Review Article

EFL pre-service teachers' professional identity in the age of AI: An integrative review (2015-2025)

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ABSTRACT

The rapid integration of artificial intelligence (AI) into education is transforming how teachers are prepared and how their professional identities evolve within digitally mediated environments. While prior studies have examined AI's influence on teaching effectiveness and digital competence, comparatively little attention has been given to its impact on the identity formation of English as a Foreign Language (EFL) pre-service teachers. This integrative review therefore aims to provide a consolidated understanding of how AI shapes their emerging teacher identities. It synthesizes 31 empirical studies published between 2015 and 2025 from Scopus and Web of Science, following PRISMA-guided screening and MMAT quality appraisal. A mixed analytical strategy combining quantitative trend mapping and qualitative thematic synthesis was employed to trace how AI use interacts with self-efficacy, reflective practice, professional agency, and ethical reasoning in teacher education. The findings indicate three interconnected roles of AI in the development of professional identity: (1) as a reflective partner that enhances metacognitive awareness through adaptive and dialogic feedback; (2) as a pedagogical scaffold that improves efficacy, motivation, and agency during lesson design and microteaching; and (3) as an ethical mediator that encourages reflection on authenticity, authorship, and moral responsibility. Across contexts, AI integration strengthens professional identity when embedded within human-centered, ethically framed pedagogies that balance automation with reflective judgment. The review concludes by proposing an AI-enhanced identity ecology and outlining implications for reflective pedagogy, ethical AI literacy, and identity-oriented teacher education, along with directions for future longitudinal and cross-cultural research.

Keywords: artificial intelligence; teacher professional identity; pre-service teachers; english as a foreign language; reflective practice; self-efficacy; AI literacy; teacher education

1. Introduction

Artificial intelligence (AI) has rapidly evolved from a supplementary digital tool into a transformative force reshaping education worldwide. In teacher education, AI now transcends administrative automation and content delivery to become an active participant in pedagogical reasoning, reflective inquiry, and identity formation. Technologies such as intelligent tutoring systems, chatbots, learning analytics, and

generative AI models have become integral to teacher preparation, providing adaptive feedback, data-informed guidance, and authentic practice opportunities[1]. This technological expansion parallels a broader pedagogical shift toward reflective, responsive, and evidence-based practice, marking a reorientation from transmission to transformation. However, despite rapid technological expansion, teacher education still lacks a coherent understanding of how AI reshapes the professional identity of pre-service teachers, particularly in EFL contexts. As teacher educators integrate AI-enhanced reflection, microteaching simulations, and generative lesson design, the central question has shifted from whether AI belongs in teacher education to how it interacts with teacher learning and professional identity development.

Teacher professional identity (TPI) refers to teachers' evolving beliefs, emotions, and self-perceptions about who they are and who they aspire to become[2-3]. For pre-service teachers (PSTs), identity formation is both cognitive and affective, shaped by mentors, peers, and institutional environments. It underpins motivation, instructional decision-making, and long-term professional commitment[4-5]. While previous studies have explored TPI through frameworks such as Social Cognitive Theory (SCT), Communities of Practice (CoP), and reflective practice, the emergence of AI introduces new mediational and epistemic layers. When PSTs engage with AI for feedback, co-design, or reflection, they enter a dialogic process that challenges traditional notions of authorship, agency, and authenticity. In this sense, AI functions not merely as a pedagogical aid but as a reflective and ethical mediator—one that prompts teachers to reconsider their values, confidence, and professional stance[6].

Despite the accelerating integration of AI into teacher education, empirical syntheses linking AI use with multiple dimensions of TPI remain scarce. Existing research primarily addresses technical competence, AI literacy, or attitudes toward technology adoption[7]. This review is grounded in established identity theories—including SCT, CoP, and reflective practice—which jointly frame how AI-mediated experiences shape teachers' cognition, participation, and ethical judgment. These studies illuminate digital readiness but rarely probe the cognitive, emotional, and ethical mechanisms through which AI reshapes teachers' professional selves. Moreover, identity-oriented inquiries are often fragmented—focusing narrowly on self-efficacy or reflection without integrating the affective and moral dimensions that sustain identity growth. The advent of generative AI since 2022, particularly ChatGPT, has further diversified the landscape, raising questions about creativity, authenticity, and moral agency. A focused synthesis is therefore needed to trace how AI-enhanced teaching and reflection intersect with core identity dimensions—self-efficacy, professional knowledge, and career commitment—within EFL teacher education.

