

AperTO - Archivio Istituzionale Open Access dell'Università di Torino

From Theory to Training: Exploring Teachers' Attitudes Towards Artificial Intelligence in Education

This is a pre print version of the following article:

Original Citation:

Availability:

This version is available <http://hdl.handle.net/2318/1979091> since 2024-11-13T11:15:08Z

Publisher:

SCITEPRESS – Science and Technology Publications

Published version:

DOI:10.5220/0012734700003693






Terms of use:

Open Access

Anyone can freely access the full text of works made available as "Open Access". Works made available under a Creative Commons license can be used according to the terms and conditions of said license. Use of all other works requires consent of the right holder (author or publisher) if not exempted from copyright protection by the applicable law.

(Article begins on next page)

FROM THEORY TO TRAINING: EXPLORING TEACHERS' ATTITUDES TOWARDS ARTIFICIAL INTELLIGENCE IN EDUCATION

Cecilia Fissore¹, Francesco Floris¹, Valeria Fradiante¹, Marina Marchisio Conte¹, and Matteo Sacchet¹

¹*Department of Molecular Biotechnology and Health Sciences, University of Turin, Via Nizza 52, 10126, Turin, Italy {cecilia.fissore, francesco.floris, valeria.fradiante, marina.marchisio, matteo.sacchet}@unito.it*

Keywords: Artificial Intelligence, Didactic activities, Mathematics, Primary school, Secondary school, Teacher training.

Abstract: Every year, there is increasing interest in applying Artificial Intelligence (AI) algorithms and systems in education. Educating students about the conscious use of AI and its challenges is essential. Still, even before that, it is necessary to educate teachers who need to acquire the necessary skills to use these technologies in the classroom to enrich their students' learning experience. Training must be theoretical and guide teachers in designing educational activities with AI, about AI, and preparing for AI. This article presents research conducted in Italy to understand educators' attitudes toward AI in Education. Responses to a nationwide questionnaire are analysed to understand the relationship between teachers at all levels of schooling and AI. The results show that teachers need more confidence in their AI skills but are also not too concerned about the increasing spread of AI at various levels. From the findings, we can also say that AI has found little space in the school activities of Italian teachers. At the same time, teachers state that they urgently need to be trained on AI issues.

1 INTRODUCTION

Artificial Intelligence (AI) is a “booming technological domain capable of altering every aspect of our social interactions” (Pedro et al., 2019; p. 6) and it now plays a significant role in multiple facets of everyday life, as well as in all education levels.

The application of AI algorithms and systems in education is gaining more and more interest every year. According to Chassignol et al. (2018), AI in education has been integrated into administration, teaching or instruction, and learning. As education evolves, researchers are trying to apply advanced AI techniques, such as deep learning, data mining, and learning analytics, to address complex problems and customise teaching methods for individual students (Floris et al., 2022; Fissore et al., 2023a). AI-enabled education provides timely and personalised instruction and feedback for both teachers and learners (Chen et al., 2020; Holmes et al., 2018). Intelligent education systems are designed to improve the value and efficiency of learning through various computing technologies, especially those related to machine learning (Kahraman et al., 2010), which are closely related to statistical models and cognitive learning theory.

AI can transform teaching and learning at all levels of education and in different fields, for example: AI to support collaborative learning; AI to support problem solving (Barana et al., 2023); AI-driven monitoring of student forums; AI to support continuous assessment; AI learning companions for students; AI teaching assistants for teachers; AI to advance learning sciences (i.e. to help us better understand learning) (Holmes et al., 2023). However, as highlighted by Holmes et al. (2023), there is also little robust evidence about the

¹ <https://orcid.org/0000-0001-8398-265X>

² <https://orcid.org/0000-0003-0856-2422>

³ <https://orcid.org/0000-0001-7647-1050>

⁴ <https://orcid.org/0000-0003-1007-5404>

⁵ <https://orcid.org/0000-0002-5630-0796>

effectiveness of the rapidly growing number of AI tools in education. Even where there is some evidence, it has typically been compared to business as usual, rather than to another technology with at least some degree of comparability. The purported effectiveness of many other tools may be due to their novelty in the classroom rather than having anything to do with the AI used. This is despite the fact that most studies of AI in education are concerned with university learning and teaching.

Several systematic reviews have been conducted by different research teams to highlight the common problem in AI in education, namely the lack of connection between AI techniques and theoretical underpinnings, which in turn critically influences the impact of AI implementations in education (Ouyang & Jiao, 2021). The use of AI in education is characterised on the one hand by the ease with which students can access AI-based tools, both for educational purposes and in everyday life, and by the difficulty for teachers to explain the mechanisms and technologies behind them, given their complexity. It is essential to train teachers in the theoretical concepts related to these issues, but above all in the planning of didactic activities using innovative pedagogical approaches (Fissore et al., in press).

