ARE FUTURE TEACHERS READY TO INTEGRATE ARTIFICIAL INTELLIGENCE INTO EDUCATION? AN EVALUATION OF A TRAINING INTERVENTION ON A SAMPLE OF ITALIAN PRE-SERVICE TEACHERS

I FUTURI INSEGNANTI SONO PRONTI A INTEGRARE L'INTELLIGENZA ARTIFICIALE NELL'ISTRUZIONE? UNA VALUTAZIONE DI UN INTERVENTO FORMATIVO SU UN CAMPIONE DI INSEGNANTI ITALIANI IN FORMAZIONE

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ABSTRACT

This study examined pre-service teachers' perceptions of AI following a 9-hour training on its educational applications. Pre/post questionnaires assessed changes in knowledge, trust, perceived ease of use and intention to use. Results showed significant improvements, confirming the effectiveness of targeted training in promoting AI integration in education.

Lo studio ha esaminato la percezione dell'IA da parte di futuri insegnanti dopo un training di 9 ore sulle sue applicazioni educative. Questionari pre/post hanno valutato cambiamenti in conoscenza, fiducia, facilità d'uso e intenzione d'uso. I risultati mostrano miglioramenti significativi, confermando l'efficacia della formazione mirata per l'integrazione dell'IA nella didattica.

KEYWORDS
AI, Education, AI training, AI perception, Pre-service Teachers
IA, Istruzione, Formazione sull'IA, Percezione sull'IA, Futuri Insegnati

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Introduction

Contemporary education is undergoing a profound transformation in which artificial intelligence (AI) is shifting from an emerging technology to an integral component of school practices. Its applications range from personalized learning and automated assessment to support for instructional design. However, alongside its potential, significant challenges arise concerning trust, transparency, and the evolving role of the teacher (Gentile et al., 2023).

Pre-service teachers tend to approach AI with a mix of enthusiasm and hesitation. While many recognize its educational potential, their engagement is often hindered by concerns about professional autonomy, the opacity of algorithmic systems, and unresolved ethical implications (Altinay et al., 2024). These concerns, combined with a generally limited familiarity with intelligent technologies, represent substantial barriers to the effective integration of AI into educational contexts (Chounta et al., 2022).

Recent literature also highlights the importance of promoting, through training, a critical understanding of artificial intelligence that goes beyond technical acquisition to include pedagogical, ethical, and relational dimensions (Re et al., 2024). In this context, training should also equip future teachers with the tools to thoughtfully address complex issues such as fairness, transparency, and accountability. Several recent contributions have begun to address this need in a structured and pedagogically grounded way, emphasizing not only the practical relevance of AI in university education, but also the importance of connecting AI ethics with broader collective moral progress (Gulbay et al.,2024). Since these aspects are highly context-dependent, there is a growing need for domain-specific educational resources to support informed and responsible AI integration in educational practice (Holstein et al., 2019). Moreover, fostering AI literacy has been shown to reduce concerns and nurture confidence among pre-service teachers, enabling more constructive engagement with intelligent technologies in educational contexts (Hur, 2024). At the same time, the implications of students' use of AI for assessment practices and classroom dynamics reinforce the urgency of preparing future educators to manage these shifts with awareness (Pitrella et al., 2023). A recent experience with primary teacher education students showed how the integration of ChatGPT into course activities, guided by shared rules and critical reflection, can support active and responsible engagement with AI (La Marca &

Falzone, 2024). Despite the growing interest, to date no studies have evaluated the effectiveness of short, practical, and reflective training interventions targeting pre-service teachers, particularly within initial teacher education programs in the Italian context.

In light of these considerations, the present study aims to analyze the effectiveness of a short training intervention on artificial intelligence addressed to first-year students enrolled in a Primary Education degree program. The objective is to assess to what extent introductory, practical, and reflective activities may influence pre-service teachers' perceptions, with a specific focus on four key dimensions: knowledge of AI, trust in its use, perceived ease of use, and intention to adopt AI in future educational practice. A pre- and post-training questionnaire was administered to detect potential changes in these areas.

To contextualize the intervention, the article is structured as follows: the first section reviews recent educational initiatives focused on AI-based teacher training; the second explores existing research on pre-service teachers' perceptions of artificial intelligence. The methodology section then outlines the training program and data collection process, followed by a presentation and discussion of the results regarding the impact of the intervention.