Pre-service teachers represent a critical stage for examining professional identity development because their beliefs, values, and role conceptions are still highly malleable and strongly shaped by early pedagogical experiences. Research has shown that identity formation is particularly dynamic during initial teacher education, where emotional responses, reflective engagement, and pedagogical participation jointly influence emerging understandings of "who I am as a teacher"[2-3]. These characteristics make pre-service teachers especially sensitive to the reflective, affective, and agency-building processes mediated by AI tools. Therefore, focusing on EFL pre-service teachers is theoretically and empirically warranted.

This review addresses three interrelated objectives:

First, it maps the evolution of AI-enhanced approaches to EFL teacher education and professional identity formation.

Second, it synthesizes empirical evidence on how AI influences core identity dimensions—self-efficacy, reflective practice, and professional agency.

Third, it identifies the theoretical mechanisms through which AI-enhanced tasks support or constrain identity development and derives implications for designing identity-oriented teacher education.

To achieve these aims, the review adopts an integrative review methodology aligned with PRISMA 2020 guidelines[8], encompassing studies published between 2015 and 2025 across Scopus and Web of Science databases. After de-duplication and systematic screening, 31 empirical papers were retained, providing a decadal perspective on continuity and transformation in AI-enhanced teacher education. The year 2022 is treated as a data-informed turning point: prior to this year, studies explicitly addressing AI in teacher education were scarce, whereas publication activity expanded rapidly thereafter, coinciding with the public release and widespread adoption of generative AI systems (e.g., ChatGPT) that shifted educational applications from automation toward dialogic and co-creative pedagogical interaction. Despite growing interest in AI-enhanced teacher education, no synthesis has specifically examined how AI mediates identity development among EFL pre-service teachers. This gap limits theoretical understanding of identity formation in technologically mediated contexts.

Guided by the overarching question—How does AI integration influence the professional identity development of EFL PSTs?—this review integrates quantitative, qualitative, and mixed-method evidence. It conceptualizes professional identity as a dynamic, context-responsive process emerging through the interplay of cognition, emotion, ethics, and mediating technologies. The review's main contribution lies in identifying the mechanisms of reflection, self-efficacy, agency, and ethical judgment, and linking them to program-level design principles. By situating these findings within an AI-enhanced identity ecology, the review reconceptualizes AI as both mirror and catalyst—a co-agent that simultaneously reflects teachers' reasoning and stimulates professional transformation.

2. Literature Review

2.1. Conceptual foundations: teacher professional identity and pre-service teacher development

TPI refers to teachers' evolving understanding of themselves as professionals—their beliefs, values, emotions, and perceived competence in performing their teaching roles[2,9]. For PSTs, identity formation is a formative and dynamic process that unfolds through the interaction of reflection, pedagogical experience, and social participation[3,10]. Within EFL education, this process becomes even more multifaceted because it requires teachers to integrate linguistic proficiency, intercultural awareness, and pedagogical translation between theory and classroom realities. Thus, TPI is not a static self-description but an ongoing negotiation between personal understanding and contextual performance, shaped by how teachers perceive and enact their professional roles within specific cultural and institutional settings.

Historically, three complementary theoretical perspectives have guided research on teacher identity. From the SCT perspective, identity development results from reciprocal interactions among personal beliefs, behavioral engagement, and environmental influences[4,11]. Self-efficacy—teachers' belief in their capability to plan and execute teaching tasks—acts as the psychological engine driving motivation, perseverance, and reflection. The CoP framework[5] extends this understanding by conceptualizing identity as a socially negotiated participation process. Teachers construct their professional selves through belonging, recognition, and shared discourse, gradually moving from peripheral observation to full participation in professional communities. For pre-service teachers, this developmental period is particularly formative, as identity is still evolving and highly susceptible to instructional feedback, reflective opportunities, and contextual affordances[2-3].

The Technological Pedagogical Content Knowledge (TPACK) model[12-13] adds a knowledge-integration dimension, emphasizing that effective teaching requires the coordination of technological, pedagogical, and content knowledge. The AI-TPACK model further extends this framework by embedding algorithmic awareness and ethical reasoning into pedagogical design, positioning AI not merely as a tool but as a cognitive and moral partner in teaching and learning. Combined with reflective practice theory[3], these frameworks portray identity development as a cognitive, social, and practice-oriented process grounded in teachers' ability to analyze and reconstruct their teaching experiences.

