

AI-Mediated Feedback in Education: Teachers' Baseline Perceptions, Opportunities, and Professional Barriers in a Research-Action Context

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Abstract

The integration of Artificial Intelligence (AI) in education is progressively reshaping feedback processes, shifting them from episodic corrective acts to continuous, data-informed, and dialogic mechanisms embedded within learning environments. Building on the Conversational Framework and feedback literacy literature, this study investigates teachers' baseline perceptions of AI-mediated feedback within a research-action professional development pathway. The dataset includes 363 teachers who completed a structured questionnaire grounded in the distinction between beliefs, perceived opportunities, and perceived barriers related to feedback and AI. Descriptive and inferential analyses were conducted; Results show a pre-existing culture of formative feedback. Perceived opportunities of AI for feedback are moderately high particularly in relation to learning analytics and immediate feedback, while perceived effectiveness is evaluated more cautiously. Notably, the need for professional training emerges as a dominant barrier, whereas ethical-normative concerns appear as a distinct and non-overlapping dimension. Innovative findings indicate that teachers do not display technophobic resistance; rather, they adopt a posture of reflective professional caution. Cluster analysis identifies a majority profile of "open but cautious" teachers who recognise AI's feedback potential but remain uncertain about its pedagogical effectiveness. The findings further reveal a distinction between perceived technological capability and educational legitimacy, suggesting that teachers evaluate as a pedagogical actor. These results indicate that the integration of AI into feedback practices is mediated more by professional agency and pedagogical judgement than by technological access alone. Feedback therefore emerges as a privileged lens through which teachers negotiate the educational legitimacy of AI.

Keywords: mediated feedback, AI literacy, professional agency

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Introduction

Artificial Intelligence (AI) is no longer an emerging technology awaiting adoption in education. It is increasingly becoming part of everyday teaching practices, reshaping how teachers design learning activities, monitor students' progress, and provide instructional support. Recent advances in generative AI and learning analytics have expanded the capacity of digital systems to generate personalised explanations, monitor learning trajectories, and deliver immediate feedback, prompting renewed debate about the evolving relationship between technology and pedagogy.

Within this debate, feedback represents one of the first educational practices to be substantially transformed by AI. Unlike traditional assessment, which often relies on delayed and teacher-centred interactions, AI-mediated environments enable continuous, adaptive, and data-informed feedback capable of supporting learning throughout the educational process. Consequently, feedback is no longer conceived as a final corrective act but as an ongoing mechanism of learning regulation embedded within increasingly dialogic learning environments. This transformation is particularly relevant from a pedagogical perspective. Feedback has long been recognised as one of the most influential factors affecting learning (Hattie & Timperley, 2007; Shute, 2008), while the Conversational Framework (Laurillard, 2012) conceptualises feedback as the mechanism that sustains iterative cycles of dialogue, reflection, and conceptual change between teachers and learners. More recently, the concept of feedback literacy has further emphasised that the educational value of feedback depends not only on the quality of information provided but also on teachers' and learners' capacity to interpret, evaluate, and use that information effectively (Carless & Boud, 2018). These perspectives suggest that the integration of AI into feedback cannot be understood solely as a technological innovation but must also be examined as a transformation of pedagogical practice. Although a growing body of research has investigated teachers' attitudes towards AI, technology acceptance, and ethical concerns, considerably less attention has been devoted to understanding how teachers interpret AI when it becomes embedded within feedback practices. Existing studies frequently examine AI adoption as a technological issue, whereas the pedagogical conditions through which teachers attribute educational value to AI-generated feedback remain underexplored. This distinction is particularly important because recognising the technical capabilities of AI does not necessarily imply recognising its pedagogical legitimacy. Against this background, the present study investigates teachers' baseline perceptions of AI-mediated feedback within a national research-action professional development pathway involving 363 Italian teachers from different educational levels. Rather than examining technology adoption per se, the study explores how teachers evaluate the opportunities, effectiveness, and barriers associated with AI-supported feedback before participating in structured professional development. By combining descriptive and inferential analyses with exploratory factor and cluster analyses, the study aims to contribute to the growing literature on AI in Education by shifting the focus from technological adoption to pedagogical judgement. It argues that teachers negotiate the educational legitimacy of AI primarily through feedback practices and that professional agency and feedback literacy play a more decisive role than technological access alone in shaping AI integration within formative assessment.

