Journal of Inclusive Methodology and Technology in Learning and Teaching
ISSN 2785-5104
Anno 5 n.4 (2025)

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

FABER: An Educational Chatbot for Inclusive and Sustainable Transformation of Instructional Design

Fabrizio Schiavo [1]*, Giuseppina Rita Jose Mangione [1] and Pio Alfredo Di Tore [2]

[1] INDIRE - National Institute for Documentation, Innovation and Educational Research; f.schiavo@indire.it; g.mangione@indire.it
[2] University of Cassino and Southern Lazio; pioalfredo.ditore@unicas.it
* Correspondence: f.schiavo@indire.it

Abstract: Artificial intelligence is reshaping educational design, fostering new models of reflection and co-creation. The Faber project introduces an embodied conversational agent developed by INDIRE and the University of Cassino and Southern Lazio, conceived not as a prescriptive tutor but as an epistemic partner for instructional design. By integrating the principles of Universal Design for Learning and the GreenComp framework, Faber supports teachers in constructing inclusive, sustainable, and personalized learning pathways. The system employs an adaptive narrative design, a curated Knowledge Bank, and transparent source management, ensuring reliability and traceability. The experimentation, conducted through two co-design ateliers involving sixty teachers, applies a qualitative methodology grounded in thematic analysis, discourse analysis, and conversation analysis. Preliminary results indicate that the tool facilitates shifts from operational action to reflective practice, promoting agency, awareness, and systemic thinking. The chatbot encourages the formulation of metacognitive questions, the reformulation of learning objectives, and the articulation of pedagogical criteria. From this perspective, Faber represents a model of Generative Educational AI that enhances teacher professionalism through dialogue, transparency, and co-design. Rather than replacing the teacher, the technology strengthens their reflective role, contributing to the development of a more equitable, inclusive, and sustainable school system.

Keywords: Conversational artificial intelligence; instructional design; sustainability; teacher reflectivity; inclusion.

1. Introduction

The emergence of pedagogical conversational agents (PCAs) as reflective tools for instructional design requires a rethinking of categories and practices in teacher education. Recent evidence on their diffusion confirms that chatbots are entering a phase of scientific maturity, with systematic reviews documenting their pedagogical roles, benefits, and limitations across the full spectrum of formal education (Yusuf et al., 2025; Pérez-Marín, 2021; Pereira et al., 2023; Ortega-Ochoa et al., 2024). The literature distinguishes in particular between purely text-based agents and embodied

[1] The paper is the result of scientific collaboration among the authors. However, the attribution of scientific responsibility is as follows: Fabrizio Schiavo is the author of sections 1 and 2; Giuseppina Rita Jose Mangione authored sections 3, 4 and 5; Pio Alfredo Di Tore authored section 6.

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

conversational agents, showing that embodiment and the design of social presence affect engagement, feedback quality, and performance in complex tasks, while also requiring careful epistemic orchestration to prevent oversimplification and hallucinations. These trends are highlighted in recent scoping and systematic reviews reporting exponential growth in research and increasing hybridization with Intelligent Tutoring Systems and immersive environments (Khosrawi-Rad et al., 2023; Weber et al., 2021; Yang et al., 2025).

Several studies emphasise that the pedagogical quality of a PCA depends not only on the accuracy of its responses but also on its ability to foster deep learning and professional reflection (Blikstein & Worsley, 2016; Graesser et al., 2017), offering dialogic contexts in which artificial intelligence (AI) acts as an amplifier of metacognition and an epistemic partner. Comparative research on embodied conversational agents further shows that embodiment—understood as the agent's visual, gestural, and prosodic presence—significantly influences engagement, trust, and feedback quality (Krajcovic et al., 2025; Lester et al., 1997). An agent that is "present" and contextualised encourages a form of distributed attention and deeper intersubjective negotiation than purely text-based systems, creating more immersive learning spaces that are, however, also more exposed to risks of cognitive offloading and didactic oversimplification (Pereira et al., 2023).

Within this framework, the literature on reflective practice (Hatton & Smith, 1995; Schön, 1983) provides a robust theoretical anchor for interpreting the use of PCAs in teacher education. Interaction with the chatbot can be understood as a device for "reflection-in-action," in which professionals verbalize and negotiate their tacit knowledge (knowing-in-action), transforming it into explicit and actionable understanding. This perspective intersects with research on teacher agency (Toom, Pyhältö, & Rust, 2015) and collaborative learning design (Järvelä & Hadwin, 2013), both of which emphasize that professional learning emerges through dialogue and perspective sharing rather than through the application of ready-made models.

The project discussed here explicitly adopts this stance: the conversation with the agent is not aimed at providing answers but at constructing meaning, articulating aims and design criteria, and fostering movement from operational action to reflective inquiry. In this sense, Faber is conceptualized as a pedagogically situated technology designed to support instructional design through a systemic and sustainable lens. The approach is rooted in the tradition of systems thinking (Meadows, 2008; Senge, 1997), which invites educators to read educational complexity as a network of dynamic interdependencies and to view learning as an emergent process of mutual adaptation. This perspective is echoed today in European sustainability education policies, encapsulated in the GreenComp (European Commission, 2022), which frames sustainability competence as a combination of knowledge, skills, and attitudes enabling systemic and responsible action.