However, in order to plan effective and usable training actions for teachers in their daily teaching, it is necessary to understand the starting point, especially concerning primary and secondary schools. In fact, it is important to understand the relationship of Italian teachers with AI: how much they know about it, how much they are interested in knowing about it, how much they talk about AI with students, how much they use it both in and out of class, how much they are interested in using it, with what frequency, how the use of AI is regulated in their school, and much more.

This paper presents part of the results of a survey proposed to Italian teachers of all levels and disciplines from October 2023 to January 2024, entitled "AI and Gamification in education". The survey was carried out among participants of the PP&S - "Problem Posing and Solving" – an initiative dedicated to the integration of advanced technologies and methods, such as artificial intelligence and gamification, in education in Italy. The PP&S (available at www.progetttopps.it), led by the Italian Ministry of Education, has been promoting, since 2012, the training of Italian lower and upper secondary school teachers in innovative teaching methods and the use of technologies as essential tools for professional growth and for improving teaching and learning (Barana et al., 2020; Fissore et al., 2023b). The survey has also been fundamental for collecting observations, suggestions, and ideas for the preparation of future training activities of the project.

In this paper we focus on AI in education, starting with the following research questions:

(RQ1) How confident are Italian teachers about AI?

(RQ2) How much do Italian teachers use AI in education?

(RQ3) How interested are Italian teachers in receiving training on AI in education?

The survey involved 255 teachers. The state-of-the-art section provides an introduction to the topic of AI in education and teacher training on it. The "Methodology" section presents the research methodology, i.e. the structure of the questionnaire, the different types of questions, and how they were analysed. The section "Results" shows data and statistics based on teachers' responses. In the "Conclusions" section, based on the results of the research, a design of training interventions aimed at integrating advanced technologies and methodologies, such as Artificial Intelligence, into training in Italy is proposed. Finally, final remarks are discussed.

2 STATE OF THE ART

2.1 Definition of AI

Despite the increased interest in AI by the academic world, industry, and public institutions, there is no standard definition of what AI actually involves (Samoili et al., 2020). Definitions of AI multiplied and expanded, often becoming entangled with the philosophical questions of what constitutes "intelligence" and whether machines can really be "intelligent" (Miao et al., 2021). For example, Zhong (2006, p. 90) defined AI as "a branch of modern science and technology aimed at the exploration of the secrets of human Intelligence "n on' hand and the transplantation of human intelligence to machines as much as possibile on the other hand, so that

machines would be able to perform functions as intelligently as they can". Luckin et al. (2016) defined IA as a computer system that has been designed to interact with the world through capabilities that we usually think of as human. The definition provided by the European AI Strategy is: "Artificial Intelligence refers to systems that display intelligent behaviour by analysing their environment and taking action — with some degree of autonomy — to achieve specific goals" (EC Communication, 2018). Chassignol et al. (2018) provide a two-faceted definition and description of AI. They define AI as a field and as a theory. As a field, they define AI as an area of study in computer science that aims to solve various cognitive problems commonly associated with human intelligence, such as learning, problem solving, and pattern recognition, and subsequent adaptation. As a theory, they define AI as a theoretical framework that guides the development and use of computer systems with human capabilities, particularly intelligence, and the ability to perform tasks that require human intelligence, including visual perception, speech recognition, decision making, and translation between languages.

In general, from these definitions and descriptions, AI encompasses the development of machines that have some level of intelligence, with the ability to perform human-like functions, including cognition, learning, decision making, and adaptation to the environment. As such, some specific characteristics and principles emerge as key to AI. Intelligence, or the ability of machines to demonstrate some level of intelligence and perform a wide range of functions and capabilities that require human-like abilities, emerges from this definition and discussion of AI as a key characteristic of AI (Chen et al., 2020).

AI research is concentrated on various components of intelligence, including learning, reasoning, problem-solving, perception, and language usage (Pedro et al., 2019). A more detailed definition is provided by UNESCO's World Commission on the Ethics of Scientific Knowledge and Technology (COMEST), which describes AI as machines capable of mimicking certain functionalities of human intelligence, including features such as perception, learning, reasoning, problem solving, language interaction, and even the production of creative works (COMEST, 2019). Samoilu et al. (2020) present a collection of key definitions of AI to define an AI taxonomy. The keywords identified as most relevant within each AI domain (Reasoning; Planning; Learning; Communication; Perception; Integration and Interaction Services; Ethics and Philosophy) were presented together with the operational definition. This list of keywords is intended to be dynamically updated according to new technological developments in core and transversal domains, and to be consistent with alternative proposals.

Definitions of AI are also changing depending on what is being considered, such as the role of people, especially younger generations, in using AI and developing their awareness. According to the UNICEF definition: "AI refers to machine-based systems that, given a set of human-defined goals, can make predictions, recommendations or decisions that influence real or virtual environments" (Dignum et al., 2021). When using AI tools, it is important to be aware that AI systems work by following rules, by learning from examples (supervised or unsupervised), or by trial and error (reinforcement learning). By recognising patterns in data, computers can process text, speech, images, or video and plan and act accordingly. For this reason, it is important to talk about other related issues, such as the conscious use of AI, the protection of personal data, bias, the ethics of AI, and more.

