit particular enthusiasm or passion for digitalization, leading to substantial variability and gaps in implementation.

For some time now, the teaching-learning paradigm has centered on the individual as the active agent in the learning process. This principle necessitates that educational institutions employ active methodologies, which are clear expressions of innovative teaching practices. These methodologies, long advocated by prominent academic figures such as Dewey, Freire, Bruner, and Vygotskij, aim to be inclusive and effective in developing essential life and soft skills. However, questions remain about which active methodologies are sufficiently inclusive and innovative in today's context, and how teachers perceive them. Additionally, in a society where technology permeates all aspects of life, there is a need to examine whether Information and Communication Technologies (ICTs) can effectively support the teaching-learning process.

This exploratory study aims to provide a platform for teachers to articulate their classroom experiences and insights. The primary objective of the research is to contextualize these experiences, assess the needs arising from them, and propose a framework for collective change. The study involved the training of primary and secondary school teachers, using semi-structured questionnaires to investigate their knowledge and beliefs about active and innovative methodologies supported by new media. Furthermore, it examines the impact of the training on the teachers' ability to implement these methodologies and tools in their practice, as well as their perception of the value these methodologies and technological innovations bring to their daily practice and the acquisition of life and soft skills.

Through an analysis of the findings, the study seeks to understand teachers' interactions with recent digital innovations and their implications for teaching strategies and approaches within the school environment. Ultimately, the research aims to start with the context, reflect on needs, and propose a model for initiating collective change in the integration of digitalization in education.

The Research

An exploratory study was conducted using a mixed-method approach to obtain both quantitative and qualitative data on the topics of digital innovation, inclusive education, and teacher training. Data collection was performed via an online questionnaire consisting of 44 items, 11 of which were open-ended. These items were evenly distributed across the three areas of investigation:

1. Digital innovation
2. Inclusive education
3. Teacher training

The structured questionnaire facilitated the acquisition of statistically meaningful data through closed-ended questions, which were equally divided between multiple-choice and checkboxes with multiple possible answer options. The open-ended questions, designed in paragraph format, allowed respondents to express personal reflections, share classroom experiences, and elaborate on their answers based on personal and professional insights.

Quantitative data were analyzed using Statistical Package for the Social Sciences (SPSS) software, employing a multivariate approach to uncover underlying patterns and relationships. The qualitative responses were examined to trace the connections between closed and open-ended questions, and more importantly, to identify the frequency and priority of specific words, terms, and needs.

This exploratory study targeted teachers from all educational levels across Italy, encompassing the North, Center, South, and Islands regions. A simple random sampling method, as described by Noor, Tajik, and Golzar (2022), was employed to select the sample of teachers. The study garnered 200 responses, a figure that reflects the challenges of reaching teachers across the Italian territory without a ministerial-level search mechanism. Although the number of responses is representative rather than exhaustive, it provides a valuable snapshot of regional differences in educational practices and needs.

The primary aim of the study was to provide a platform for teachers to voice their experiences and perspectives, contextualize their needs, and propose a model for collective change. By analyzing teachers' experiences with recent digital innovations and their implications for teaching strategies, the research offers insights into the integration of digitalization in education and its potential to foster inclusive and effective learning environments.

The Results

The data analysis highlighted the significance of incorporating technologies in schools, including cutting-edge tools such as Artificial Intelligence (AI), within a pedagogical framework that emphasizes active learning. The difference lies not in the mere presence of the tool but in the manner in which the teacher designs and implements the instructional activity in the classroom.

Central to this approach, particularly in addressing the needs of students with Special Educational Needs, is the role of student engagement. Word frequency analysis revealed the teachers' need to focus on instructional strategies that make students "active" participants during activities, thereby promoting a teaching approach that encourages the development of each individual's potential, without exception.

The analysis of the questionnaires reveals a strong correlation between teachers' perceived risks regarding the introduction of Artificial Intelligence in schools and the lack of adequate training for teachers. Consequently, while teachers generally acknowledge the potential of AI, they fear they lack the necessary skills to prepare students to use it effectively. This concern is underscored by the frequent mention of the term "passive consumer", highlighting teachers' primary fear that students might not engage actively with AI technologies.