1. Teacher Training on Artificial Intelligence: Evidence from recent educational interventions

Several studies have proposed training programs aimed at in-service or pre-service teachers, with the goal of introducing AI into educational practice. Some contributions have focused on the development of operational skills and the exploration of the didactic potential of generative tools. Kaya (2024) designed an intervention focused on the educational use of AI technologies for English language instruction, combining demonstration-based activities, practical exercises, and guided reflection. The program reported increased levels of confidence, motivation, and willingness to use AI tools in educational settings. In a similar direction, Hur (2025) integrated a module on AI into a university-level educational technology course for future teachers. The intervention included content on machine learning, generative AI, and educational applications, and aimed to foster pedagogical familiarity with intelligent systems. Across these interventions, a recurring emphasis is placed on the need for experiential, practice-based learning

environments that allow teachers to understand not only how AI works, but how it can be pedagogically integrated.

Other authors have developed training models oriented toward transferability and personalization. A notable example is the program by Jetzinger et al. (2024), designed for computer science teachers and structured around conceptual content, practical applications, and active teaching strategies, with a modular format to allow adaptation to different contexts. In contrast, Shi (2021) proposed a model based on an AI-driven platform, capable of generating individualized training pathways aligned with participants' preferences and initial performance. These models reflect a growing awareness of the need to differentiate training based on participants' background, competencies, and instructional environments. In both cases, the results indicate a positive impact on the perceived relevance and effectiveness of the training.

Another line of research has focused on the relationship between teacher training and trust in intelligent technologies. Nazaretsky et al. (2022) presented a program focused on AI-based grading systems in secondary education, with particular attention to the limits of automation and the comparison with human evaluation. Complementarily, professional development opportunities were offered to teacher educators in higher education to foster critical reflection on the pedagogical, ethical, and institutional implications of generative AI (Estaiteyeh & McQuirter, 2024). These contributions highlight how structured reflection and collaborative discussion can foster not only technical knowledge but also a more critical and informed engagement with AI in education.

Another recurrent element is the tension between enthusiasm for innovation and persistent concerns about ethical risks, particularly regarding data use, assessment fairness, and the evolving role of teachers. Overall, the reviewed literature highlights not only a diversity of training formats, but also a shared recognition of the importance of structured, flexible programs that combine technical knowledge, pedagogical reflection, and professional relevance.

While these initiatives highlight the importance of experiential and context-sensitive approaches, to date little attention has been devoted to the development and evaluation of early-stage training programs for pre-service teachers, particularly addressing their trust and acceptance of AI tools. This gap underlines the relevance of the present study.

2. Attitude of teachers towards AI

Numerous studies have highlighted that teachers' perceptions of AI represent a key factor in the effective adoption of AI-based technologies in education. In particular, theoretical models such as the Technology Acceptance Model (Venkatesh & Bala, 2008) emphasize that perceived usefulness and ease of use directly influence the intention to adopt new technologies. For example, Zhang et al. (2025) applied an extended TAM3 model to a sample of 483 pre-service teachers, integrating variables such as trust in AI and perceived risks related to privacy and security. Their results confirmed the central role of perceived usefulness and ease of use in predicting the intention to use AI, while also highlighting that trust, influenced by privacy and data security concerns, acts as a mediating factor in AI acceptance. Similarly, Nazaretsky et al. (2022) pointed out that practical activities and reflective exercises can reduce algorithmic aversion and foster a more informed trust towards AI-based educational systems. Procedural knowledge and direct experience thus appear to be key elements in promoting critical trust. Another study (Nazaretsky et al., 2025) highlighted the role of perceived teachers' trust in shaping both attitudes and actual adoption of technologies such as IA.

Several qualitative and mixed-methods studies have further shown that, even in the absence of specific training, teachers perceive AI ambivalently. On one hand, they recognize its potential for supporting personalized learning, classroom management, and fostering student creativity (Nirchi et al., 2024; Altinay et al., 2024). On the other hand, they express concerns about technological dependence, loss of educational control, weakening of students' critical thinking skills, and lack of transparency in AI decision-making processes (Chounta et al., 2022; Gulbay & Pitrella, 2024).

Altinay et al. (2024), for instance, found that while future teachers appreciate the potential of AI to personalize and enhance student feedback, they also express significant concerns about ethical risks, emotional distancing, and the possible replacement of human teachers. Similarly, Chounta et al. (2022) revealed that although teachers often have only superficial knowledge of AI, they maintain a generally positive attitude, accompanied by significant concerns regarding the erosion of human interaction and the reliability of AI systems operating independently. Particular attention should also be given to widespread misconceptions. Antonenko and Abramowitz (2023) identified frequent