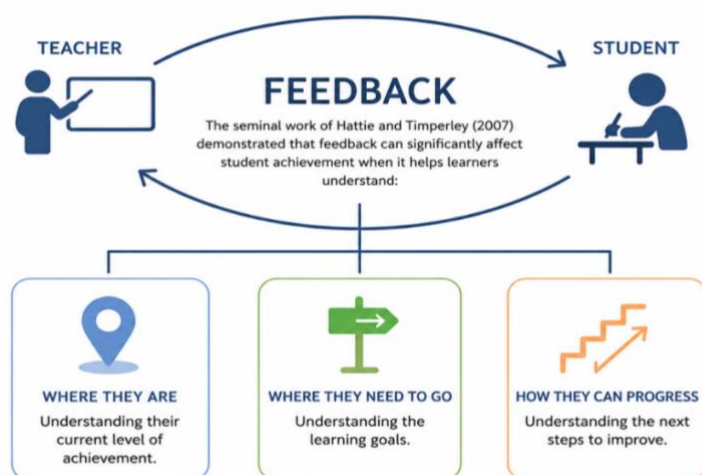
Literature Review

Feedback has long been identified as a major influence on learning, although its effects depend on the form it takes, the level at which it operates, and the learner's capacity to use it. Hattie

and Timperley (2007) conceptualise feedback as information concerning aspects of a learner's performance or understanding. Its formative value lies in its capacity to reduce the distance between current performance and desired learning goals by addressing three interrelated questions: Where am I going? How am I going? Where to next? Feedback is therefore not intrinsically effective; it becomes educationally meaningful when it supports learners in interpreting goals, monitoring progress, and identifying subsequent actions.

Figure 1

Information Feedback Hattie and Timperly (2007)



Similarly, Shute (2008) defines formative feedback as information intended to modify learners' thinking or behaviour in ways that improve learning. This perspective shifts attention from the simple provision of comments to their potential effects on cognitive and metacognitive regulation. Timeliness, specificity, clarity, and alignment with the learning task influence whether feedback supports improvement or generates confusion, dependency, or cognitive overload. Feedback should consequently be understood not as an isolated message transmitted after performance, but as an intervention situated within a broader learning process. This process-oriented interpretation is central to Laurillard's (2012) Conversational Framework. In the framework, learning develops through iterative interactions between teachers, learners, peers, concepts, and practice environments. Learners act, receive information about the consequences of their actions, reflect on discrepancies, and revise both their conceptual understanding and subsequent performance. Feedback sustains this recursive movement between conceptual and practical levels. It is therefore embedded throughout the learning cycle rather than confined to assessment at its conclusion. From this perspective, digital technologies can expand the frequency and forms of feedback, but they do not automatically improve its educational quality. Their value depends on how feedback is incorporated into designed cycles of action, interpretation, reflection, and revision. This distinction is particularly important for Artificial Intelligence, whose capacity to generate immediate responses may increase the quantity and speed of feedback without necessarily ensuring its pedagogical appropriateness.

Contemporary feedback research has progressively moved beyond transmission models in which teachers provide information and students receive it. Learners are increasingly regarded as active participants who must interpret feedback, evaluate its relevance, manage emotional responses, and use it to improve future work. Carless and Boud (2018) describe feedback literacy as the understandings, capacities, and dispositions required to make sense of information and use it to enhance learning strategies or performance. Feedback literacy