Synthesizing across these perspectives, this review adopts a triadic conceptualization of TPI—self-efficacy, reflective practice, and professional agency—as the recurring constructs that explain how teachers learn, act, and position themselves within evolving professional ecologies. This triadic framing aligns with recent AI-era conceptualizations of teacher identity, which emphasize the interplay of cognitive, reflective, and agentic processes as teachers negotiate their roles in technology-mediated environments[6-7]. These updated perspectives further justify examining how AI interacts with the formative mechanisms of identity among EFL pre-service teachers.

2.2. Artificial intelligence in teacher education: scope and relevance to identity

Over the past decade, AI has evolved from a peripheral educational technology to a core pedagogical mediator in teacher preparation. This evolution signifies a broader shift from technology-assisted instruction toward technology-enhanced learning design, where AI systems serve not as delivery mechanisms but as interactive partners in teaching and reflection. Within EFL teacher education, diverse AI applications—including intelligent tutoring systems, adaptive feedback mechanisms, and generative AI platforms—have been investigated for their potential to enhance instructional effectiveness, personalization, and authenticity[14-16]. Across empirical studies, successful integration is consistently described as pedagogically driven rather than tool-driven, aligning with the principles of TPACK and reflective practice.

Empirical evidence indicates that AI integration substantially influences PSTs' professional preparedness, reflective engagement, and confidence. Intervention studies report improvements in pedagogical awareness, ethical sensitivity, and adaptive expertise[17]. AI-enhanced feedback mechanisms, such as automated lesson analysis or chat-based reflection prompts, foster deeper metacognitive awareness and self-assessment accuracy[18]. Studies in Asian contexts have demonstrated that AI-enhanced modules bolster motivation and improve practice-based knowledge[19]. However, despite these promising outcomes, most interventions remain short-term, small-scale, or exploratory, and thus furnish little information about long-term identity development. Recent studies further extend this view by examining affective and motivational dimensions of AI use in language education. For example, lecturers and students often have different ideas about generative AI[20]. AI-driven and game-based engagement strategies have shown promise in reducing demotivation and keeping students interested[21]. Understanding how AI-driven learning influences sustained professional growth therefore requires contextualized interpretation and explicit attention to boundary conditions such as mentoring quality, feedback framing, and institutional support.

Parallel conceptual and review-oriented scholarship has introduced frameworks for AI literacy and teacher competence[22-23], emphasizing data awareness, algorithmic ethics, and critical evaluation as essential components of 21st-century teacher professionalism. AI literacy, as distinguished from digital literacy and technological competence, is conceptualized in this review as the ethical-cognitive capacity to understand algorithmic reasoning, evaluate pedagogical implications, and engage critically with AI systems. Nevertheless, as multiple authors note, many existing frameworks remain technocentric—focused on skill acquisition rather than the transformative dimensions of teaching and identity[22]. Spasopoulos et al.[24] and

Salas-Pilco et al.[25] argue that AI adoption must be guided by pedagogy and ethics, ensuring that technology enhances learning quality rather than efficiency alone. This distinction is crucial: most frameworks define what teachers should know about AI but rarely address who teachers become through its use, leaving the deeper identity-related consequences underexplored.

Since 2024, an emerging body of empirical research has begun to confront this issue directly. Studies by Guan et al.[26], Ghiasvand and Seyri[27], and Lan[28] demonstrate that AI competence, reflective capacity, and professional identity evolve interdependently within AI-enhanced environments. AI-supported collaborative reflection fosters dialogic exchange, identity reconstruction, and co-agency—a relational form of agency in which human intentionality interacts with algorithmic feedback to shape professional growth[27]. The tensions generated by AI integration often trigger curiosity, motivation, and ethical awareness. Because pre-service teachers are still forming foundational professional beliefs and practices, AI-enhanced feedback and reflective scaffolds often exert stronger influence on their identity development than on more experienced teachers. These findings collectively illustrate that AI's educational value extends beyond cognitive scaffolding: it reshapes the psychological, pedagogical, and moral dimensions of becoming a teacher.

Taken together, the literature portrays AI as a transformative force that expands the conceptual landscape of teacher education, linking technological competence with self-efficacy, reflection, and ethical discernment. Yet the research base remains fragmented, context-bound, and temporally narrow, with limited longitudinal or cross-contextual evidence. A comprehensive synthesis is therefore required to clarify how AI-enhanced learning shapes the multidimensional development of EFL PSTs' professional identity.