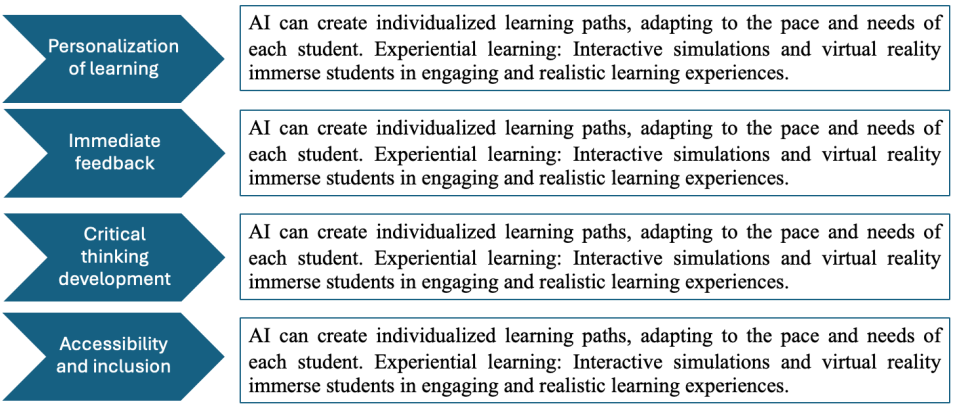
Nowadays, Artificial Intelligence is part of the world of science education, revolutionizing learning, and opening new frontiers for teaching (Nihal & Akbay, 2023). The use of AI-based tools offers a range of opportunities to make science learning more engaging, effective, and personalized. However, this evolution requires teachers to develop new skills to take full advantage of the potential of AI and guide students in this new educational context. In this paper, we can explore the teachers' feelings on AI guided by some questions.

Question 1. What are the benefits of AI in science education?

AI has the potential to revolutionize education and promote student engagement in a meaningful way (see Figure 1). However, it is important to address the challenges and obstacles with appropriate strategies and training to make the most of the potential of this technology. Conscious use of AI can transform schools into a more inspiring, effective, and inclusive learning environment, preparing students for the challenges of the future.

Figure 1

Four Benefits of AI in Science Education



All the technologies mentioned by teachers in the collected responses are consistently linked to active teaching strategies when cited as good practices or positive examples of technology use. From the analysis of the open-ended responses, it emerges that teachers believe that, to adequately prepare students for acquiring the skills needed to meet the demands of a complex society and job market, it is essential to provide them with appropriate technological training. This training should ensure that students are active users of the tools.

This premise implies that teachers must learn to become conscious guides for their students, necessitating specific training not only in digital competencies but also in the broader skills required to empirically understand and address student needs. Both digital skills and life skills will be indispensable for students. It is through the integration of these competencies that students will find the support needed to navigate the complexities of contemporary society.

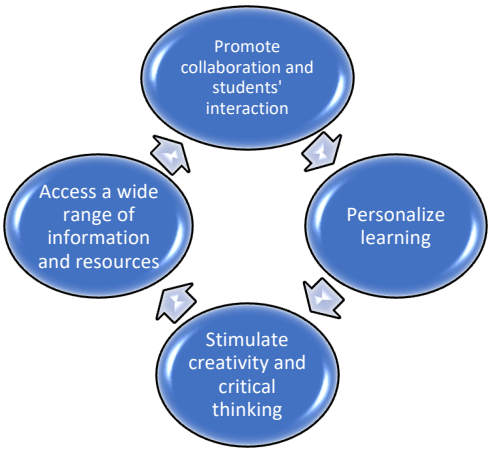
To meet these new demands, teachers highlight two major training needs: firstly, training in active teaching methodologies, and secondly, but equally important, training in how to promote student engagement. From the teachers' perspective, as revealed by the analysis of open-ended responses, placing the student at the center with their needs, following them by proposing a pedagogy that makes them the main actor, attending to their emotional needs, and training them in the digital skills required by our society, will enable schools to truly address the educational needs of students in this era.

The Active Learning Role

The Active learning model (Patiño et al, 2023) represents an innovative pedagogical approach that places students in an active role in the learning process at the center. It contrasts with traditional teaching, which is based on the passive transmission of notions, and focuses on engaging experiences that stimulate students' curiosity, participation, and responsibility. Digital innovation plays a key role in facilitating and enhancing active learning.

Figure 2

Active Learning Process



Indeed, digital technologies offer a wide range of tools and resources that can be used to:

- Promote collaboration and interaction among students: e-learning platforms, online forums, social media, and virtual learning environments (VLEs) enable students to work together, share ideas, and build knowledge collectively.
- Personalize learning: instructional software, educational apps, and artificial intelligence systems can tailor content and activities to the needs and learning pace of each student.
- Stimulate creativity and critical thinking: digital tools such as video cameras, editing software, coding, and simulations allow students to explore, experiment, and create independently.
- Access a wide range of information and resources: the Internet, digital libraries, and online archives make an unlimited amount of data and learning materials on any subject available to students.

The active methodologies most frequently featured in teachers' responses are:

- Flipped classroom (Huang et al, 2023): students learn new concepts independently at home, through videos, ebooks, or other digital content, and in class discuss, deepen, and apply what they have learned with collaborative and interactive activities.
- Problem-solving and project work (Diwan et al, 2023): students work in groups on real problems or research projects, using digital technologies for data collection, communication, and presentation of results.
- Gamification (Bezzina & Dingli, 2023): the use of game elements, such as prizes, badges, and leaderboards, makes learning more fun and motivating for students.
- Augmented and virtual reality-based learning (Geroimenko, 2023): these immersive technologies allow students to have realistic and interactive learning experiences in virtual or overlaid contexts with the real world.