The political-ethical positioning of the initiative aligns with UNESCO (2023) and OECD (2021) recommendations, as well as with the recent guidelines for the introduction of Artificial Intelligence in schools issued by the Italian Ministry of Education and Merit (MIM, 2025), all of which call for human-centric, transparent, and accountable educational AI that enhances rather than narrows teachers' professional autonomy. In this direction, Micheli, Ponti, Craglia, and Suman (2020) demonstrated that data governance and algorithmic accountability are prerequisites for the sustainable integration of AI in educational systems. The adoption of agents such as

Faber thus falls within the trajectory of "reflective technology," in which the machine acts as an interpretive partner rather than a replacement for human expertise.

The inclusive and democratic ethos of this approach resonates with the maker education movement (Blikstein & Worsley, 2016), which conceptualizes design as a practice of emancipation and informed participation. The construction of scenarios, dialogues, and digital artefacts through interaction with the agent can be viewed as a form of learning by designing, in which teachers become co-authors of their own professional development, supported by an environment that stimulates reflection, creativity, and epistemic responsibility. This positions the present research at the intersection of reflective pedagogy, dialogic technology, and systems thinking, aiming to explore how an embodied chatbot—designed according to coherent ethical, narrative, and epistemological criteria—can function as a catalyst for teachers' professional learning and for the development of more sustainable, intentional, and consciously designed educational practices

2. Chatbot design

The development of Faber is grounded in the integration of conversational artificial intelligence, narrative design, and embodied presence, following a methodological framework that combines learning design, professional reflectivity, and epistemic governance. The primary goal was not to create a simple technical assistant, but an epistemic partner capable of supporting instructional design processes and fostering critical reflection.

From an architectural standpoint, the initial prototype was developed with GPT4All, an open-source model derived from LLaMA 7B (Meta), selected for its low computational requirements and its high adaptability to small, domain-specific datasets. This choice aligns with research showing that smaller-scale models can still guarantee effective performance when trained on curated and high-quality corpora (Brown et al., 2020; Hoffmann et al., 2022).

During subsequent development and training phases, the project leveraged the potential of the Convai platform, an advanced environment for creating intelligent 3D avatars capable of processing multimodal input (text, voice, images) and producing animated responses that align with educational content. This enabled the construction of a narrative character endowed with identity, communicative tone, and educational role, articulated through three main components:

1. **Backstory**, outlining the agent's personality, mission, and pedagogical stance;
2. **Knowledge Bank**, a dataset containing verified and structured materials on sustainability, systems thinking, and instructional design;
3. **Narrative Design**, a conversational architecture based on triggers and branching choices that guides the user along interactive and personalized learning paths.

Faber's "story" depicts him as a visionary and determined teacher committed to disseminating a culture of sustainability through education. This backstory helps build empathy and identity recognition, strengthening the agent's presence and conversational credibility.

The Knowledge Bank constitutes the cognitive core of the system. It includes scientific literature, institutional reports, national and international guidelines, and policy documents, carefully selected, cleaned, and normalized in .txt format to optimize language processing. It is periodically updated to ensure scientific integrity and alignment with current evidence. This approach reflects recommendations on data governance and AI ethics in education (Micheli, Ponti, Craglia, & Suman, 2020; Holmes, Bialik, & Fadel, 2021; Kooli, 2023).

The narrative design is based on a branching structure of micro-conversations activated by semantic triggers. Each user choice opens different narrative pathways (e.g., sustainable development, Agenda 2030, systems thinking, instructional design), leading to thematic expansions, reflective questioning, or operational suggestions. This approach follows the tradition of story-based learning (Bruner, 1991), in which narrative functions as a device for meaning-making. A story-based approach fosters meaningful learning, cognitive continuity, and intrinsic motivation, enabling users to situate interactions within a coherent storyline. Faber adopts a branching structure of learning stories, constructed as personalized learning pathways in which conversational nodes are activated by triggers according to the user's responses and goals. This architecture maintains a balance between teacher agency and chatbot scaffolding, avoiding forms of cognitive over-direction.

During the training phase, transfer learning techniques were used to adapt the model to the curated contents. The algorithmic configuration was designed to minimize bias and hallucinations through generative temperature calibration (0.2–0.4) and semantic coherence filters, privileging consistency and relevance. This control was complemented by a reflective feedback system in which the agent encourages users to make constraints, choices, and criteria explicit, fostering the emergence of systems thinking and metacognitive awareness (Järvelä & Hadwin, 2013; Sedrakyan, 2024). From the initial stages, the agent's role was defined as an epistemic coach for instructional design. This decision reflects evidence showing that the "role design" of educational agents influences cognitive depth and users' ability to develop systems thinking and metacognitive reflection. Accordingly, Faber's conversational architecture prioritizes exploratory questions, reflective prompts, and requests for explicit criteria and objectives, in line with the paradigm of reflective professional learning.

The development of Faber followed an iterative co-design and validation process with a team of experts in education, sustainability, and systems thinking, grounded in the active involvement of teachers. Recent literature (Bahja, Hammad, & Butt, 2020; Silva & Canedo, 2024; Valtolina, 2024) highlights that involving end-users in design processes enhances usability, engagement, and professional appropriation. Each testing cycle included data collection (conversations, logs, perception questionnaires) and review of conversational functions and communicative tone.