misconceptions such as anthropomorphizing AI systems, overestimating their decision-making capabilities, and confusing automation with true artificial intelligence. These misunderstandings contribute to both unrealistic expectations and unjustified resistance. Ethical concerns appear central to the perceptions emerging from more recent studies. Gulbay and Pitrella (2024) conducted a qualitative analysis involving 244 pre-service teachers, highlighting major concerns about privacy, data security, technological illiteracy, the potential decline of critical thinking, algorithmic bias, and the impoverishment of the teacher-student relationship. At the same time, participants recognized multiple perceived benefits of AI in education, including personalized learning pathways, increased inclusivity, easier access to educational resources, and support for teachers. This research also emphasized the urgent need for transparent AI systems and structured training programs that foster a critical and responsible use of AI technologies. As noted by UNESCO (Cukurova & Miao, 2024), the responsible integration of AI in education requires teachers to develop critical understanding of AI mechanisms, ethical awareness, pedagogical integration skills, and a human-centered approach. Similarly, Korte et al. (2024), in an international training initiative involving students from 13 countries, demonstrated that collaborative, flipped-classroom-based laboratories can significantly enhance conceptual knowledge and trust in AI even among participants with little prior experience.

In summary, recent literature confirms that teachers' perceptions of AI are complex and multifaceted, influenced by cognitive, emotional, and ethical factors. Nevertheless, there remains a lack of studies systematically analyzing how short, targeted training interventions can modify these perceptions, correct misconceptions, reduce emotional barriers, and promote a critical, informed, and responsible approach to AI in education. The present study aims to contribute to filling this gap by evaluating the impact of a short training intervention on pre-service teachers' knowledge, trust, perceived ease of use, and intention to use AI in their future professional practice.

3. Aims of the study

Based on the analysis of the existing literature, the main research question the current study focused on was the evaluation of the effect of a training intervention

on teacher students' acceptance of and literacy in AI solutions. Specifically, the study was primarily interested in answering the following question:

To what extent did a training intervention focused on AI tools for education impact future teachers' AI literacy and their acceptance of AI educational tools in terms of perceived ease of use, perceived usefulness, perceived trust, and intention to use?

As a consequence, the specific aims of the study were:

1) to examine whether the training intervention had a significant impact on students' AI literacy;
2) to assess the impact of the intervention on participants' acceptance of AI tools, measured in terms of a) perceived ease of use, b) perceived usefulness, c) perceived trust, and d) intention to use AI tools for educational purposes.

4. Method

4.1 Research Design and participants

The research design selected for the current study was a single group pre-test/post-test design. Specifically, participants were selected among students of the second year of a Degree program in primary education of an Italian University. Students attending a course of Educational Technologies participated in a training of 9 hours designed to deepen knowledge and educational application of Generative AI tools for educational purposes. Participants underwent a pre-test and a post-test administration of questionnaires to evaluate their AI literacy and acceptance of AI technology before and after the educational training respectively. Participation in the study was voluntary and participants were asked to provide their consent before any evaluation and training activity was started.

4.2 Measures

4.2.1 Demographics

First of all, the survey included questions about age, gender, high school degree, and current academic year of study. After these first introductive questions, a questionnaire comprising 14 item was administered at both pre- and post-test evaluations to assess participants' acceptance of AI and their trust levels. Finally,

for the purposes of evaluating AI literacy learning gains among participants, an additional questionnaire consisting of 22 items was administered at the end of the training program.

4.2.2 Acceptance of AI technology

Participants' acceptance of AI in terms of perceived usefulness (PU), perceived ease of use (PEU), and behavioral intention to use (BI) was assessed using items derived from the TAM 3 model (Venkatesh & Bala, 2008). Specifically, 4 items were used to assess both PU and PEU, and 3 items for behavioral intention. Four additional items, adapted from Choi et al. (2023) (Choi et al., 2023) were included as a measure of participants' perceived trust in AI technologies. All the items were measured on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). These items were administered at both pre- and post-test evaluation.

4.2.3 AI Literacy

The Scale for the Assessment of Non-Experts' AI Literacy (SNAIL; Lauplicher et al., 2023a, 2023b) was used to assess participants' learning gains and thus evaluate the effectiveness of the AI training. The scale consists of 31 items asking participants to rate their competencies both in a retrospective manner (i.e., before the participation in the training) and with regard to their current capability (i.e., after the training). Each competency (presented in the corresponding item) can be rated on a seven-point Likert scale from "strongly disagree" to "strongly agree". In the original studies the 31 items loaded into three factors, evaluating technical understanding, critical appraisal, and practical application. Given the specific topics of the training evaluated in the current study, a selection of 22 items was made to evaluate AI literacy and its specific dimensions. To this aim, total scores were first calculated by summing all the 22 selected items, as a measure of general AI literacy. In addition, total scores were also calculated by summing items composing each dimension as measures of technical understanding, critical appraisal, and practical application, respectively. oThe questionnaire was administered only at post-test evaluation.