According to Luckin & Holmes (2016), even experts find it difficult to define AI. One reason is that what AI includes is constantly shifting. Another reason is the interdisciplinary nature of the field. Anthropologists, biologists, computer scientists, linguists, philosophers, psychologists, and neuroscientists all contribute to the field of AI, and each group brings its own perspective and terminology.

2.2 Teacher training on AI in Education

AI has given rise to novel teaching and learning solutions in education, which are currently being evaluated in various settings. In particular, the literature on AI in education has grown with the introduction of artificial intelligence-based chatbots, such as ChatGPT. ChatGPT has the potential to serve as an assistant for teachers and a virtual tutor for students, but there are challenges associated with its use. Immediate steps should be

taken to train instructors and students to respond to the impact of ChatGPT on the educational environment (Lo, 2023).

Nevertheless, research into AI in education goes back several years. The earliest notable AI efforts in educational technology for education materialised in the early 1970s. Balacheff (1993) argued that the main advantage of AI in mathematics education is its ability to provide concepts, methods, and tools for designing adaptable and appropriate computerised systems for educational purposes.

The relationship between AI and education covers three areas:

- Learning with AI, which involves the use of AI-powered tools in the classroom;
- Learning about AI, which involves the study of its technologies and techniques;
- Preparing for AI, which involves enabling all citizens to gain a better understanding of the potential impact of AI on human life.

According to Fissore et al. (in press), the use of AI in education is characterised by a large gap between:

- The ease of use of AI-based tools (for educational purposes, but also in other aspects of daily life) and, consequently, their widespread use by students;
- The difficulty for teachers to explain the mechanisms and technologies behind them, given their complexity.

The skills required to adopt, use, and interact with AI tools are many, such as:

- Basic knowledge of AI;
- Ability to use mobile devices or smartphones;
- Analytical skills, problem solving, critical thinking and judgement;
- Creativity, communication, teamwork, multitasking.

For this reason, it is essential to focus not only on improving the skills of teachers in schools, but also on revising the structure of the school curriculum. At the same time, it is important to train teachers not only in the theoretical content related to these topics, but also in the planning of didactic activities in order to adopt innovative pedagogical approaches (Fissore et al., 2022).

There are many challenges and policy implications that should be part of global and local conversations about the opportunities and risks of introducing AI into education and preparing students for an AI-powered context. A key challenge is to prepare teachers for AI-powered education while preparing AI to understand education, but this must be a two-way street (Gocen & Aydemir, 2020). Teachers need to learn new digital skills to use AI in a pedagogical and meaningful way, and AI developers need to learn how teachers work and create solutions that are sustainable in real-world environments. Another important challenge is to make research on AI in education meaningful. While it is reasonable to expect that research on AI in education will increase in the coming years, it is worth remembering that the education sector has struggled to take stock of educational research in a way that is meaningful for both practice and policy-making (Gocen & Aydemir, 2020).

The use of AI in education should be regulated at the national level, and teachers should be provided with guidelines to help them introduce AI tools into everyday teaching. The Digital Education Action Plan 2021-2027, a policy initiative of the European Union, introduces AI as a key issue and emphasises the need to update digital literacy curricula to reflect this new reality. Two actions (Action 6 and Action 8) aim to ensure that the use of AI and data in education is conducted ethically and that educators are equipped with the necessary skills to integrate these technologies effectively. In Italy, the report 'Proposals for an Italian Strategy for Artificial Intelligence' (Ministry of Economic Development, 2020) highlights the strategy's strong emphasis on education, skills, and lifelong learning. The report states that training people with digital skills is a fundamental requirement for this transformation, with AI playing a prominent role. However, it does not provide any guidelines or regulations for schools.

3 METHODOLOGY

The idea for this national survey came from previous teacher training experiences on AI in education within the PP&S project, such as immersive workshops and open online courses (Fissore et. al., 2022). The survey was

initially distributed among the community of teachers gravitating around the PP&S project, but then it was spread to all Italian teachers through the communication line of the projects that the research group manages with the schools. We also asked teachers to distribute the survey among colleagues. The results showed that teachers are extremely interested in AI in education, but at the same time, they have a great need for support and training in the use of AI in education and the design of effective teaching activities. Before designing new training actions aimed at different aspects of AI (knowledge of AI, use of AI in education, possible implications of AI in education, etc.), it was necessary to understand the national scenario of AI in Italian schools.

The questionnaire is aimed at Italian teachers of all subjects, from primary to upper secondary school. The survey is still open, but the responses received from 17 October 2023 to 31 January 2024 are taken into account. The responses of 255 teachers were considered.

The questionnaire is characterised by open questions, Likert scale questions, multiple choice questions, and open-ended questions.

The part of the questionnaire considered in this research is structured in 3 stages:

- Teachers' personal data: age, gender, discipline they teach, name of the school they teach in, type of school, region, years of teaching;
- Background on AI: personal thoughts about AI, the frequency of using AI for personal use, the knowledge about AI and AI in education, considerations about the proliferation of AI, school policies and guidelines on the use of AI, the frequency of using AI with students;
- Teachers' considerations on their training on AI: their needs, the areas of AI where training is most required, and the development of educational activities that cover the three areas: learning with AI, learning about AI, preparing for AI.