Attention to inclusion and accessibility principles was constant throughout development. The agent uses clear and non-directive language and offers multimodal interaction (voice and text) to accommodate different communicative preferences and educational needs. As UNESCO (2023) emphasizes, linguistic and cognitive inclusion is a condition for equity and sustainability in the adoption of educational technologies.

Through this integration of artificial intelligence, narrative design, and educational reflection, Faber aims to promote a new form of reflective and sustainable instructional design that combines technological innovation with pedagogical value.

3. Research methodology

The research is situated within the framework of laboratory-based and reflective teacher education (Mangione, 2017; Altet, 2010; Zecca, 2016), adopting the adult workshop as a privileged device for professionalisation and the shared construction of pedagogical knowledge. In this perspective, the atelier is not merely an operational space, but a reflective environment for professional learning in which experience becomes the object of cognitive and collective re-elaboration (Mottet, 1992; Zeichner, 2010). The research design is qualitative and exploratory, and aims to investigate how an embodied chatbot, conceived as a pedagogical conversational agent (Pérez-Marín, 2021; Schiavo et al., 2025), can support teachers' instructional design processes and foster the development of systemic and sustainable competences, with reference to the GreenComp Framework (European Commission, 2022).

3.1. The exploratory workshop as a research tool

The empirical investigation was carried out through two exploratory ateliers organised as co-design workshops. Each atelier, led by researchers with expertise in pedagogy and educational technologies, involved heterogeneous groups of 60 teachers from different school levels, with the aim of fostering interdisciplinary dialogue and the negotiation of professional meanings (Wenger, 1998; Stoll et al., 2006). The workshop format was structured around three distinct yet integrated phases, corresponding to the functions of activation, contextualisation, and dialogic experimentation (Mottet, 1992).

1. In the first phase, dedicated to engagement, teachers were guided through a collective reflection on the core components of instructional design and on the critical issues emerging from their own contexts. This phase served as a moment of reflective mobilisation (Schön, 1983), intended to elicit personal conceptions and initiate a shared professional language;
2. The second phase involved the presentation of the chatbot Faber, introduced as a conversational agent designed to support sustainability-oriented instructional design and ecological citizenship. The workshop facilitators provided the theoretical background to clarify the logic of the experiment and to build a shared epistemological framework around the concepts of systems thinking and cognitive scaffolding (Jonassen, 1999; Bickmore & Picard, 2005);
3. The third phase focused on hands-on experimentation and interaction: each group formulated its own questions and appointed a representative responsible for interacting with the chatbot, with the goal of constructing an instructional design pathway aligned with the key issues identified during the initial discussion.

All dialogues were recorded, transcribed, and constitute the textual corpus for the qualitative analysis. This phase made it possible to observe practices of mediation and meaning negotiation, positioning the atelier as a space of co-reflection and action research (Cerini & Spinosi, 2016).

3.2. Analytical approach and epistemological orientation

The analysis of the conversations was conducted using an interpretative qualitative approach that integrates perspectives from thematic analysis (Braun & Clarke, 2006), educational discourse analysis (Gee, 2014), and conversation analysis (Heritage, 2004). This methodological integration responds to the need to capture the pragmatic, semantic, and relational complexity of educational dialogue (Mishler, 1990; Mercer, 2000). The adoption of an interpretive approach is justified by the discursive nature of the object of study: interactions between teachers and the chatbot constitute a dialogic process of meaning-making in which cognitive, relational, and pedagogical dimensions intersect (Pérez-Marín, 2021; Khosrawi-Rad et al., 2022).

The minimal unit of analysis was defined as the "teacher → chatbot" turn pair, while the broader unit corresponded to the conversational episode centred on a specific instructional design theme. Attention was paid not only to the semantic content of the responses but also to pragmatic dynamics, indicators of dialogic agency, and forms of co-construction of meaning. This perspective reflects a socio-constructivist view of language, according to which educational discourse constitutes a site of cognitive and identity negotiation (Vygotsky, 1978; Gee, 2014).

3.3. Framework analysis construction

The construction of the analytical framework was based on an iterative process of data interpretation conducted according to the logic of hybrid thematic analysis (Fereday & Muir-Cochrane, 2006). This approach, widely adopted in qualitative educational research, allows for the integration of a deductive level—grounded in theoretical categories derived from the literature on laboratory-based learning and professional development (Mangione, 2017; Darling-Hammond et al., 2017)—with an inductive level aimed at capturing the empirical specificity of the conversational corpus. This methodological choice, proportionate to the consistency of the data, made it possible to develop a flexible interpretative structure capable of accounting for the complexity of discursive processes without resorting to rigid coding models typical of grounded theory.

Category development occurred through successive readings and researcher triangulation, with the aim of identifying the most relevant semantic and pragmatic recurrences and linking them to the pedagogical and communicative functions of the interaction. The analysis thus took the form of a dialogic process between data and theory, in which categories were progressively refined according to their explanatory power with respect to the observed phenomena. The resulting analytical dimensions respond to a twofold purpose: on the one hand, to interpret the pedagogical nature of the interaction and the role assumed by the chatbot in the design process; on the other, to observe the emergence of forms of professional learning among teachers.