From the teachers' views, based on the questionnaire's answers, to introduce such sophisticated digital innovations, such as AI, it is not possible not to start by renewing traditional teaching through the proposal of active teaching that puts the student in a position to be a co-constructor of his or her learning. If the teacher does not decentralize, embracing the active role of the student and the classroom, there is a risk that innovation, even with sophisticated technologies such as AI, will become merely a tool devoid of any genuine transformative effect.

The Students' Engagement

Student engagement is a key factor in effective and sustained learning. It is a state of active participation and interest in the learning process, manifested through curiosity, motivation, collaboration, and engagement. Artificial intelligence can play a significant role in promoting student engagement in several ways:

1. Personalization of learning
AI can analyze individual student data, such as their learning styles, interests, and progress, to create personalized learning experiences. This can include choosing content and activities suited to each student's level, providing real-time feedback, and creating individual learning paths.

2. Interactive and engaging learning:
AI can be used to create interactive and engaging learning experiences that capture students' attention and motivate them to learn. This can include the use of educational games, simulations, virtual and augmented reality, chatbots, and other immersive technologies.

3. Immediate feedback and individualized support:

AI can provide students with immediate and individualized feedback on their tasks and progress. This can help them identify their strengths and weaknesses, correct errors, and improve their performance.

4. Individualized tutoring and support:
AI can be used to provide students with individualized tutoring and support. This can include access to intelligent chatbots that can answer students' questions, provide explanations of difficult concepts, and help them solve problems.

5. Development of future skills:
AI can help students develop key future skills such as critical thinking, problem-solving, communication, and collaboration. This can be done through project-based learning activities, role-playing, and simulations.

The principal AI tools individualized by teachers as inclusive and useful tools to promote learning engagement are:

1. Intelligent tutoring systems: these systems can assess students' knowledge and provide them with personalized explanations of difficult concepts.
2. Adaptive learning platforms: these platforms provide students with content and activities tailored to their learning level and interests.
3. Educational simulations and games: these immersive experiences allow students to learn in a fun and engaging way.
4. Intelligent chatbots: these chatbots can answer students' questions, and provide support and encouragement.

Teachers' Training

What emerges very clearly and across the board in all areas and the totality of the responses analyzed is that to use AI competently in school, the teacher needs to be trained. There is a fear of misusing the tool, of not being able to anchor it to purely didactic goals, of risking an introduction devoid of pedagogical and educational purposes.

All teachers have highlighted that they need specific training.

Question 2. And, therefore, what new skills do teachers need?

In order to effectively integrate AI into their teaching, teachers need to develop several key competencies. First, they require digital skills to understand and use AI tools effectively in educational settings (Al Darayseh, 2023). Instructional design skills are also essential, enabling teachers to create hybrid learning paths that combine AI with traditional methods. Additionally, assessment skills are crucial to accurately evaluate student learning in hybrid contexts. Teachers must also cultivate inclusive skills to guide students in using AI responsibly and

independently. Lastly, ethical skills are vital, as teachers must be able to reflect on the ethical implications of AI and foster its responsible use in the classroom (Nguyen et al., 2023).

Figure 3

Five Skills Needed to Integrate AI into Teaching

- Digital skills: Know and be able to use artificial intelligence tools for teaching.
- Instructional design skills: Know how to design hybrid learning paths that integrate AI with traditional teaching.
- Assessment skills: Know how to assess student learning in a hybrid learning context.
- Inclusive skills: Know how to guide students in using AI tools and learning independently.
- Ethical skills (Nguyen et al, 2023): Reflect on the ethical implications of using AI in the classroom and promote responsible use of technology.

Conclusion

In conclusion, the exploratory study highlights a significant need for teacher training in the effective integration of AI within Italian schools. Teachers emphasized that technological innovation must be accompanied by innovation in teaching practices. They have a clear understanding of the benefits of incorporating AI in education, particularly in fostering inclusive education. However, there are lingering concerns regarding the use of AI and the instructional design that leverages AI as a comprehensive learning environment, rather than merely as a tool. This statement emphasizes that, for AI to be a transformative force in education, professional development must address two critical areas: digital competencies and

pedagogical skills. Teachers need not only technical training in AI and digital tools but also guidance on adapting their teaching methods to foster a learning environment where AI can be effectively utilized. This dual focus is essential because, without a robust understanding of both the technology itself and the strategies to integrate it meaningfully into the classroom, AI risks being underutilized or even misapplied. As a result, professional development programs should aim to empower teachers to understand, adapt, and implement AI in ways that enhance student engagement, support differentiated learning, and foster critical and creative thinking.

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