Descriptive statistics utilizing mean and standard deviation were employed in the analysis of Likert scale questions.

4 RESULTS

To answer the research questions, we considered the 255 responses from the national survey. The majority of teachers surveyed are women (75.7%). Moreover, most respondents are elderly teachers, since 50.4% are over 50 years old and 25.3% are in the range 40-50 years old. Only 12.6% are between 30 and 40 years old and 11.7% are under 30. These first two results of the national survey are in line with the periodic reports on the Italian education system (OECD, 2023) which highlights the predominance of women and older teachers in the Italian school context. On the other hand, older age is associated with more teaching experience; in fact, more than half of teachers (52.2%) have taught for more than 15 years. The teachers surveyed are from primary (6.3%), lower secondary (44.7%), and upper secondary (49%) schools. In addition, 67.4% are STEM teachers. The sample of teachers considered is almost entirely representative of all regions of Italy (16 out of 20) even if a major part of teachers come from Piedmont (65.9%). The success of the initiative in Piedmont may also be attributed to the close collaboration between the University of Turin and local schools in the context of the PP&S Project.

Regarding the AI background of the respondents, 34.1% of them have already attended AI training courses. The graph in Figure 1 shows that there are relatively few teachers who frequently use AI for personal use on a Likert scale from 1 (not at all) to 5 (very much). This is probably due to their fear and low confidence in their abilities and knowledge of AI as emerged in Figure 2 and Figure 3. In fact, on the same Likert scale, the mean obtained for the questions "How confident are you in your knowledge of AI?" and "How confident are you in your knowledge of AI applications in education?" are respectively 2.13 and 2.01. This is consistent with the fact that if teachers are not confident in their knowledge and the use of AI, they will also lack confidence in applying AI in education. In this sense, it can be noticed that the graphs in Figure 2 and Figure 3 follow a similar trend, with the only difference being that for the second question there were more responses with a value of 1 (not at all) instead of 2 (not much) than for the first question.

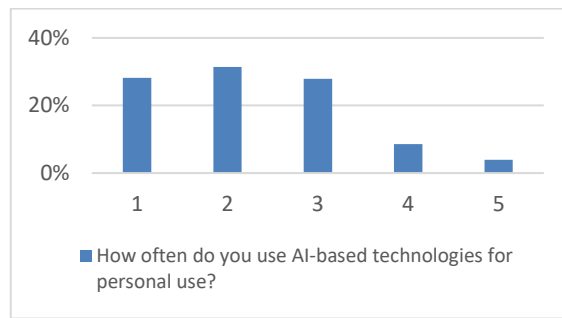


Figure 1: Frequency of teachers' self-use of AI technology.

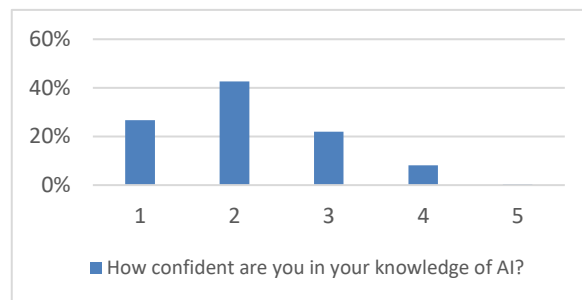


Figure 2: Teachers' level of confidence in their knowledge of AI.

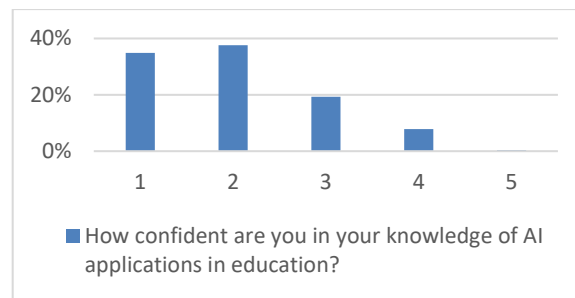


Figure 3: Teachers' level of confidence in their knowledge of AI applications in education.

Surprisingly, although teachers are not sure of their skills in the field of AI, they do not appear to be too worried about the growing prevalence of AI in various fields. In fact, the answer to the question "How worried are you about the growing presence of AI in many fields?", given on a scale from 1 (not at all) to 5 (very much) received an average value of 2.95 with a standard deviation of 1.13. Figure 4 shows the frequency of answers to this question on a Likert scale from 1 (not at all) to 5 (very much). It is possible to notice that 3 is the most frequent value, and the number of responses "2" is higher than the number of responses "4", the number of "1" and "5" is exactly the same. It means that teachers are moderately worried about the massive diffusion of AI in various sectors, including education.