In particular, the analysis considered:

1. **Teachers' communicative intention**, to identify the function and cognitive level of the request (informative, design-oriented, reflective);
2. **Type of chatbot response**, in order to identify the pedagogical function enacted in the interaction—elaborative, operational, dialogic, or motivational—in line with the literature on pedagogical conversational agents (Pérez-Marín, 2021; Yusuf et al., 2025);

3. **Directionality and agency of the interaction**, to assess the degree of co-construction of meaning and the balance of dialogic roles (Mercer, 2000; Vygotsky, 1978);
4. **Pedagogical and systemic depth**, as an indicator of reflective complexity and the ability to connect concepts, context, and educational purposes (Sterling, 2010; Wals, 2015);
5. **Communicative quality**, referring to clarity, tone, and the chatbot's adaptability to educational language (Bickmore & Picard, 2005);
6. **Level of instructional design support**, understood as the relevance and effectiveness of the chatbot's contribution to the educational objective (Darling-Hammond et al., 2017);
7. **Indicators of professional learning**, observable through reformulations, appropriation of pedagogical language, and the emergence of design insights (Schön, 1983; Mangione, 2017).

Coding was carried out independently by two researchers, followed by collegial discussion until interpretative consensus was reached (Miles & Huberman, 1994). The process was accompanied by analytic memos and by constant triangulation between empirical evidence and theoretical frameworks, in line with qualitative research criteria of credibility and transparency (Lincoln & Guba, 1985).

From this perspective, the framework is not merely a technical classification tool but an epistemic device that supports the interpretation of phenomena and captures the complexity of the discursive practices observed. The analysis thus constitutes an integral component of the formative device itself: the atelier emerges as a space of shared knowledge in which meaning-making and professional reflection converge in a unified process of inquiry and learning.

4. Results

Analysis of the conversations collected in the two workshops shows that interaction with the Faber chatbot encouraged teachers to rethink the professional significance of educational planning. Rather than answering questions or providing tools, the chatbot acted as a reflective device, prompting participants to question their choices, implicit educational values, and the connections between different levels of the curriculum. The conversation thus took the form of a dialogical learning space, in which cognitive, relational, and identity dimensions were intertwined. The results, presented here in interpretative form, correspond to the main areas of meaning that emerged in the corpus.

4.1. From operational intent to reflective awareness

The initial interactions reveal a clear tendency among teachers to conceive instructional design as a primarily instrumental action, focused on producing activities or materials. However, the chatbot triggers an epistemic shift: it encourages the teacher to make explicit the underlying educational purposes of the request.

Teacher: "I need an activity to explain to children how to do waste sorting."

Faber: "We can design it together. Would you rather focus on how to do it, or on why it is important to do it?"

This exchange illustrates the transition from an operational logic to an intentional logic, in which the doing is subordinately framed by the why. The chatbot becomes a catalyst for reflective mobilisation (Schön, 1983), returning to the teacher the epistemic responsibility of their own choices.

As the dialogue develops, a shift emerges in the teacher's discursive posture: verbs associated with cognition ("understand," "reflect," "bring out") begin to appear, signalling a movement towards meaning-making rather than task production. This shift, recurrent across the corpus, can be interpreted as the emergence of situated reflective learning (Darling-Hammond et al., 2017): reflection is not an abstract exercise but arises from the concrete interactional context..

4.2. Chatbot as epistemic co-designer

In the later stages of the dialogue, Faber assumes the role of a co-designer, not replacing the teacher but amplifying their capacity for design-oriented thinking.

Teacher: "I'd like to build a learning pathway on biodiversity, but I don't know where to start."

Faber: "We could begin with a real-world problem, such as habitat loss, and move towards a local stewardship project. Would you like to explore this idea together?"

In this exchange, the agent displays a dialogic behaviour consistent with the logic of cognitive scaffolding (Jonassen, 1999). The interaction is not linear but maieutic: the agent does not provide answers; rather, it offers generative questions that orient the teacher's thinking toward problem-based and meaning-centred design.

From a theoretical perspective, this form of interaction enacts a type of community of inquiry (Wenger, 1998), in which artificial intelligence participates in knowledge construction as an epistemic interlocutor. Teachers do not passively follow the chatbot's guidance: they negotiate it, re-elaborate it, and often use it to shape their own pedagogical synthesis. In this sense, AI becomes a "cognitive mirror" (Pérez-Marín, 2021), enabling teachers to observe their own decision-making patterns and reformulate them with greater awareness..

4.3. From disciplinary simplification to systemic thinking

One of the chatbot's most significant contributions concerns its pedagogical depth and its ability to foster systemic connections across domains of knowledge. Guided by Faber, teachers shift from a content-centred approach to an ecological vision of the curriculum.

Teacher: "I'd like to talk about recycling, but I'm afraid it will remain a technical topic."

Faber: "We could link it to the life cycle of products and the circular economy. Would you like to encourage students to reflect on how everyday choices impact the environmental system?"