includes appreciating the purpose of feedback, making evaluative judgements, managing affect, and taking action. Its introduction has important consequences for the study of AI-mediated feedback. The availability of rapid or personalised information does not guarantee that learners will understand, trust, or productively use it. Automated feedback may appear clear and authoritative while containing inaccuracies, oversimplifications, or recommendations that are insufficiently sensitive to learning goals and individual contexts. Students therefore need to compare outputs, recognise limitations, and decide how to act upon them. Feedback literacy also has a teacher dimension. Teachers must design processes that enable learners to engage with feedback, while critically evaluating the quality and appropriateness of the information generated by technological systems. Teacher feedback literacy involves pedagogical knowledge, evaluative expertise, relational sensitivity, and the capacity to create conditions in which feedback produces meaningful learner action (Carless & Winstone, 2023). In AI-supported environments, it additionally requires teachers to understand how automated outputs are produced, identify their possible limitations, and determine when they should be accepted, adapted, supplemented, or rejected. Consequently, AI-mediated feedback cannot be interpreted as the substitution of teacher feedback with automated information. It is better understood as a reconfiguration of feedback roles. AI may generate preliminary explanations, detect patterns, suggest revisions, or support the monitoring of learner progress. Teachers, however, remain responsible for relating such information to curricular intentions, disciplinary standards, student needs, classroom relationships, and the broader purposes of education. The development of learning analytics, adaptive systems, and generative AI has increased the possibility of providing feedback at a scale and speed that are difficult to achieve through teacher intervention alone. AI systems may support immediate responses, identify recurring errors, personalise explanations, and make patterns in student performance more visible. These functions are especially relevant in formative assessment, where the timely identification of learning needs can inform subsequent teaching and learning actions. Recent literature nevertheless presents a more complex picture than a straightforward narrative of technological improvement. AI-generated feedback may be valued for its accessibility, immediacy, and capacity to offer repeated support. At the same time, its effectiveness varies according to the task, disciplinary domain, quality of prompts, characteristics of the system, and learners' ability to evaluate its outputs. Automated systems may address easily identifiable or surface-level features more successfully than conceptual ambiguity, originality, relational factors, or the contextual meaning of student performance. The distinction between technical performance and educational value is therefore essential. An AI system may generate fluent, detailed, and immediate feedback while failing to support the intended learning process. It may provide a plausible correction without identifying the learner's underlying misconception or suggest an improved product without encouraging the learner to understand the reasoning required to produce it. Increased automation may also reduce opportunities for dialogue when feedback is treated as a completed output rather than as the beginning of further interpretation and action. International guidance consequently stresses that AI should support rather than displace human responsibility in education. Human-centred approaches emphasise transparency, inclusion, data protection, pedagogical appropriateness, and the continued responsibility of teachers and institutions for educational decisions (UNESCO, 2023). These principles suggest that the central issue is not simply whether AI can provide feedback, but under which pedagogical, professional, and ethical conditions its feedback can become educationally legitimate. The integration of AI into feedback practices raises questions about teachers' professional agency. From an ecological perspective, agency is not a fixed attribute possessed by an individual teacher but an achievement emerging from the interaction between professional capacities, past experiences, future orientations, cultural expectations, institutional structures, and available resources (Priestley et al., 2015). Teachers exercise agency when they make intentional and

context-sensitive choices within the opportunities and constraints of their working environments. In AI-mediated learning environments, professional agency concerns teachers' capacity to evaluate, interpret, and pedagogically mediate AI outputs while retaining responsibility for educational decisions. It does not imply rejecting automation or preserving exclusive human control over every instructional action. Rather, it involves determining which functions can appropriately be supported by AI, which require professional intervention, and how technological outputs should be integrated into meaningful learning processes. This interpretation helps distinguish technological capability from educational legitimacy. Technological capability refers to what an AI system appears able to perform, such as generating explanations, analysing data, or producing immediate responses. Educational legitimacy concerns whether and how those capabilities should be used in relation to particular learners, goals, contexts, and educational values. The latter cannot be established through technical performance alone because it requires pedagogical judgement. Much research on teachers and AI has focused on adoption intentions, perceived usefulness, ease of use, confidence, ethical concerns, or frequency of use. These dimensions are important, but they do not fully explain how teachers judge AI when it enters a pedagogically significant practice. A teacher may recognise the usefulness of immediate automated responses while remaining uncertain about their reliability, relational adequacy, or contribution to learning. Such caution should not automatically be interpreted as resistance to innovation. It may instead represent an exercise of professional judgement. The present study addresses this gap by examining teachers' baseline perceptions of AI-mediated feedback through the interconnected dimensions of feedback beliefs, perceived opportunities, perceived effectiveness, professional training needs, and ethical-normative concerns. Feedback is treated as a privileged analytical lens because it is the point at which AI capability encounters pedagogical judgement. The study therefore asks not merely whether teachers are willing to adopt AI, but how their feedback literacy and professional agency shape the educational legitimacy they attribute to AI-supported feedback.

Research Questions

Building upon the literature on formative feedback, feedback literacy, Artificial Intelligence in education, and professional agency, this study investigates teachers' baseline perceptions of AI-mediated feedback before participating in a structured professional development programme. Rather than examining technology adoption as an end in itself, the study explores how teachers evaluate the pedagogical integration of AI within one of the core practices of teaching and learning: formative feedback. Accordingly, the study addresses the following research questions:

- RQ1. What beliefs do teachers hold regarding formative feedback and AI-mediated feedback before participating in professional development?
- RQ2. What opportunities and barriers do teachers perceive in the use of AI to support formative feedback?
- RQ3. Which underlying dimensions characterise teachers' perceptions of AI-mediated feedback, and what teacher profiles emerge from these perceptions?

