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Teachers, Artificial Intelligence, and Special Educational Needs: Knowledge, Practices, and Operational Awareness in the Italian School System

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Abstract: The integration of Artificial Intelligence (AI) into educational contexts requires teachers to move beyond technical proficiency toward reflective and inclusive practices. This study investigates Italian teachers' knowledge, practices, and operational awareness of AI-based tools, with particular attention to their application for students with special educational needs (SEN). A mixed-method design was adopted, combining a questionnaire administered to 160 teachers with open-ended responses analyzed thematically. Quantitative analyses (ANOVA, MCA, cluster analysis, and ordinal logistic regression) were conducted using Jamovi, while qualitative data were coded with Taguette and supported by lexical analysis in Voyant Tools. Results highlight significant differences in AI Literacy across school levels: secondary teachers and those in support roles display higher reflective and adaptive use of AI. Four teacher profiles emerged, ranging from functional to reflective-experimental. Thematic analysis confirmed a predominance of functional familiarity and disciplinary use, alongside increasing attention to personalization and accessibility. Overall, findings indicate that Italian teachers are in a transition phase toward reflective and inclusive AI integration, emphasizing the need for structured training that transforms technical competence into pedagogical and ethical awareness.

Keywords: Artificial Intelligence in Education; Teacher professional development; Inclusive practices; AI Literacy; Special Educational Needs.

1. Introduction

The integration of Artificial Intelligence (AI) in educational settings is profoundly redefining teaching, assessment, and instructional design, opening up new horizons for innovation but also for pedagogical complexity (Crompton & Song, 2024; Isidori, Muccini, & Evangelista, 2024). The use of intelligent systems capable of generating content, personalizing learning paths, or anticipating learning difficulties has ushered in a momentous transition in the way schools interpret learning and inclusion processes (Raza A., 2024). However, the pace of technological innovation has not been matched by an equivalent development in teachers' readiness and the

operational awareness required for critical and reflective integration of these tools (Ertmer & Ottenbreit-Leftwich, 2010; Zawacki-Richter et al., 2024).

Internationally, the literature highlights a progressive convergence between digital competence models and emerging concepts of AI literacy, understood not only as a technical skill but as the ability to understand, evaluate, and consciously use artificial intelligence in educational processes (Long & Magerko, 2020). AI literacy therefore emerges as an extension of the DigCompEdu framework (Redecker, 2017) and TPACK models (Koehler, Mishra, & Cain, 2013), in which the ethical, reflective, and inclusive dimensions play a central role. Despite this, numerous studies confirm that teachers' skills remain fragmented, with a gap between theoretical knowledge and the ability to apply it in a situated way (Nirchi et al., 2025; Karatas & Yüce, 2024).

From a theoretical perspective, the technology acceptance paradigm has provided effective interpretative tools for understanding technology adoption processes over the decades, starting with the Technology Acceptance Model (Davis, 1989) and its subsequent extensions (Venkatesh & Davis, 2000; Venkatesh et al., 2003). These models have highlighted the role of perceptions of usefulness and ease of use, as well as subjective beliefs and norms, in determining technology use behavior. Applied to the educational context, they have helped explain the complex interaction between knowledge, beliefs, and organizational culture that influences the integration of digital technologies into teaching practice (Straub, 2009; Šumak, Heričko, & Pušnik, 2011; Teo, 2011). In the AI era, however, these models require a conceptual extension capable of including epistemic, ethical, and relational dimensions that influence teacher agency and teaching design.

In the Italian context, the digital transformation of schools has been driven by far-reaching policies, such as the National Digital School Plan (MIUR, 2015) and Decree 328/2022, which have promoted the strengthening of digital skills in initial and in-service teacher training. However, recent surveys indicate that specific training on AI remains limited and uneven, with significant regional and school-level differences (Lamacchia et al., 2024). Only a minority of teachers report feeling ready to integrate AI-based tools into their daily practice, and even fewer report possessing skills related to personalization or inclusion (Fiorucci & Bevilacqua, 2024). This gap between technological availability and operational awareness risks amplifying inequalities, especially in the field of Special Educational Needs (SEN), where instructional design mediated by intelligent technologies requires careful ethical and pedagogical reflection.

Against this backdrop, this study aims to systematically analyze the relationship between declarative knowledge, operational practices, and reflective awareness among Italian teachers in the use of digital and AI-based tools, with particular attention to their application in cases of Type B Special Educational Needs (specific learning disabilities, ADHD, language disorders, and mild intellectual disabilities). The objective is twofold: on the one hand, to map current knowledge and practices; on the other, to identify the predictive factors that foster a conscious and inclusive use of artificial intelligence in teaching. The approach follows the lines of sociomaterial models of distributed agency (Latour, 2005; Suchman, 2007), considering teachers not as simple users, but as co-constructors of pedagogical meaning through interaction with intelligent technologies.