Through this prompt, the chatbot opens up the possibility of designing for connections, in which disciplinary content is continually re-contextualised.

This supports teachers in becoming aware of their role as cultural mediators rather than mere transmitters of content.

The dialogue thus becomes a tool for 'situated systems thinking' (Sterling, 2010), where sustainability is not a topic but a way of thinking.

This shift reflects a deep epistemological transformation: instructional design is no longer solely a matter of planning but a search for meaning within a network of cognitive, social, and environmental relationships.

4.4. The relational dimension of dialogue as a space of trust

From a communicative perspective, the quality of the chatbot's responses proves to be a decisive factor.

The analyses show that Faber adopts a collaborative, empathic, and validating rhetoric that reduces the asymmetry between interlocutors and creates a climate of trust.

Teacher: "I'm not sure I'm able to design such a complex pathway."
Faber: "It's normal to have doubts. We can move forward together step by step, starting from what feels most familiar to you."

The effect of this dialogic stance is twofold: on the one hand, it provides emotional and motivational support to the teacher; on the other, it encourages continued cognitive reflection.

The combination of relational warmth and argumentative rigour enacts a form of cognitive empathy (Bickmore & Picard, 2005), translating the educational relationship into a conversational format.

In this sense, the technology is not perceived as an external tool but as a pedagogical presence (Zecca, 2016), capable of expanding the scope of formative interaction.

4.5. The emergence of professional learning

Finally, the data reveal the emergence of forms of reflective professional learning.

Teachers gradually not only assimilate methodological concepts but also reuse them explicitly, indicating conceptual appropriation.

Teacher: "I realise that I'm working backwards, starting from the expected outcomes—it's a bit like backward design."
Faber: "Exactly. You're reasoning systemically: objectives, activities, and assessment need to be coherent. Would you like to check this together?"

This exchange demonstrates a clear internalisation of professional language.

The teacher recognises a methodological principle and applies it autonomously, showing that the interaction with the agent has generated second-order learning—learning about design and not only within design.

The chatbot thus functions as a facilitator of professional reflectivity, contributing to the construction of situated knowledge (Lincoln & Guba, 1985) and epistemic agency (Wenger, 1998).

In this sense, the interaction with Faber aligns fully with the paradigm of adult laboratory-based learning (Mangione, 2017; Altet, 2010): a context in which knowledge emerges from practice and is consolidated through shared reflection.

A comprehensive reading of the results allows the teacher–chatbot dialogue to be interpreted as a space of reflective professional learning, in which artificial intelligence acts as an epistemic mediator between theoretical knowledge and instructional practice.

The analytical dimensions—intention, agency, systemic depth, communicative quality, and learning—do not operate independently; rather, they interweave into a single fabric of dialogic construction of professional knowledge.

The chatbot's contribution does not lie in producing correct answers, but in slowing down the teacher's thinking, prompting them to articulate assumptions, purposes, and connections.

It is within this pause that the space of pedagogical reflection emerges—a site of authentic and transformative learning.

The dialogue with AI is therefore not a simulation of the educational relationship, but a possible extension of it: a context in which technology becomes a reflective mirror of teacher professionalism.

5. Discussions

The experience analysed shows that the dialogue between teachers and the chatbot can be interpreted not merely as a technological experiment, but as a pedagogical opportunity for professional learning.

The results highlight a subtle yet profound transformation: through conversational mediation, teachers shift from an operational approach to instructional design toward a more reflective and argumentative stance, in which technology becomes a companion in thinking.

This section offers a critical reading of the findings, articulated across four interwoven dimensions: the chatbot as a reflective device, epistemic co-construction, the transformation of teacher professionalism, and finally, the educational possibilities that emerge from the limits of the experience.

5.1. Chatbot as a reflective device

The first interpretative lens concerns the chatbot's ability to function as a device for professional reflection, capable of activating processes of thinking-in-action in teachers (Schön, 1983). The conversations analysed show that Faber does not provide predefined solutions; rather, it returns questions, prompts, and counter-proposals—strategies that compel the interlocutor to make their criteria explicit and to think while acting.

As highlighted by Pérez-Marín (2021) and by recent research on pedagogical conversational agents, the educational value of such interactions lies precisely in their metacognitive function. In the case of Faber, the dialogue is never neutral: its reflection-oriented structure transforms the conversation into a space of professional learning.

EDIZIONI UNIVERSITARIE ROMANE
editoria scientifica dal 1952

The teacher, encouraged to clarify objectives, meanings, and methodological choices, experiences a process of awareness that recalls the kind of reflection typical of the pedagogical laboratory (Mangione, 2017; Altet, 2010).

In this sense, the chatbot becomes a cognitive mirror of professional practice—an interlocutor that makes visible the invisible thinking embedded in action.

5.2. Epistemic co-construction and instructional design

A second interpretative layer concerns the epistemic nature of the interaction. The conversations show that the teacher–chatbot relationship does not merely involve an exchange of information, but becomes a space for the construction of shared knowledge. The conversational agent acts as a co-designer, fostering a negotiation of meanings and a progressive refinement of the pedagogical categories used by teachers. This dynamic reflects the paradigm of *design-based professional learning* (Darling-Hammond et al., 2017), according to which teacher learning develops through the very act of designing.