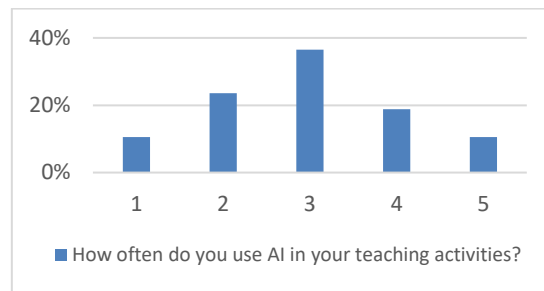


Figure 4: Frequency of teachers' concerns about the spread of AI in different areas.

This last result becomes even more significant when we combine it with the fact that 96.1% of teachers stated that the school in which they work does not follow specific guidelines on the use of AI. This aspect could have caused further apprehension among teachers, who despite the lack of clarity on the use of AI in different areas, do not seem to be too worried about its spread in the educational context. In addition, only 11.4% of respondents said that the school where they work encourages the use of AI-based applications in the classroom. This aspect could be the basis for the low use of AI in education by teachers, as they are not stimulated by their schools to include AI technologies in their teaching practices. In addition, teachers may be concerned about the use of unregulated AI by students and the use of their data, as they are mostly minors. As shown in Figure 5 and Figure 6, 63.5% of teachers never use AI in their didactics and 62.7% of them never teach their students to use AI in the classroom (on a scale of 1=never to 5=always).

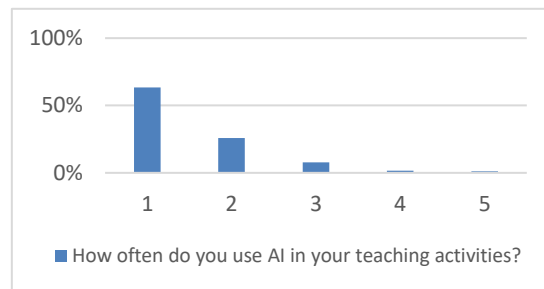


Figure 5: Frequency of teachers' use of AI in their didactic activities.

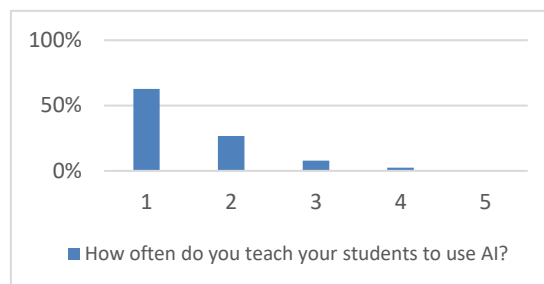


Figure 6: How often teachers introduce their students to the use of AI in the classroom.

Although teachers are not used to employing AI in their daily activities with the students, almost all of them (90.6%) agree that it is important for students to learn to recognise AI and its applications in everyday life. They also agreed (86.6%) that it is important for students to have a deep understanding of AI.

Regarding teachers' needs for training on AI topics, the majority of them (70.6%) stated that they feel a strong need for AI training while 21.5% think that it would be beneficial and 7.9% think that it is not so urgent.

In addition, the number of teachers who expressed a need for educational activities on AI to be offered to their students was also high (61.2%). In particular, Table 1 shows teachers' opinions on their needs for training in AI. For each sentence, they were asked to indicate how much they agreed on a Likert scale from 1=“Completely disagree” to 5=“Completely agree. Table 1 shows the mean and standard deviation (SD) obtained for each question.

Table 1: Teachers' considerations on their training on AI.

	How much do you agree with the following statements about AI:	Mean	SD
Q1	It is important for teachers to learn how to recognise AI and its applications in everyday life.	4.3	0.72
Q2	Teachers must learn to understand AI.	4.3	0.70
Q3	Learning the ethics of AI is important for teachers.	4.5	0.67
Q4	Teachers need to design didactic activities with AI.	3.3	0.99
Q5	It is important for teachers to design didactic activities about AI.	3.6	0.94
Q6	It is important for teachers to design didactic activities to prepare for AI.	3.8	0.94

From Table 1, we can see that teachers perceive a greater need to learn about AI and recognise its areas of application and the issues related to its ethics. In fact, the answers to the first three questions concerning AI general features obtained an average score between 4.3 and 4.5. Similarly, within the three areas identified above: Learning with AI, Learning about AI, Preparing for AI, it can be noted that it is more urgent for teachers to design teaching activities that prepare students for AI (3.8) and include the study of its technologies and techniques (3.6). Therefore, for teachers, before designing didactic activities that involve the use of AI (3.3), it is necessary to develop materials that enable them to gain a better understanding of AI. This result shows that if teachers do not feel confident about how a tool works, they will not feel confident about using it with students. This may be a good general rule. However, a deep understanding of AI requires deep skills. AI tools are used every day by people who do not have many digital skills. Teachers do not necessarily need to be computer scientists to be able to design activities that use AI, but they can engage with their students with a basic understanding of AI. In this case, the difficulty may lie in the paradigm shift between the teacher as a dispenser of knowledge and the teacher as a facilitator of learning.