2. Background

Integrating Artificial Intelligence (AI) into educational settings requires a perspective that transcends the technical dimension, incorporating reflective, ethical, and inclusive skills. Several theoretical models, AI Literacy, TPACK, DigCompEdu, and Technology Acceptance, offer complementary insights into how teachers understand, evaluate, and use intelligent technologies in teaching practice.

2.1. AI Literacy and Reflective Awareness

AI literacy (Long & Magerko, 2020) encompasses the ability to understand, use, and critically evaluate AI systems in relation to educational purposes. It integrates operational skills, ethical awareness, and metacognitive reflection, emerging as a key skill for teaching in the 21st century (Lintner, 2024; Pagliara, Rossi, & Bianchi, 2024). In inclusive contexts, AI literacy becomes essential for discerning the appropriate use of tools such as text simplification, speech synthesis, or adaptive systems, capable of reducing or amplifying learning inequalities (Raza A. , 2024).

2.2. TPACK and DigCompEdu: Toward Educational Intelligence

The TPACK model (Koehler, Mishra, & Cain, 2013) interprets technological integration as a dynamic balance between disciplinary, pedagogical, and technological knowledge. With the introduction of AI, this balance extends to a new level: intelligent systems become co-agents in teaching processes, requiring ethical awareness and data-driven decision-making (Celik, 2023).
Similarly, the European DigCompEdu framework (Redecker, 2017) defines six areas of digital competence for teachers, but needs to be expanded to include the management of algorithms and generative systems (Bekiaridis & Attwell, 2024). Both models converge on the idea that teachers' digital competence is not merely technical, but above all, planning, reflective, and relational.

2.3. Technology Acceptance and Teacher Agency

The Technology Acceptance Model (Davis, 1989) and its extensions (Venkatesh et al., 2003) explain technology adoption based on perceived usefulness and ease of use. However, in schools, these variables interact with pedagogical beliefs, professional culture, and contextual conditions (Ertmer & Ottenbreit-Leftwich, 2010). According to the Diffusion of Innovation Theory (Rogers, 2003), teachers act as mediators between educational policies and classroom practices, influenced by organizational culture and risk perception (Karatas & Yüce, 2024). Understanding these factors is crucial to developing an AI readiness that combines technical expertise and ethical reflexivity.

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2.4. Inclusive Education and Distributed Agency

In the field of inclusive education, AI-based technologies offer valuable tools for personalizing curricula and supporting students with Special Educational Needs, but they also raise questions about the risk of bias, decision-making delegation, and the dehumanization of learning (Fiorucci & Bevilacqua, 2024). The socio-material perspective of distributed agency (Latour, 2005; Suchman, 2007) helps us understand the interaction between teachers, technology, and context as a network of co-constructions. In this network, teachers are not simple users, but critical actors who interpret, adapt, and govern the affordances of AI.

Moving at the intersection of these references, this study adopts a systemic and multidimensional approach to analyzing teachers' skills. It is situated:
within the context of AI Literacy, to assess teachers' level of operational and reflective awareness in the use of AI;
In dialogue with TPACK and DigCompEdu, to explore the connection between technological, pedagogical, and inclusive knowledge; and, in the wake of technology acceptance models, to identify the predictive factors (experience, training, self-efficacy) that foster the informed use of AI for Special Educational Needs.
This integrated perspective allows us to analyze AI not as a simple technical innovation, but as an epistemic and pedagogical device that redefines the role and agency of teachers in contemporary inclusive schools.

3. Materials and Methods

3.1 Research design and methodology

The study adopts a mixed-method design approach with an exploratory-descriptive purpose, aimed at investigating teachers' perceptions and informed use of AI in inclusive teaching across different school levels. The research integrates quantitative and qualitative analyses to outline AI literacy profiles and map predictive factors and discursive representations.

3.2 Sample and tools

The sample consisted of 160 teachers from the four levels of education (preschool, primary, lower and upper secondary), with a balanced distribution between general and support positions. Approximately two-thirds reported having received training in digital or AI-based tools. The online questionnaire, structured into closed and open-ended sections, captured:

- socio-professional variables (gender, level of education, type of position, training received);
- dimensions of operational and reflective AI literacy (identification, use,
- planning, adaptation, and trust in AI);
- attitudes and perceptions of effectiveness (e.g., trust, usefulness, inclusive potential);

- *open-ended questions* for the qualitative analysis of the meanings attributed to AI.