In our case, instructional design becomes an opportunity for dialogic inquiry: a process in which the teacher reflects on their choices, discusses them, and reformulates them together with the agent. As in *communities of practice* (Wenger, 1998), professional knowledge is not transmitted but socially constructed—even though, in this case, the "dialogic partner" is a technology that mirrors and amplifies the human subject's intentions.

The epistemic co-construction activated by Faber is not, however, automatic: it depends on the teacher's level of engagement, their degree of reflectivity, and their willingness to use the conversation as a context for inquiry.

This highlights the educational responsibility of those who design and facilitate the interaction: for the chatbot to function as a true learning partner, the teacher must maintain conscious dialogic agency and avoid slipping into a passive user role.

5.3. Teaching professionalism transformation

One of the most significant outcomes concerns the identity transformation that the dialogue with Faber generates in teachers.

The conversations reveal clear signs of conceptual appropriation — the spontaneous use of terms such as backward design, scaffolding, and systemic competences — as well as metacognitive reflection on one's own practice ("I realise that your questions help me think better").

These indicators can be interpreted in light of theories of situated professional learning (Eraut, 2004; Darling-Hammond et al., 2017): teachers learn not only about practice but within practice, thanks to a context that enhances their capacity for reflection.

In this sense, artificial intelligence does not replace the formative relationship but extends it: it becomes an interlocutor capable of returning to teachers a reflective image of their own professional thinking.

The relational dimension of the dialogue is central. Faber builds trust, acknowledges uncertainty, and legitimises doubt.

Through a rhetoric of accompaniment rather than prescription, the agent creates a discursive context that echoes the "epistemic care" characteristic of educational relationships (Zecca, 2016).

From this perspective, the human–machine relationship is not merely technical but pedagogical: it is a space in which reflexivity is exercised as a form of professional self-care.

5.4. Opportunities and educational prospects

Despite its promising results, the experience retains the features of an exploratory study: the number of conversations is limited and the workshop setting is a protected environment.

However, interpreting these elements merely as limitations would be reductive.

They instead constitute thresholds for learning—starting points for rethinking how teachers can be supported in the formative use of artificial intelligence.

The situated nature of the atelier created ideal conditions for the emergence of the dialogic and reflective dimensions of instructional design; what remains to be understood is how to transfer this quality into everyday school contexts, where time constraints, curricular pressure, and professional culture may hinder deeper exploration.

This highlights the need to design hybrid learning environments in which chatbots do not replace human interaction but support it as tools of distributed reflexivity (Mangione, 2017).

A further reflection concerns the very nature of the reflexivity activated by the chatbot.

It is always, to some extent, mediated by the system's dialogic structure, and thus culturally and pedagogically situated.

This raises a crucial ethical-educational question: to what extent can AI shape teachers' reflection? And how can we ensure that the dialogue remains an experience of cognitive freedom rather than implicit steering?

These questions do not diminish the value of the experience; rather, they open it to a broader perspective—that of pedagogically sustainable artificial intelligence, grounded in principles of care, reciprocity, and awareness.

The atelier experience with Faber confirms that technological mediation can constitute a new pedagogical space in which teachers' professional reflection is supported, amplified, and made more intentional.

The chatbot does not operate merely as a tool for supporting instructional design, but as an epistemic partner that stimulates meaning-making, argumentation, and critical reframing of practices.

This perspective invites educational research to move from a functionalist view of AI to a relational and reflective one, where technology is conceived as an opportunity for dialogue rather than substitution.

The true educational value of the chatbot lies not in its ability to provide answers, but in its ability to prompt thinking.

6. Conclusions

The investigation into the device shows that when conversational agents are conceived not as mere content providers but as epistemic partners within processes of instructional design and pedagogical reflection, they can support a significant transition from operational action to professional awareness. In particular, the dialogue with Faber acted as a discursive laboratory in which AI did not replace the teacher but

amplified their reflection, stimulated the articulation of criteria, design outcomes, and systemic constraints, and contributed to strengthening professional agency.

The evidence collected suggests that the adoption of conversational agents in education, when well designed, promotes mediations that go beyond mere technical assistance. Recent studies highlight that agents encouraging negotiation, the articulation of design assumptions, and shared reflection foster deeper and more transformative instructional design practices (Ortega-Ochoa et al., 2024).

However, the effectiveness of such tools is neither automatic nor guaranteed. Systematic reviews indicate that the main conditions for success include: clarity in the agent's role, adaptive narrative and conversational design, a strong epistemic grounding, and well-defined ethical governance (Kuhail et al., 2023). In the case of Faber, these factors were integrated into the design, yet the research remains constrained by the workshop setting, the limited scale, and its pilot nature. It is therefore essential to acknowledge that the transferability of the results requires further testing in real, variable, and internationalised school contexts.

From a practical standpoint, the use of conversational agents in preservice and in-service teacher education can become a strategic lever for professional development, particularly when embedded in collaborative and reflective learning ecosystems. Ledtieg & Leitgeb (2025) demonstrated that chatbots designed to support teachers' digital and instructional competence enhance motivation, autonomy, and the perceived relevance of professional learning. From this perspective, Faber represents a replicable application model, provided that the principles of reflective design, systemic thinking, and sustainability are maintained.