2.3. Research gaps and rationale for the present review

Existing studies vary widely in focus, with some emphasizing digital reflection, others AI literacy, and others teacher agency, yet few integrate these dimensions into a coherent identity framework. Despite promising progress, research on AI-enhanced teacher identity remains conceptually fragmented and methodologically uneven. Thematically, many studies address discrete variables—such as AI literacy, reflective capacity, or teaching confidence—without integrating them into a unified theoretical model[22,26,27]. Consequently, the cognitive, emotional, and ethical components of identity are frequently examined in isolation rather than as mutually reinforcing processes. Methodologically, short-term interventions and self-reported data dominate the field, emphasizing immediate perceptions while overlooking longitudinal identity trajectories[22]. The durability, scalability, and contextual transferability of identity growth thus remain underexplored.

Geographically, most research originates from East Asian and Middle Eastern programs, which constrains cross-cultural inference and raises questions of contextual generalizability[23]. Earlier digital reflection and e-portfolio studies provided valuable conceptual scaffolding for understanding reflective practice but were not designed to explain how AI-enhanced mechanisms—such as generative feedback, adaptive analytics, or algorithmic mediation—transform identity development[19]. Cultural orientations may also moderate AI's impact on identity formation: in collectivist contexts, AI feedback tends to reinforce social harmony and mentor validation, whereas in individualist settings, it promotes experimentation and autonomy[21]. Recognizing such cultural moderators is critical for designing context-responsive, AI-enhanced teacher education. However, no review to date has systematically examined how AI-mediated reflection, feedback, and ethical reasoning jointly shape the identity development of EFL pre-service teachers, which constitutes the central gap addressed in this review.

Addressing these conceptual, methodological, and contextual gaps, the present review synthesizes 31 empirical studies published between 2015 and 2025 to illuminate how AI-enhanced processes influence

PSTs' learning and identity formation. It consolidates fragmented findings into a coherent interpretive framework that links AI-facilitated reflection and agency with the core identity dimensions of self-efficacy, reflective practice, and professional agency. This synthesis lays the groundwork for the systematic procedures, inclusion criteria, and analytical steps detailed in the following Methodology section.

3. Methodology

This integrative review employed a structured and transparent procedure to synthesize empirical research on how AI and related digital technologies have been incorporated into the professional identity development of EFL and education PSTs. Following an integrative review design[29] and the PRISMA 2020 framework[8], the study combined quantitative trend mapping with qualitative thematic synthesis to ensure analytical rigor, transparency, and reproducibility. This methodology was selected because it accommodates heterogeneous empirical designs and enables integration of both pre-AI digital mediation studies and recent AI-enhanced interventions. This approach is appropriate because identity-oriented AI research is methodologically heterogeneous, and an integrative review enables the synthesis of diverse empirical designs while preserving conceptual coherence.

Two databases—Scopus (Core Collection) and Web of Science (SSCI)—were systematically searched between April and October 2025 to capture peer-reviewed studies published from 2015 to 2025. The decade-long window covers both the pre-AI digital mediation phase (2015–2021) and the AI-integrated phase (2022–2025). The year 2022 is identified as a practical threshold, as the volume of research on AI-enhanced teacher education increased sharply after this point, reflecting the wider adoption of generative AI technologies in educational contexts. The 2015–2025 window captures both foundational digital reflection research and the rapid expansion of AI-enhanced teacher education since 2022.

A Boolean search string combined the core constructs of artificial intelligence, teacher education, and professional identity, as follows: ("artificial intelligence" OR "AI" OR "ChatGPT" OR "machine learning" OR "digital technology") AND ("pre-service teacher" OR "student teacher" OR "novice teacher") AND ("professional identity" OR "teacher identity" OR "self-efficacy" OR "reflection" OR "digital literacy" OR "TPACK") AND ("English" OR "EFL" OR "language education"). The search was restricted to English-language, peer-reviewed journal articles, omitting conference papers, dissertations, book chapters, and non-research commentaries. Conceptual papers with clear empirical grounding related to AI-enhanced identity development were retained for triangulation. All search procedures, inclusion decisions, and coding records were documented to ensure replicability and auditability.