The quantitative scales showed good internal reliability (Cronbach's α 0.79–0.88).

The analyses were conducted with:

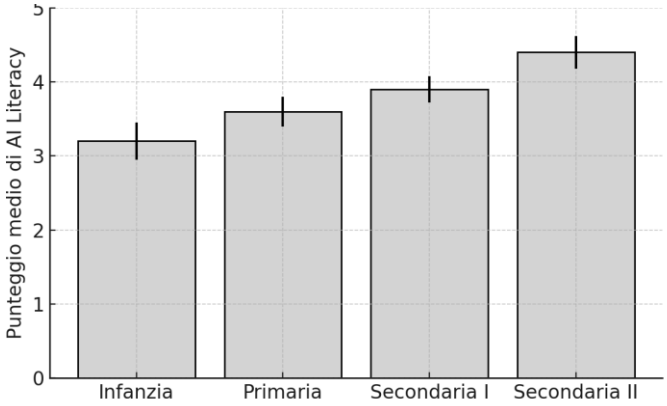
- *Jamovi* (v. 2.6) for statistical analyses: descriptive, MCA (*Multiple Correspondence Analysis)*, *K-means cluster*, *ANOVA*, and o*rdinal logistic regression*;
- *Taguette* for inductive thematic coding (5 categories: knowledge, use, perceived effectiveness, personalization, and BES adaptation);
- *Voyant Tools* for lexical analysis (frequencies, co-occurrences, and lexical density).

4. Results

4.1. Quantitative analysis

Descriptive and inferential analyses allowed us to outline a complex picture of teachers' skills and perceptions regarding the use of artificial intelligence in inclusive teaching. *Multiple Correspondence Analysis* (MCA) showed that the variables most closely associated with the sample distribution were school level and position type. The first dimension, which explains 24.6% of the variance, distinguishes teachers with a pragmatic approach from those with a reflective approach, while the second dimension (18.9%) separates profiles based on training and experience in using AI-based technologies. *ANOVA* revealed significant differences in mean AI literacy scores ($p < .01$). Secondary school teachers reported the highest values, followed by lower secondary school teachers, while primary school and preschool teachers showed lower scores. The *trend* suggests a progressive maturation of digital and reflective skills as professional experience and the complexity of the teaching context increase.

Figure 1. *Differences in mean AI Literacy scores by grade level.*



L'analisi di *cluster* (*K-means*) ha permesso di individuare quattro profili distinti di docenti:

- un profilo medio-equilibrato, con livelli omogenei ma non elevati in tutte le dimensioni;
- un profilo formativo-iniziale, caratterizzato da conoscenza teorica e scarsa applicazione;
- un profilo riflessivo-sperimentale, che integra consapevolmente strumenti di IA nella progettazione e personalizzazione didattica;
- un profilo tradizionale-pragmatico, ancorato a pratiche trasmesse e uso strumentale delle tecnologie.

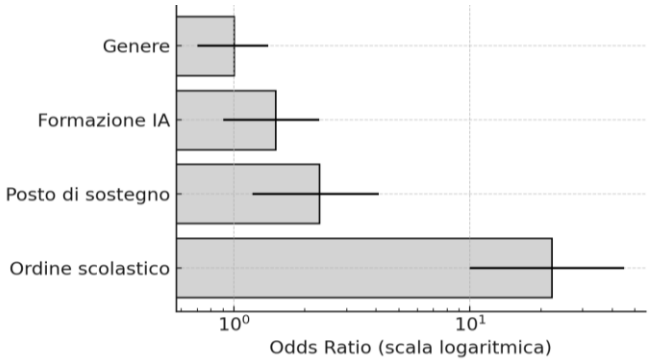
Table 1. Teacher profiles identified through cluster analysis on the dimensions of AI Literacy.

Clustering Table	
Cluster No	**Count**
1	61
2	10
3	15
4	76

Cluster analysis (K-means) identified four distinct teacher profiles:

- an average-balanced profile, with homogeneous but not high levels across all dimensions;
- an initial-formative profile, characterized by theoretical knowledge and limited application;
- a reflective-experimental profile, which consciously integrates AI tools into teaching design and personalization;
- a traditional-pragmatic profile, anchored in transmitted practices and the instrumental use of technology.