In terms of risks and implementation conditions, the introduction of conversational agents raises issues of equity, teachers' digital competence, trust in technology, and the management of algorithmic complexity. In this study, more than one-third of participating teachers reported not feeling adequately prepared to use AI tools. This underscores the need for prior investments in training policies, adequate infrastructure, and co-design processes to prevent technology from becoming an additional factor of inequality.

The broader perspective is that such tools should not be conceived as an end in themselves, but as means to amplify professional reflection, collaboration, and inclusion. Their adoption must be accompanied by source-audit policies, ongoing professional development, impact monitoring, and iterative design evolution, so as to avoid the trap of uncritical automation. In summary, the educational value of conversational agents materialises when they become tools for accessing complex thinking, intentionality, and collective action, rather than substitutes for human reasoning.

The forthcoming pilot test, planned with a group of volunteer teachers, will assess Faber's functionality, usability, and pedagogical relevance. Participating schools will engage through co-design modalities, contributing to the iterative improvement of the model.

References

Altet, M. (2010). *La formazione degli insegnanti tra teoria e pratica*. Roma, Italia: Armando.

Bahja, M., Hammad, R., & Butt, G. (2020, July). A user-centric framework for educational chatbots design and development. In *International conference on human-computer interaction* (pp. 32-43). Cham: Springer International Publishing.

Bickmore, T., & Picard, R. W. (2005). Establishing and maintaining long-term human–computer relationships. *ACM Transactions on Computer–Human Interaction, 12*(2), 293–327.

Blikstein, P., & Worsley, M. (2016). Children are not Hackers: Building a culture of powerful ideas, deep learning, and equity in the maker movement. *Harvard Educational Review, 86*(2), 203–232. https://doi.org/10.17763/0017-8055.86.2.203

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.

Brown, T., Mann, B., Ryder, N., Subbiah, M., Kaplan, J. D., Dhariwal, P., ... & Amodei, D. (2020). Language models are few-shot learners. *Advances in neural information processing systems*, *33*, 1877-1901.

Bruner, J. (1991). The narrative construction of reality. *Critical inquiry*, *18*(1), 1-21.

Cerini, G., & Spinosi, M. (2016). *Il laboratorio nella formazione degli insegnanti*. Firenze, Italia: Giunti Scuola.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2017). *Effective teacher professional development*. Palo Alto, CA: Learning Policy Institute.

Eraut, M. (2004). Informal learning in the workplace. *Studies in Continuing Education, 26*(2), 247–273.

European Commission. (2022). *GreenComp: The European sustainability competence framework*. Luxembourg: Publications Office of the European Union.

Fereday, J., & Muir-Cochrane, E. (2006). Demonstrating rigor using thematic analysis: A hybrid approach of inductive and deductive coding. *International Journal of Qualitative Methods, 5*(1), 80–92.

Gee, J. P. (2014). *An introduction to discourse analysis: Theory and method* (4th ed.). New York, NY: Routledge.

Graesser, A. C., Lippert, A. M., & Hampton, A. J. (2017). Successes and failures in building learning environments to promote deep learning: The value of conversational agents. In *Informational environments: Effects of use, effective designs* (pp. 273-298). Cham: Springer International Publishing.

Hatton, N., & Smith, D. (1995). Reflection in teacher education: Towards definition and implementation. *Teaching and teacher education*, *11*(1), 33-49.

Heritage, J. (2004). Conversation analysis and institutional talk. In R. Sanders & K. Fitch (Eds.), *Handbook of language and social interaction* (pp. 103–147). Mahwah, NJ: Lawrence Erlbaum.

Hoffmann, J., Borgeaud, S., Mensch, A., Buchatskaya, E., Cai, T., Rutherford, E., ... & Sifre, L. (2022). Training compute-optimal large language models. *arXiv preprint arXiv:2203.15556*.

Holmes, W., Bialik, M., & Fadel, C. (2021). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Jonassen, D. H. (1999). *Designing constructivist learning environments*. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (Vol. 2, pp. 215–239). Mahwah, NJ: Lawrence Erlbaum.

Järvelä, S., & Hadwin, A. F. (2013). New frontiers: Regulating learning in CSCL. *Educational Psychologist, 48*(1), 25–39. https://doi.org/10.1080/00461520.2012.748006

Khosrawi-Rad, B., Rinn, P., & Thomann, G. (2022). Conversational agents in education – A systematic literature review. In *Proceedings of the 30th European Conference on Information Systems (ECIS 2022)*.

Khosrawi-Rad, B., Grogorick, L., & Robra-Bissantz, S. (2023). Game-inspired pedagogical conversational agents: A systematic literature review. *AIS Transactions on Human-Computer Interaction*, *15*(2), 146-192.

Krajcovic, M., Demcak, P., & Kuric, E. (2025). Talking Surveys: How Photorealistic Embodied Conversational Agents Shape Response Quality, Engagement, and Satisfaction. *arXiv preprint arXiv:2508.02376*.

Kuhail, M. A., Alturki, N., Alramlawi, S., & Alhejori, K. (2023). Interacting with educational chatbots: A systematic review. *Education and Information Technologies*, *28*(1), 973-1018.