The initial search identified 125 records: 32 from Web of Science (SSCI), 47 from Scopus (2022–2025), and 46 from extended Scopus searches (2015–2021). Because empirical research on AI in pedagogy before 2021 was limited, earlier studies were retained to provide conceptual continuity. After removing seven duplicates, 118 studies remained for title, abstract, and keyword screening. Two reviewers independently conducted the screening, resolving disagreements through discussion. Following PRISMA 2020 procedures, the selection progressed through four stages: Identification (125 records located); Screening (118 after de-duplication, 70 excluded); Eligibility (48 full texts assessed); Inclusion (31 studies retained). **Figure 1** (PRISMA Flow Diagram) displays the complete screening pathway and the reasons for exclusion.
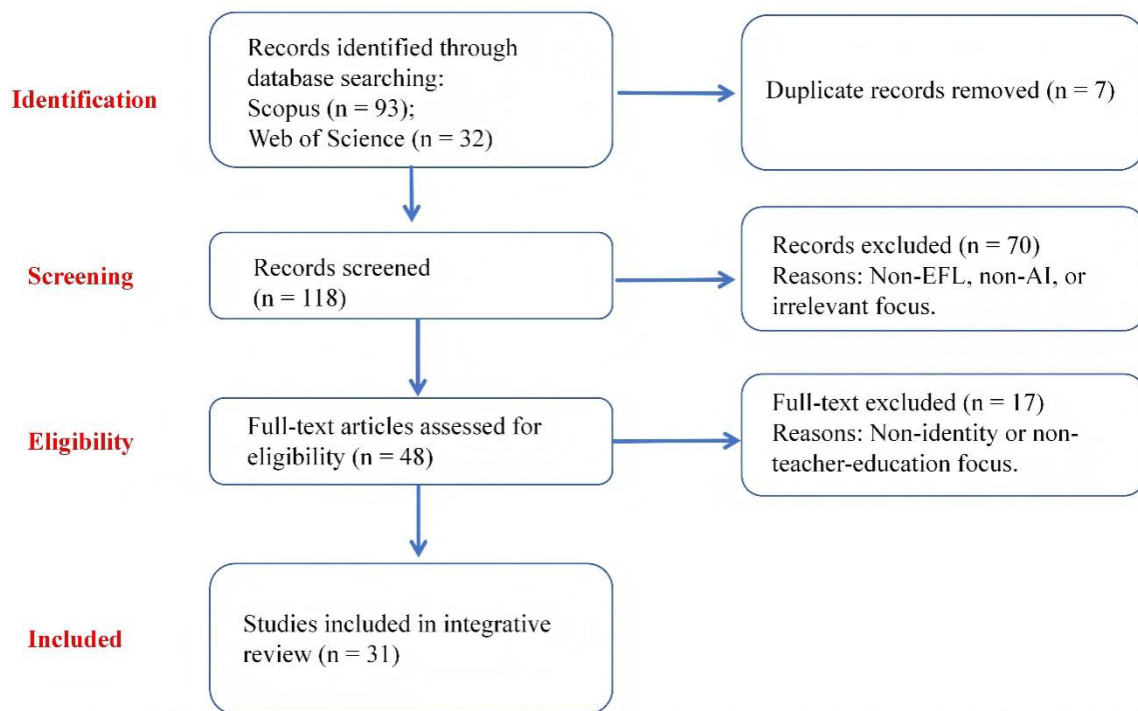
Figure 1. PRISMA Flow Diagram of Study Selection Process.

Studies were included if they met all of the following criteria: (a) investigated PSTs or novice teachers within language or teacher education contexts; (b) integrated AI or digital mediation as a pedagogical component in lesson design, reflection, microteaching, assessment, or peer collaboration; (c) examined identity-related constructs such as professional identity, self-efficacy, reflective practice, or motivation; and (d) employed an empirical or theoretically conceptual grounded design (quantitative, qualitative, mixed-methods, design-based, or conceptually grounded theoretical analysis).

Exclusion criteria included studies that (a) focused on in-service teachers or general learners, (b) examined technical or algorithmic system design without pedagogical application, (c) addressed non-educational computing or engineering contexts, or (d) were non-peer-reviewed or purely speculative conceptual commentaries without theoretical grounding.

All 31 included studies were appraised using the Mixed Methods Appraisal Tool[30], evaluating five quality criteria: (a) clarity of research purpose, (b) methodological appropriateness, (c) data collection rigor, (d) analytical transparency, and (e) validity of interpretation. Two raters independently assessed all studies (agreement = 87%, $\kappa = 0.82$, 95% CI [0.76–0.88]), resolving discrepancies through discussion with a third reviewer. Studies scoring ≥ 3 out of 5 criteria were classified as moderate to high quality. The PRISMA framework ensures transparency and completeness in study selection, while MMAT provides a consistent standard for evaluating mixed empirical designs, thereby strengthening methodological rigor. A sensitivity analysis excluding five lower-scoring studies produced identical thematic patterns, confirming the robustness and stability of the synthesis.