Figure 2. *Predictors of AI use for differentiated tasks (Ordinal logistic regression)*



Overall, the quantitative results paint a mixed yet consistent picture: awareness and thoughtful use of AI increase with experience and role complexity, while specific training still has limited impact. These findings converge to suggest the need for training programs aimed at developing design and inclusive skills, capable of transcending the rationale of using technology instrumentally.

4.2 Qualitative analysis

The thematic analysis identified five main categories:

Tabella 2. *Categorie tematiche emerse dall'analisi qualitativa delle risposte aperte dei docenti.*

Codice	Tema	Sintesi interpretativa
C1	**Conoscenza**	Familiarità "funzionale" con strumenti di accessibilità e visualizzazione (text-to-speech, mappe, semplificazione).
C2	**Uso disciplinare**	Impiego pragmatico e multimodale: IA integrata in attività tradizionali (mappe, presentazioni, coding).
C3	**Percezione di efficacia**	L'IA percepita come strumento motivante e metacognitivo (mappe, gamification, esercizi adattati).
C4	**Personalizzazione**	Intesa come differenziazione dei materiali, più che adattamento cognitivo o predittivo.
C5	**Adattamento BES**	Focus su strumenti compensativi (LeggiXme, Balabolka, CAA), con richiesta di maggiore formazione.

Lexical analysis confirms a limited but shared vocabulary (590 forms out of 3,772 words), dominated by terms such as "disciplinare"," mappe", "testi", and "accessibili". This indicates an exploratory and functional teacher profile, with AI Literacy still emerging and oriented more toward simplification than critical reflection.

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4.3. Integrated synthesis

The triangulation of quantitative and qualitative analyses paints a coherent picture of Italian teachers' skills and perceptions regarding the use of artificial intelligence in teaching. The results show that AI literacy increases with experience and school level: secondary school teachers and support teachers exhibit higher levels of reflective use and inclusive adaptation, while in primary and early childhood education, an exploratory and instrumental approach still prevails. Qualitative analyses confirm this trend, highlighting five key themes: functional knowledge, pragmatic disciplinary use, perceived motivational effectiveness, personalization of materials, and adaptation for special educational needs. Responses reveal a growing familiarity with AI, but still focused on compensatory tools rather than predictive or adaptive applications.
Lexical analysis indicates a shared, operational language, oriented toward practice rather than theoretical reflection. Overall, the emerging system is in transition, in which AI is recognized as an opportunity for educational innovation but not yet integrated in a systematic and informed manner.

5. Discussion

This study addressed a critical *gap* in understanding how Italian teachers navigate the integration of artificial intelligence in inclusive education, particularly for students with special educational needs. Our findings reveal a school system in transition, where teachers demonstrate varying levels of AI literacy that correlate significantly with school level and professional role. The emergence of four distinct teacher profiles, from traditional-pragmatic to reflective-experimental, confirms that AI integration in education extends beyond mere technical adoption. These results align with and extend current theoretical frameworks of AI literacy (Long & Magerko, 2020) and technology acceptance (Venkatesh et al., 2003), while highlighting specific challenges in the Italian educational context.

The significant differences in AI literacy across school levels merit particular attention. Secondary school teachers demonstrated markedly higher reflective and adaptive AI use compared to their primary and preschool counterparts, a pattern that challenges the assumption of uniform digital readiness across educational sectors. This finding extends beyond previous research that primarily focused on general digital competence (Redecker, 2017), revealing that *AI literacy* develops through a complex interplay of contextual demands, professional experience, and disciplinary complexity. The higher *AI literacy* among support teachers further suggests that inclusive pedagogical challenges may act as catalysts for technological innovation, supporting Fiorucci and Bevilacqua's (2024) assertion that special education contexts drive adaptive technology use. However, this dis-

parity also raises concerns about equity in AI implementation across school levels, potentially creating divergent educational experiences for students at different developmental stages. The qualitative analysis reveals a predominance of functional familiarity over critical reflection, with teachers primarily conceptualizing AI tools through the lens of compensatory support rather than transformative pedagogical agents. This finding resonates with Ertmer and Ottenbreit-Leftwich's (2010) observation that teachers' pedagogical beliefs significantly influence technology integration, yet it also exposes a concerning limitation. While teachers demonstrate competence with accessibility tools like text-to-speech and concept mapping software, their limited engagement with predictive or adaptive AI applications suggests an incomplete understanding of AI's pedagogical potential. This functional orientation, though pragmatic, may inadvertently perpetuate a deficit model of special education support, where technology serves primarily to remediate rather than reimagine learning experiences. The lexical analysis's revelation of a shared but limited vocabulary further confirms this interpretation, indicating that the discourse around AI in Italian schools remains constrained by traditional conceptual frameworks. The identification of four distinct teacher profiles through cluster analysis provides crucial insights into the heterogeneity of AI readiness within the Italian school system. The prevalence of the traditional-pragmatic profile (47.5% of the sample) alongside the minority reflective-experimental group (9.3%) illustrates the challenge facing educational policymakers. This distribution contradicts assumptions of linear technology adoption suggested by Rogers' (2003) diffusion theory, instead revealing a more complex landscape where professional identity, pedagogical philosophy, and contextual factors interact to shape AI integration patterns. The limited size of the reflective-experimental cluster is particularly noteworthy, as these educators represent the potential vanguard for systemic transformation. Their practices, consciously integrating AI into instructional design and personalization, exemplify the sophisticated *AI literacy* needed for truly inclusive education.