4.2.4 Statistical Analyses

Frequencies, means and standard deviations, and range were to describe the sample of students participating in the study. In order to answer the research

questions, a series of Welch's t-tests were computed to assess the difference between pre-test and post-test administrations in participants' level of AI acceptance, trust, and AI literacy (i.e., retrospective vs. current evaluation). All the data analyses were run using RStudio (v. 2024.04.1+748).

4.3 Procedure

Participants were first required to complete a pre-test evaluation of their level of AI acceptance and trust. After this preliminary administration, they participated in a training program which consisted of seven modules, divided across three sessions each lasting 3 hours, for a total of 9 hours. The course was held between March and April 2024, for a total of 3 weeks.

The training program was designed to foster these topics through introductory, practical, and reflective activities. The contents were organized into seven thematic modules combining conceptual foundations with applications of AI in education. Table 1 provides an overview of the training schedule and topics addressed during the intervention.

Module	Topic	Description
1	History of AI	Overview of key developments in the evolution of artificial intelligence.
2	Strong vs. Weak AI	Introduction to the distinction between general (strong) and narrow (weak) AI.
3	Symbolic vs. Sub-symbolic AI	Comparison between rule-based systems and data-driven approaches.
4	Generative AI and LLMs	Exploration of generative AI technologies, with a focus on large language models.
5	Learning Analytics	Presentation of AI tools for tracking and analyzing student learning data.
6	Chatbots in Education	Use of AI-driven conversational agents to support learning and interaction.
7	Prompt Engineering	Practical strategies for crafting effective prompts to guide AI responses.

Table 1. Schedule of the training program

5. Results

A total of 312 student teachers completed the pre-test questionnaires while only 216 participants completed the post-test survey. Data from both pre-test and post-test administrations were available only for 205 participants and results reported here are derived from analyses run on data from those participants. Table 2 reports descriptive statistics for the sample of participants who completed both assessments. Most of participants were female (n=195) with a mean age of 20.85 years (s.d. = 4.6) and a range from 18 to 51. Moreover, almost all (n= 201) were attending the first year of the university degree when the study was conducted.

Characteristics	**N (%)**	**M (± d.s.)**
Age		20.85 (± 4.6)
Gender		
Female	195 (95%)	
Academic year		
First	201 (98%)	
Second	2	
Fifth	2	

Table 2. Participants' characteristics

With regard to the first aim of the study, a series of four paired Welch's t-test were computed to evaluate the difference in total scores in perceived usefulness, perceived ease of use, trust, and behavioral intention to use between pre-test and post-test administrations. According to the results highlighted in Table 3, all Welch tests show a statistically significant increase in the total scores across the four evaluated dimensions; consequently, the results confirm that the intervention had a positive impact on the four dimensions of acceptance of AI tool for educational purposes.

AI Acceptance	Pre-test M (± s.d.)	Post-test M (± s.d.)	t statistic	p value
Ease of use	12.48 (2.91)	13.34 (2.79)	4.60	<0.001
Perceived usefulness	14.00 (3.01)	15.33 (3.04)	7.03	<0.001
Trust	12.54 (2.76)	13.18 (3.05)	3.74	<0.001
Intention to use	10.75 (2.42)	11.58 (2.41)	5.25	<0.001

Table 3. Results of the paired Welch tests for AI Acceptance levels

As for the second aim, an additional series of four paired Welch's t-test were computed to evaluate participants' learning gains in AI literacy and in its dimensions potentially due to the training intervention. Similar to the previous table, Table 4 reports the results of the four t-tests.

AI Literacy	Pre-test M (± s.d.)	Post-test M (± s.d.)	t statistic	p value
Total scores	20.34 (8.88)	42.78 (7.48)	30.47	<0.001
Technical understanding	17.83 (9.62)	43.2 (9.42)	29.12	<0.001
Critical appraisal	15.11 (5.86)	28.19 (4.83)	28.57	<0.001
Practical application	20.34 (8.88)	42.78 (7.48)	29.41	<0.001

Table 4. Results of the paired Welch tests for AI Literacy learning gains

All the Welch t-tests showed statistically significant differences between participants' retrospective assessment of their AI literacy and the assessment done with regard to their perceptions at the end of the training intervention. These results provide confirmation to the hypothesis that the training intervention could have exerted a positive impact on student teachers' literacy in AI tools.