By addressing these questions, the study seeks to move beyond technology acceptance models and contribute to a deeper understanding of how teachers negotiate the educational legitimacy of AI through feedback practices.

Methodology

This study adopts a quantitative baseline design within a broader research-action project investigating the pedagogical integration of Artificial Intelligence through Diana Laurillard's Conversational Framework. The overall project aims to support teachers in designing, implementing, and reflecting upon AI-mediated learning activities across different educational contexts. The present contribution focuses exclusively on the baseline phase, conducted before participants engaged in the professional development programme, in order to examine teachers' initial perceptions of AI-mediated feedback. Rather than evaluating the effects of training, the baseline provides a reference point for understanding teachers' existing beliefs, expectations, and perceived challenges concerning the integration of AI into formative feedback practices. The study involved 363 Italian teachers representing different educational levels, including kindergarten, primary, lower secondary, and upper secondary schools. Participation was voluntary and formed part of a national professional development initiative on Artificial Intelligence and innovative pedagogy. The sample included teachers with heterogeneous disciplinary backgrounds, teaching experience, and previous exposure to AI technologies, allowing the investigation of baseline perceptions across a broad educational population. Data were collected through a structured online questionnaire specifically developed for the research project. The instrument was theoretically informed by the literature on formative feedback, AI in education, feedback literacy, and Laurillard's Conversational Framework. The questionnaire explored three main dimensions: teachers' beliefs regarding formative feedback; perceived opportunities offered by AI-mediated feedback; perceived barriers to AI integration. Additional items investigated professional training needs, ethical and normative concerns, AI-supported feedback practices, and demographic characteristics. Responses were collected using a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The statistical analysis was conducted using a sequential analytical strategy. First, descriptive statistics were calculated to examine central tendency and variability across all questionnaire dimensions. Internal consistency was assessed using Cronbach's alpha to evaluate the reliability of the principal constructs. Inferential analyses were subsequently performed to explore relationships between teachers' characteristics and perceptions of AI-mediated feedback. Independent-samples t-tests and one-way analyses of variance (ANOVA) examined differences across participant groups, while Pearson correlation analyses investigated associations among the principal variables. To explore the underlying structure of teachers' perceptions, an Exploratory Factor Analysis (EFA) using Principal Component Analysis with Varimax rotation was conducted. The adequacy of the data for factor analysis was verified through the Kaiser-Meyer-Olkin (KMO) measure and Bartlett's Test of Sphericity. Finally, a cluster analysis was performed to identify distinct teacher profiles based on patterns of responses across the principal dimensions of the questionnaire. This person-centred approach enabled the identification of groups characterised by different combinations of beliefs, perceived opportunities, perceived effectiveness, and professional concerns regarding AI-mediated feedback. Participation in the study was voluntary and anonymous. Teachers completed the questionnaire before the beginning of the professional development activities and were informed that the collected data would be analysed exclusively for research purposes. All procedures complied with institutional guidelines concerning informed consent, confidentiality, and the ethical treatment of research participants.

Findings

The first research question investigated teachers' baseline beliefs regarding formative feedback and AI-mediated feedback before participating in the professional development programme.