The limited impact of formal training on *AI literacy,* despite two-thirds of participants reporting some form of digital or AI-related professional development, raises fundamental questions about current training approaches. This finding aligns with international evidence suggesting that traditional professional development models fail to address the epistemological and ethical dimensions of AI integration (Zawacki-Richter et al., 2024). The disconnect between training exposure and practical application indicates that current programs may emphasize technical skills at the expense of pedagogical reflection and inclusive design thinking. This interpretation is reinforced by the qualitative data showing teachers' continued reliance on established practices rather than innovative AI applications. From a theoretical perspective, our results extend the *TPACK framework* (Koehler, Mishra, & Cain, 2013) by demonstrating that AI integration requires a fourth knowledge domain: ethical-reflective competence. This dimension, evident in the reflective-experimental profile but absent in others, encompasses the ability to critically evaluate AI affordances, recognize algorithmic biases, and make informed decisions about appropriate use in inclusive contexts. The socio-material

lens of distributed agency (Latour, 2005; Suchman, 2007) proves particularly illuminating here, as teachers' responses reveal ongoing negotiations between human expertise and algorithmic assistance, with many expressing uncertainty about maintaining pedagogical authority while leveraging AI capabilities. The sample size (n=160), while adequate for exploratory analysis, may not fully capture regional variations in the Italian educational landscape. The self-reported nature of AI literacy measures potentially introduces social desirability bias, particularly given current policy emphasis on digital transformation. Additionally, the cross-sectional design prevents causal inferences about the relationship between training, experience, and AI literacy development. The study's focus on Type B special educational needs, while providing specificity, may not address the full spectrum of inclusive challenges faced by Italian teachers. Our findings underscore the inadequacy of purely technical training approaches, advocating instead for professional development that integrates pedagogical, ethical, and inclusive dimensions. The persistence of functional rather than transformative AI use suggests that educational systems must address underlying beliefs about technology's role in learning before meaningful integration can occur. The emergence of teacher profiles provides a framework for targeted interventions, where one-size-fits-all approaches may fail to meet the diverse needs and levels of preparation within the teaching workforce.

6. Conclusions

This study investigated Italian teachers' AI literacy and inclusive practices, revealing a critical transition phase in educational technology integration. Our multi-dimensional analysis advances current understanding by demonstrating that AI literacy transcends technical competence, requiring ethical-reflective capabilities not captured by existing frameworks like *TPACK* or *DigCompEdu*. The identification of four distinct teacher profiles provides an empirical taxonomy for targeted professional development, while the divergence between school levels exposes systemic inequities requiring differentiated policy interventions.

Theoretically, our findings necessitate reconceptualizing *AI literacy* as a fourth-order competence integrating pedagogical, technological, and ethical dimensions within distributed agency networks. The predominance of functional over transformative AI use demands immediate restructuring of teacher training programs. Current professional development, despite widespread implementation, does not yet cultivate the critical-reflective stance essential for inclusive AI integration. Educational policies must shift from generic digital skills training to context-specific programs.

The study's limitations highlight the need for longitudinal, multi-site investigations tracking AI literacy development across diverse regional contexts. Future research should examine the causal mechanisms linking training modalities to reflective practice, investigate AI's impact on learning outcomes for students with diverse special educational needs, and develop validated instruments for assessing ethical-reflective AI competencies.

The emergence of a small but significant reflective-experimental teacher cohort signals transformative potential within the Italian educational system. However, realizing this potential requires systemic commitment to developing teachers as critical co-constructors rather than passive consumers of AI technologies. As artificial intelligence increasingly shapes educational futures, cultivating teachers' capacity for ethical, inclusive, and pedagogically-grounded AI integration becomes not merely desirable but essential for educational equity and innovation.

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