This research also aims at investigating how responses to the questions in Table 1 were affected by various parameters. For instance, when considering the order of the school in which teachers worked, Figure 7 illustrates that, on average, primary school teachers gave lower responses to all questions. This could be attributed to the difficulty of introducing and using AI-related concepts at a lower level of schooling. This trend was observed across all questions.

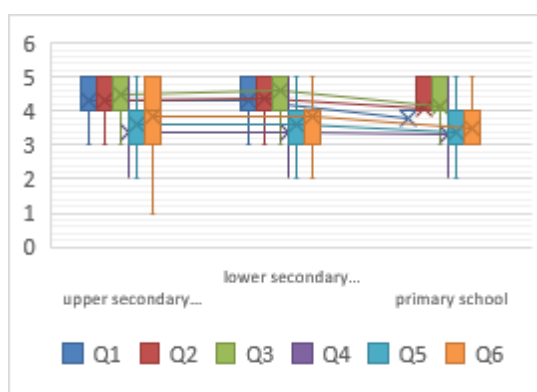


Figure 7: Answers to questions of Table 1 divided by order of school.

Considering the age of the teacher (Figure 8), the trend is similar for all questions across all three age groups, with a slight difference for Q6. Younger teachers appear to agree more on the fact that designing teaching activities to prepare for AI is necessary.

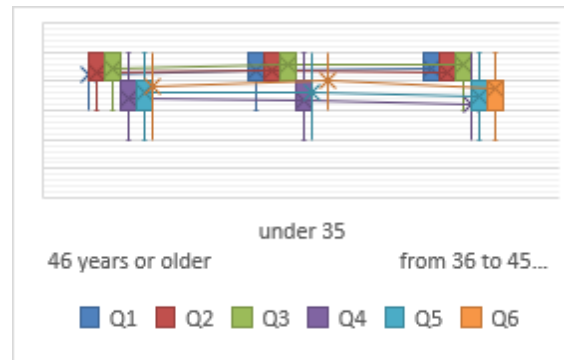


Figure 8: Answers to questions of Table 1 divided by age of teachers.

Regarding years of teaching (Figure 9), the answers do not differ among the groups considered. Based on the average trends, it can be concluded that teachers with fewer years of service are the category that most agrees with the statements in Table 1.

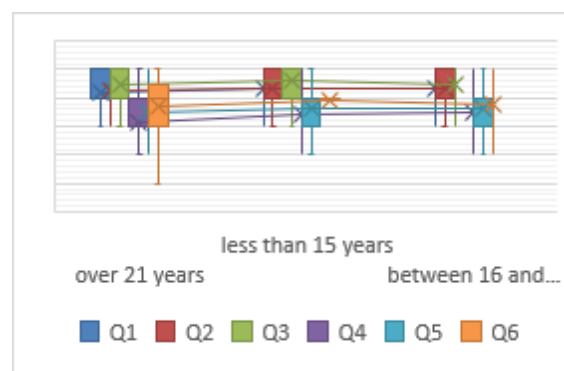


Figure 9: Answers to questions of Table 1 divided by levels of years of teaching.

The investigation into gender differences did not yield significant results (Figure 10). However, it should be noted that the number of female teachers who responded is approximately three times higher than that of male teachers.

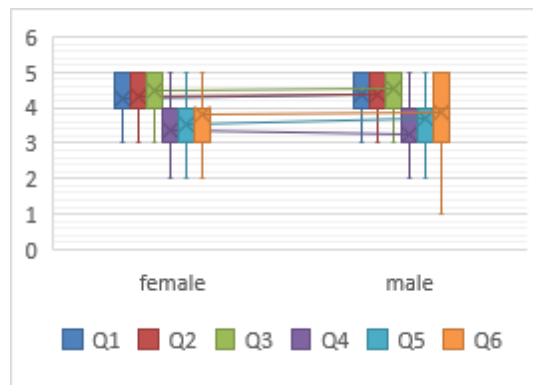


Figure 10: Answers to questions of Table 1 divided by gender of teachers.

5 DISCUSSION

The increasingly widespread use of AI across various sectors is a notable trend globally. AI technologies are being adopted in diverse fields, including education. The paper presents teachers' perspectives on AI in terms of their knowledge, use, and interest in receiving training on AI in the education field. The results from a survey proposed to 255 Italian teachers of all levels and disciplines from October 2023 to January 2024 managed to identify important considerations and needs of teachers. The results show the level of diffusion and the teachers' perspective on the use of AI in Italian schools.