6. Discussion

The primary aim of the present study was to examine the effectiveness of a training intervention in enhancing teacher students' AI literacy and their acceptance of AI tools for educational purposes. More specifically, the first aim was to evaluate the impact of a training intervention on participants' perceived ease of use, perceived usefulness, trust, and behavioral intention to use AI technologies. The second aim focused on assessing improvements in participants' AI literacy, with regard to technical understanding, critical appraisal, and practical application of existing AI solutions. The results revealed statistically significant increases in participants' levels of all dimensions of AI acceptance after the intervention. Similarly, significant learning gains were observed across all components of AI literacy. Overall, the findings from this study support the effectiveness of the intervention in fostering both higher acceptance and enhanced literacy in the use of AI tools among future teachers.

A closer look at individual results highlights several relevant trends. The significant increase in perceived ease of use suggests that hands-on activities and guided exploration within the training were effective in demystifying AI tools. This result aligns with Kaya (2024), who emphasized that experiential learning supports the development of self-efficacy in using educational technologies, thereby reducing initial anxiety and barriers to adoption.

The improvement in perceived usefulness indicates that participants not only learned how to use AI tools, but also began to recognize their pedagogical value. This mirrors the findings by Jetzinger et al. (2024), who demonstrated that training programs that contextualize AI applications within authentic teaching scenarios contribute to a stronger sense of relevance and applicability, which in turn increases perceived utility.

The positive change in trust toward AI tools is particularly noteworthy. Trust is a critical yet often fragile factor in the adoption of AI in education, often undermined by concerns about transparency, privacy, and autonomy (Zhang et al., 2025; Nazaretsky et al., 2022). The results suggest that even a short training, when designed to encourage critical engagement, can reduce algorithmic aversion and foster informed trust. This supports the idea promoted by Gulbay & Pitrella (2024) that structured opportunities for reflection, combined with improved literacy, help future teachers develop a more balanced and responsible view of AI systems.

The increase in behavioral intention to use AI reflects a convergence of the above dimensions. According to the TAM3 model (Venkatesh & Bala, 2008), intention is shaped by the interplay between cognitive (ease and usefulness) and emotional (trust) factors. The coherence between these constructs in the present results supports the validity of the extended TAM3 framework employed.

From the perspective of AI literacy gains, the results indicate a clear enhancement in technical understanding; this suggests that participants acquired foundational knowledge about how AI works, that is a basic requirement for any informed educational use. The increase in critical appraisal shows that participants developed the ability to reflect on ethical, societal, and pedagogical implications; these dimensions have been emphasized as relevant for teachers in recent recommendations such as the UNESCO AI Competency Framework for Teachers (Cukurova & Miao, 2024).

The improvement in practical application indicates that students not only gained conceptual knowledge but were able to translate it into classroom-relevant strategies. This outcome echoes the findings by Korte et al. (2024), who showed that collaborative, application-oriented formats enhance not only confidence but readiness to integrate AI tools into practice.

In summary, the findings support the hypothesis that short, focused training interventions, designed to be reflective, contextualized, and experiential, can significantly impact both the perception and the readiness of future teachers to engage with AI in meaningful ways. They also highlight the need for future teacher education programs to address not only the technical aspects of AI, but also its ethical, relational, and pedagogical dimensions.

7. Conclusions

The results of this study highlight the transformative potential of short and targeted training programs on artificial intelligence for future teachers. The observed increases across all measured dimensions of AI acceptance (i.e., perceived ease of use, usefulness, trust, and intention to use) and participants' perceived learning gains related to AI literacy suggest that even brief interventions, when well-designed, can produce meaningful changes in participants' attitudes and competencies.

A key strength of this study lies in the integration of theoretical, practical, and reflective components within the training program, which enabled a multi-layered learning experience (cognitive, critical, and operational). The use of validated instruments and the extension of the TAM3 model to include the variable of *trust* allowed for a more nuanced understanding of the adoption process, capturing dimensions that are often overlooked in educational technology research.

Nevertheless, several limitations must be acknowledged. Most notably, the absence of a control group prevents any definitive attribution of the observed effects solely to the intervention. Additionally, data collection from a single Italian university and the use of retrospective self-assessment measures limit the generalizability and reliability of the findings. The lack of a follow-up assessment also makes it impossible to determine the long-term retention of acquired skills and attitudes.

Future research should adopt more robust experimental designs, involve multiple educational contexts, and incorporate qualitative methods (e.g., reflective journals, interviews, classroom observations) to better explore how perceptions and practices related to AI evolve over time. Furthermore, it will be important to examine whether and how the acquired competencies are actually translated into teaching practices during internships or in the early years of professional experience.

Author contributions

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