Lester, J. C., Converse, S. A., Kahler, S. E., Barlow, S. T., Stone, B. A., & Bhogal, R. S. (1997, March). The persona effect: affective impact of animated pedagogical agents. In Proceedings of the ACM SIGCHI Conference on Human factors in computing systems (pp. 359-366).

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage.

Mangione, G. R., Di Tore, P. A., & Paloma, F. G. (2025). Perspective Chapter: Embodied AI and the Educational Turn–From Cognition to Situated Presence. In *Teacher Training and Student Learning - Past Values, Present Uncertainties and Future Prospects*.

Mangione, G. R. (2017). Il laboratorio nel curricolo formativo dei neoassunti. *Formazione & Insegnamento, 15*(3), 71–92.

Meadows, D. (2008). *Thinking in systems: International bestseller*. chelsea green publishing.

Mercer, N. (2000). *Words and minds: How we use language to think together*. London, UK: Routledge.

Micheli, M., Ponti, M., Craglia, M., & Suman, A. B. (2020). Emerging models of data governance in the age of AI. *Public Policy and Administration, 35*(4), 485–502. https://doi.org/10.1177/0952076720907087

Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded sourcebook* (2nd ed.). Thousand Oaks, CA: Sage.

MIM (2025). Linee guida per l'introduzione dell'Intelligenza Artificiale nelle Istituzioni scolastiche. https://mim.gov.it/documents/20182/0/MIM_Linee+guida+IA+nella+Scuola_09_08_2025-signed.pdf/b70fdc45-4b75-1f7e-73bf-eab12989b928

Mottet, G. (1992). Les ateliers de formation professionnelle: une proposition pour les IUFM. *Recherche et Formation, 11*, 93–106.

OECD. (2020). Trustworthy artificial intelligence (AI) in education: Promises and challenges. *OECD education working papers*, (218), 0_1-17.

Ortega-Ochoa, E., Sabaté, J. M., Arguedas, M., Conesa, J., Daradoumis, T., & Caballé, S. (2024). Exploring the utilization and deficiencies of generative artificial intelligence in students' cognitive and emotional needs: A systematic Mini-Review. *Frontiers in Artificial Intelligence*, *7*, 1493566.

Pérez-Marín, D. (2021). A review of the practical applications of pedagogic conversational agents to be used in school and university classrooms. *Digital, 1*(1), 18–33.

Schiavo, F., Mangione, G. R. J., Di Domenico, M., & Di Tore, P. A. (2025). Towards a Somatic Pedagogy of Artificial Intelligence: interdisciplinary reflections between Embodied Cognition and Educational Design. *Journal of Inclusive Methodology and Technology in Learning and Teaching*, *5*(2).

Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York, NY: Basic Books.

Sedrakyan, G. (2024). AI-driven feedback for metacognitive reflection: A design-based study. *Proceedings of the ACM Learning Analytics Conference*, 3702386. https://doi.org/10.1145/3702386.3702405

Senge, P. M. (1997). The fifth discipline. *Measuring business excellence*, *1*(3), 46-51.

Silva, G. R. S., & Canedo, E. D. (2024). Towards user-centric guidelines for chatbot conversational design. *International Journal of Human–Computer Interaction*, *40*(2), 98-120.

Sterling, S. (2010). Learning for resilience, or the resilient learner? Towards a necessary reconciliation in a paradigm of sustainable education. *Environmental Education Research, 16*(5–6), 511–528.

Stoll, L., Bolam, R., McMahon, A., Wallace, M., & Thomas, S. (2006). Professional learning communities: A review of the literature. *Journal of Educational Change, 7*(4), 221–258.

Valtolina, S. (2024). Designing Conversational Agents for Empowering Human Work. In CEUR WORKSHOP PROCEEDINGS (Vol. 3685). CEUR Workshop Proceedings. https://ceur-ws.org/Vol-3685/short7.pdf

Vygotskij, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wals, A. E. J. (2015). *Beyond unreasonable doubt: Education and learning for socio-ecological sustainability in the Anthropocene*. Wageningen, The Netherlands: Wageningen University.

Weber, F., Wambsganss, T., Rüttimann, D., & Söllner, M. (2021, February). *Pedagogical Agents for Interactive Learning: A Taxonomy of Conversational Agents in Education*. In ICIS.

Wenger, E. (1998). *Communities of practice: Learning, meaning, and identity*. Cambridge, UK: Cambridge University Press.

Yang, F. C., Acevedo, P., Guo, S., Choi, M., & Mousas, C. (2025). Embodied Conversational Agents in Extended Reality: A Systematic Review. *IEEE Access*.

Yusuf, H., Money, A., & Daylamani-Zad, D. (2025). Pedagogical AI conversational agents in higher education: a conceptual framework and survey of the state of the art. *Educational technology research and development*, *73*(2), 815-874.

Zecca, L. (2016). *Didattica laboratoriale e formazione. Bambini e insegnanti in ricerca*. Milano, Italia: FrancoAngeli.

Zeichner, K. (2010). Rethinking the connections between campus courses and field experiences in college-and university-based teacher education. *Journal of teacher education*, *61*(1-2), 89-99.