Descriptive analysis indicates that teachers already attribute high pedagogical value to formative feedback ($M = 4.14$; $\alpha = .77$). Across the sample, participants consistently recognised feedback as an essential component of effective teaching and learning, highlighting its importance for supporting student progress, monitoring understanding, and promoting continuous improvement. The reliability analysis confirmed satisfactory internal consistency of the construct, suggesting that teachers' beliefs regarding formative feedback were coherent across questionnaire items. These findings indicate that participants entered the professional development programme with an already well-established appreciation of formative feedback as a core pedagogical practice. The second research question examined teachers' perceptions of AI-supported feedback. Overall, teachers expressed moderately positive perceptions regarding the opportunities offered by Artificial Intelligence for formative feedback ($M = 3.64$; $\alpha = .87$). The highest-rated opportunities concerned immediate feedback, learning analytics, personalised support, and the possibility of monitoring learning processes more efficiently. However, perceived effectiveness received considerably lower ratings ($M = 3.16$; $\alpha = .80$). Although participants acknowledged AI's technical capabilities, they expressed greater uncertainty regarding its actual contribution to improving teaching and learning processes. The difference between these two dimensions suggests that teachers distinguished between recognising AI's potential functionalities and evaluating their educational usefulness. Teachers identified professional preparation as the most significant challenge for integrating AI into formative feedback practices. The perceived need for professional training obtained the highest mean score among all barrier-related dimensions ($M = 4.13$), indicating widespread recognition that effective AI integration requires specific pedagogical competencies. Reliability analyses further showed that professional training needs and ethical-normative concerns did not belong to a single underlying construct. Rather, they emerged as conceptually distinct dimensions, suggesting that teachers differentiate between acquiring operational competence and addressing broader ethical or regulatory issues associated with AI. To investigate the underlying structure of teachers' perceptions, an Exploratory Factor Analysis was conducted. The analysis revealed a two-factor solution accounting for a substantial proportion of the total variance. The first factor grouped items associated with AI capabilities, including immediate feedback, personalisation, learning analytics, and technological support for instructional processes. The second factor included items referring to the perceived educational effectiveness of AI-supported feedback, reflecting teachers' evaluation of its pedagogical contribution to learning. The factor structure therefore distinguished between perceptions of technological capability and perceptions of educational effectiveness. Cluster analysis revealed three distinct profiles of teachers. The first profile consisted of teachers characterised by high confidence in both AI opportunities and educational effectiveness. These participants demonstrated strong readiness to integrate AI into formative feedback practices. The second profile, representing the majority of the sample, included teachers who recognised AI's potential while maintaining reservations regarding its pedagogical effectiveness. This group was labelled *Open but Cautious*. The third profile included teachers reporting comparatively lower confidence in both AI opportunities and effectiveness, indicating a lower level of readiness for AI integration. These findings reveal considerable heterogeneity in teachers' baseline perceptions and suggest that different professional development needs may characterise different teacher profiles.

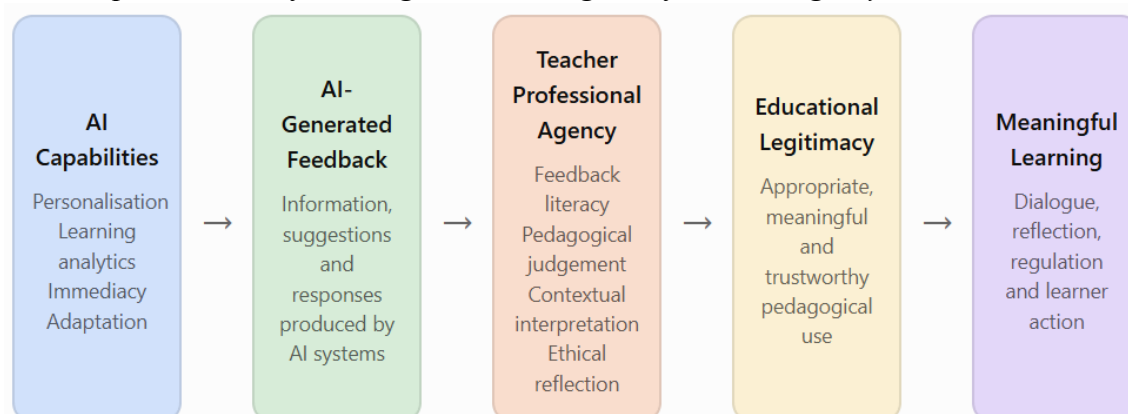
Discussion

The findings contribute to the growing literature on Artificial Intelligence in education by shifting attention from technology adoption towards pedagogical judgement. Rather than asking whether teachers are willing to use AI, the present study examined how they evaluate