The sample of respondents is largely made up of elderly teachers, some of whom may be at the end of their careers, and one might expect them to be less inclined to use innovative tools; instead, a high propensity to learn about and use AI tools for teaching purposes was found. Some teachers (34.1%) have already attended AI training courses, but few of them frequently employ AI for personal use in their daily lives (14.8%). The low confidence in their skills and knowledge of AI emerged. This is probably due to a lack of previous steps, i.e. general knowledge about AI, how it works and its aspects and characteristics, in fact, teachers strongly agree with the statement related to their needs to learn to use, know and recognise AI and its ethics and where it intervenes in everyday life. Their insecurity could be due to the fact that the schools where they teach (96.1% of the schools of the respondents) do not follow specific policies on the use of AI and only 11.4% of respondents state that the school where they work encourages the use of AI-based applications in the classroom. Accordingly, if teachers are unsure of their AI skills, they are reluctant to use AI not only for personal use, but also for educational purposes. Teachers' confidence in their knowledge of AI applications in education is very low, as highlighted in the results. Integrating AI into education requires not only technological literacy but also an understanding of how to effectively leverage AI tools to enhance the learning experience. In this sense, an important synergy between education, research, and teacher training is necessary to meet the educational and training needs of the constantly evolving technological field. As emphasised by Gocen and Aydemir (2020), in order to implement strategic and targeted interventions, it is necessary to know what teachers need and how they work to create solutions that are sustainable in real-world settings. It is precisely from this perspective that the survey has been formulated precisely to test the waters of Italian teachers and to be able to act with targeted interventions to accompany teachers in this delicate transition. The fact that teachers are not too afraid of the massive proliferation of AI in various fields is a hopeful sign, suggesting that they are willing to learn new tools and keep up with technological developments. As highlighted in the results, the majority of teachers said they strongly need training in AI, which is another sign of the current willingness and readiness of teachers to learn and integrate new AI tools into education. The urgent need of training programs for teachers was also suggested in (Lo, 2023) and it is probably also dictated by the large gap between the ease of use of AI-based tools and the difficulty teachers have in explaining the mechanisms and technologies behind them (Fissore et al., in press).

6 CONCLUSIONS

This study provides an overview of Italian teachers' attitudes towards AI-related topics and an overview of the use of AI in Italian schools. The findings suggest a need for teacher training to prepare them for AI, including its integration into daily life and the associated ethical issues. At the European level, there are many initiatives to define guidelines for the use of AI in education, to guide schools, teachers, and students in the conscious use of AI.

To answer the first research question "How confident are Italian teachers about AI?" even though about 1/3 of the teachers interviewed have attended a training course on AI, it is possible to state that they are not yet confident in their knowledge of the topics. As a consequence, even if teachers agree that it is important for students to learn about and recognise AI and where it is intervening in everyday life, a large proportion of them do not include AI tools in their teaching or introduce students to AI technologies.

To answer the second research question "How much do Italian teachers use AI in education?" up to now it is possible to state that AI is slowly making its way into didactics of Italian teachers. It might depend on the fact that teachers still do not know how to deal with AI technologies. It could also depend on the fact that teachers still do not know how to move into AI technologies, so it is necessary to train them to deepen these new realities and tools and to integrate them into education. In this moment it is important to support teachers through this important change and guide them to use AI tools without seeing them as a threat but rather as a resource to enhance the learning process.

Thus, in response to the third research question, "How interested are Italian teachers in training on AI in education?", it is not only possible to state that the majority of teachers are interested in training on AI, because it is not just a question of interest, but there is an urgent need at the moment to know and to be able to use new AI technologies.

We are aware that the sample of teachers is limited to STEM teachers mainly in upper secondary education. This was a first step of scanning teachers' attitude towards AI aimed at fostering a reasoned and purpose-driven use of AI in educational practice.

In the future, we hope that Italian schools will also play their part in facilitating the use of innovative tools such as AI by introducing guidelines, also defined by institutional reference frameworks, that could guide them in this transition and also facilitate teachers' work.

Additionally, we aim to understand how students at different levels of education perceive the world of AI. The goal will be to understand how students interact with new and emerging tools in the field of AI, how consciously they use them both in educational settings and in everyday life, and how much they understand about the mechanisms behind using AI-based tools.

The impact of AI on education and research is significant and will continue to evolve and increasingly change the way we teach, learn, and research. To explore the implications of AI in education, the world of education and research must work together.

ACKNOWLEDGEMENTS

The research was carried out within Indam - Istituto Nazionale di Alta Matematica "Francesco Severi" and the national PP&S - Problem Posing and Solving Project.

REFERENCES

Balacheff, N. (1993). Artificial intelligence and mathematics education: Expectations and questions. In *14th Biennial of the Australian Association of Mathematics Teachers* (pp. 1-24). Curtin University.