AI when it becomes embedded within one of the most pedagogically significant practices of teaching: formative feedback. Research on AI in education has frequently examined teachers' attitudes, acceptance, trust, or intention to use AI systems. While these perspectives remain important, they primarily describe teachers' relationships with technology itself. The present findings suggest a different interpretation. Teachers do not appear to evaluate AI exclusively according to its technical characteristics. Instead, they assess its contribution through the educational functions it is expected to support. In this study, feedback represents the pedagogical context through which AI is interpreted. This perspective extends existing technology acceptance approaches by introducing pedagogical judgement as a central explanatory dimension. The consistently high valuation of formative feedback demonstrates that teachers already possess a well-established feedback culture before engaging with AI. Consequently, AI does not introduce feedback into educational practice; rather, it enters an already existing pedagogical process. This distinction is theoretically important because it positions feedback not simply as one possible application of AI but as the pedagogical environment in which teachers negotiate the educational value of AI-generated information. From the perspective of Laurillard's Conversational Framework, AI-generated feedback becomes meaningful only when incorporated into iterative cycles of dialogue, reflection, adaptation, and action. Immediate responses alone cannot sustain learning unless they are pedagogically interpreted within these conversational processes. Perhaps the most significant contribution of this study concerns the role of professional agency. Teachers recognised numerous technological opportunities offered by AI while simultaneously expressing greater caution regarding its educational effectiveness. This distinction suggests that teachers separate what AI is capable of doing from what they believe should be educationally valued. Professional agency therefore emerges as the mechanism through which teachers evaluate, interpret, adapt, and contextualise AI-generated feedback before incorporating it into teaching practice. Following Priestley et al. (2015), agency should not be understood as an individual characteristic but as an ecological achievement emerging from professional knowledge, contextual conditions, educational values, and pedagogical judgement. Within AI-mediated feedback environments, teachers do not simply receive technological outputs; they actively determine their educational legitimacy. This interpretation is represented in the conceptual model proposed in Figure 1.

Figure 2

A Conceptual Model of AI Integration Through Professional Agency



The model proposes that AI does not directly improve learning. Instead, AI generates information that only becomes educationally meaningful when teachers transform it into pedagogically legitimate feedback through their professional judgement. The distinction

emerging from the factor analysis between technological capability and educational effectiveness provides empirical support for introducing the concept of educational legitimacy. Educational legitimacy refers to teachers' judgement regarding whether AI-generated feedback is appropriate, meaningful, trustworthy, and educationally valuable within a particular pedagogical context. Unlike technological capability, which depends on the performance of AI systems, educational legitimacy depends upon teachers' interpretation of those performances in relation to curriculum, learner needs, educational aims, and classroom relationships. The findings therefore suggest that successful AI integration depends less on increasing technological functionality than on strengthening teachers' capacity to exercise informed pedagogical judgement. The prominence of professional training as the principal perceived barrier has important implications for teacher education. Professional development should move beyond technical instruction concerning AI tools and instead cultivate teachers' feedback literacy, AI literacy, and professional agency. Preparing teachers for AI-supported education requires developing their ability to critically evaluate AI-generated feedback, integrate it within pedagogically coherent learning designs, and maintain responsibility for educational decisions. Such an approach aligns with recent international recommendations advocating human-centred and pedagogically grounded AI integration in education.

Conclusion

This study examined how teachers perceive Artificial Intelligence when it is introduced into formative feedback practices. Moving beyond a general focus on technological acceptance, the analysis explored the distinction teachers make between the opportunities offered by AI and its perceived educational effectiveness. The findings show that participants entered the professional development programme with a strong pre-existing appreciation of formative feedback. They also recognised the potential of AI to support immediacy, personalisation, learning analytics, and the monitoring of learning processes. However, their evaluation of AI's actual educational effectiveness was more cautious. This difference suggests that teachers do not automatically equate technological capability with pedagogical value. On this basis, the study proposes that professional agency plays a mediating role between AI-generated feedback and its educational use. AI systems can produce information, suggestions, and responses, but these outputs do not constitute pedagogically meaningful feedback by themselves. Teachers must interpret them in relation to learners, curriculum aims, classroom contexts, ethical considerations, and the intended learning process. Through this professional judgement, AI-generated information may acquire educational legitimacy. The proposed conceptual model therefore describes a progression from AI capabilities to AI-generated feedback, teacher professional agency, educational legitimacy, and meaningful learning. The model should not be interpreted as a deterministic causal sequence. Rather, it offers an interpretative framework for understanding how teachers may transform technological outputs into educationally meaningful feedback.

The study also highlights the importance of professional development. Training should not be limited to the operational use of AI tools but should strengthen feedback literacy, pedagogical judgement, ethical awareness, and teachers' capacity to make context-sensitive decisions. AI literacy should consequently be understood as both a technological and a pedagogical competence. Several limitations should be acknowledged. The study is based on self-reported baseline perceptions from a voluntary sample of Italian teachers and does not measure classroom implementation or student learning outcomes. The exploratory factor and cluster solutions also require confirmation with further samples. Future phases of the research-action programme will examine how teachers' perceptions evolve through professional development

and how AI-mediated feedback is designed, implemented, and revised in practice. Ultimately, the educational value of AI does not reside solely in what the technology can generate. It depends on teachers' capacity to determine when, why, and under which pedagogical conditions its outputs can legitimately contribute to meaningful learning.

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