- Barana, A., Fissore, C., & Marchisio, M. (2020, May). Automatic Formative Assessment Strategies for the Adaptive Teaching of Mathematics. In *International Conference on Computer Supported Education* (pp. 341-365). Cham: Springer International Publishing.
- Barana, A., Marchisio, M., & Roman, F. (2023). Fostering problem solving and critical thinking in Mathematics through generative artificial intelligence. In *The 20th international conference on Cognition and Exploratory Learning in the Digital Age (CELDA 2023)* (pp. 377-385). IADIS press.
- Chassignol, M., Khoroshavin, A., Klimova, A., & Bilyatdinova, A. (2018). Artificial Intelligence trends in education: a narrative overview. *Procedia Computer Science*, 136, 16-24.
- Chen, L., Chen, P., & Lin, Z. (2020). Artificial intelligence in education: A review. *Ieee Access*, 8, 75264-75278.
- COMEST (World Commission on the Ethics of Scientific Knowledge and Technology). (2019). Preliminary study on the Ethics of Artificial Intelligence. <https://unesdoc.unesco.org/ark:/48223/pf0000367823> (last access 26 January 2024).
- Dignum, V., Penagos, M., Pigmans, K., Vosloo, Policy, S. (2021). *Guidance on AI for children (Version 2.0): Recommendations for building AI policies and systems that uphold child rights*. United Nations Children's Fund (UNICEF).
- EC Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions. *Artificial Intelligence for Europe*. COM(2018) 237 final {SWD(2018) 137 final}.
- Fissore, C., Floris, F., Marchisio, M., & Rabellino, S. (2023a). Learning analytics to monitor and predict student learning processes in problem solving activities during an online training. In *2023 IEEE 47th Annual Computers, Software, and Applications Conference (COMPSAC)* (pp. 481-489). IEEE.
- Fissore, C., Fradiante, V., Marchisio, M., Pardini, C. (2023b). Design didactic activities using gamification: the perspective of teachers. In: *Nunes, M. B., Isaías, P., Issa, T., Issa, T. (eds.) Proceedings of E-Learning and Digital Learning* (pp. 11-18). IADIS Press, Porto.
- Fissore, C., Floris, F., Marchisio, M., & Sacchet, M. (2022). Didactic activities on Artificial Intelligence: the perspective of STEM teachers. In *Proceedings of the 19th international conference on Cognition and Exploratory Learning in the Digital Age (CELDA 2022)* (pp. 11-18). IADIS press.
- Fissore, C., Floris, F., Marchisio Conte, M., Sacchet, M. (in press). Teacher training on artificial intelligence in education.
- Floris, F., Marchisio, M., Rabellino, S., Roman, F., & Sacchet, M. (2022). Clustering Techniques to investigate Engagement and Performance in Online Mathematics Courses. In *Proceedings of the 19th international conference on Cognition and Exploratory Learning in the Digital Age (CELDA 2022)* (pp. 27-34). IADIS press.
- Gocen, A., & Aydemir, F. (2020). Artificial Intelligence in Education and Schools. *Research on Education and Media*, 12(1), pp. 13-21.
- Kahraman, H. T., Sagioglu, S., & Colak, I. (2010). Development of adaptive and intelligent web-based educational systems. In *2010 4th international conference on application of information and communication technologies* (pp. 1-5). IEEE.
- Holmes, W., Anastopoulou, S., Schaumburg, H., Mavrikis, M. (2018). *Technologyenhanced Personalised Learning: Untangling the Evidence*. Robert Bosch Stiftung GmbH, Stuttgart.
- Holmes, Wayne; Bialik, Maya; Fadel, Charles; (2023) Artificial intelligence in education. In: *Data ethics : building trust : how digital technologies can serve humanity*. (pp. 621-653). Globethics Publications.
- Lo, C.K. (2023). What Is the Impact of ChatGPT on Education? A Rapid Review of the Literature. *Educ. Sci.*, 13, 410. <https://doi.org/10.3390/educsci13040410>
- Luckin, R., & Holmes, W. (2016). *Intelligence unleashed: An argument for AI in education*. Pearson.
- Miao, F., Holmes, W., Huang, R., & Zhang, H. (2021). *AI and education: A guidance for policymakers*. UNESCO Publishing.
- Ministry for Economic Development (2020), *Proposte per una Strategia italiana per l'intelligenza artificiale*, Elaborata dal Gruppo di Esperti MISE sull'intelligenza artificiale. Retrieved from https://www.mise.gov.it/images/stories/documenti/Proposte_per_una_Strategia_italiana_AI.pdf, last accessed July 25th, 2022.
- OECD. (2023). *Education at a Glance 2023: OECD Indicators*. OECD Publishing, Paris, (<https://doi.org/10.1787/e13bef63-en>)
- Ouyang, F., & Jiao, P. (2021). Artificial intelligence in education: The three paradigms. *Computers and Education: Artificial Intelligence*, 2, 100020.
- Pedro, F., Subosa, M., Rivas, A., & Valverde, P. (2019). Artificial intelligence in education: Challenges and opportunities for sustainable development, Education 2030, UNESCO (<https://unesdoc.unesco.org/ark:/48223/pf0000366994>)
- Samoili, S., Cobo, M. L., Gómez, E., De Prato, G., Martínez-Plumed, F., & Delipetrev, B. (2020). *AI Watch. Defining Artificial Intelligence. Towards an operational definition and taxonomy of artificial intelligence*. EUR 30117 EN, Publications Office of the European Union, Luxembourg, ISBN 978-92-76-17045-7, doi:10.2760/382730, JRC118163.
- Zhong, Y. X. (2006, July). A cognitive approach to artificial intelligence research. In *2006 5th IEEE International Conference on Cognitive Informatics* (Vol. 1, pp. 90-100). IEEE.