To maintain conceptual coherence, the retained corpus was organized into two analytical layers:

Core AI Layer (2022–2025; N = 21)—studies focusing explicitly on AI-enhanced teaching, reflection, and professional agency;

Pre-AI Digital Mediation Layer (2015–2021; N = 10)—earlier studies on e-portfolios, telecollaboration, and digital reflection that provided conceptual grounding for later AI-based designs.

Each study was coded for publication year, region, participants, research design, AI/application type, and focal constructs. Coding templates captured operational measures such as self-efficacy scales, reflective-depth rubrics, AI literacy dimensions, and ethical-awareness indicators. The analytic framework systematically represented both technological and psychosocial variables thanks to this structured coding.

The integrative synthesis proceeded in two analytical steps: (1) Quantitative trend mapping identified temporal patterns and research concentration; (2) Qualitative thematic synthesis[31] extracted recurring mechanisms through which AI influenced professional identity formation—such as reflective feedback loops, emotional regulation, and ethical reasoning. This dual-layered approach enabled both macro-level trajectory mapping and micro-level mechanism interpretation, ensuring that analytical depth was balanced with methodological transparency. The corpus characteristics and construct-measure correspondence are detailed in Appendix A (**Table 1** and **Table 2**), while the overall review protocol aligns with the AI-enhanced identity ecology conceptual framework guiding this study.

4. Findings

In addressing the overarching research question—How does AI integration influence the professional identity development of EFL PSTs?—this review synthesizes findings from 31 empirical studies published between 2015 and 2025. Of these, 21 recent studies (2022—2025) directly investigated AI-enhanced teaching, reflection, and professional growth, while 10 earlier works (2015—2021) explored digital reflection, telecollaboration, or learning analytics as conceptual precursors to AI integration. Collectively, they reveal a decade-long progression from technology-supported pedagogy to AI-enhanced identity development, signaling a paradigmatic shift in how professional growth is conceptualized, scaffolded, and ethically negotiated.

Across the corpus, three interrelated mechanisms consistently shaped identity formation:

(1) The deepening of reflective quality through dialogic and data-informed feedback;

(2) The strengthening of self-efficacy and professional agency;

(3) The expansion of AI literacy and ethical reasoning as integral to reflective practice.

These processes interacted dynamically with emotional and institutional factors—such as mentoring intensity, feedback design, and cultural expectations—indicating that AI operates as a relational scaffold within cognitive, affective, and ethical dimensions rather than as a deterministic agent of change.

4.1. AI-enhanced reflection and feedback

Reflection emerged as the most consistent mechanism linking AI engagement to professional identity formation. Earlier digital-reflection studies[32-35] demonstrated that e-portfolios, blogs, and telecollaborative tools encouraged descriptive recounting and peer dialogue, thereby strengthening accountability and professional self-awareness. In contrast, post-2022 research introduced AI-enhanced reflection systems—including chatbots, analytics dashboards, and voice journaling—that enabled adaptive, personalized, and multimodal feedback[36-40].

Across studies, three interconnected reflection pathways were identified:

(1) AI-enhanced self-reflection: Tools such as ChatGPT dashboards and Question Bots[37,38] enabled pre-service teachers to analyze lesson plans and microteaching videos with linguistic precision and pedagogical depth, transforming reflection into data-informed inquiry.

(2) Peer-AI hybrid reflection: Triadic feedback systems combining peer, AI, and mentor input[35,41] fostered dialogic exchange and feedback literacy, aligning with Wenger's CoP model[5].

(3) Multimodal and emotional reflection: AI voice journaling and generative storytelling platforms enhanced affective understanding, enabling teachers to articulate growth narratives with emotional coherence[40,42].

Across contexts, reflection quality rather than frequency emerged as the key predictor of identity growth. Combining AI-enhanced feedback with human mentoring enabled PSTs to progress from descriptive recounting to diagnostic, criteria-based reasoning[17,18,36]. These findings confirm that AI functions as a reflective and dialogic partner, cultivating metacognitive awareness and longitudinal self-monitoring[43]. Within this recursive process, reflective engagement becomes the foundation of sustainable professional identity.

4.2. Self-efficacy, agency, and professional growth

Self-efficacy and professional agency constituted the psychological foundation of identity development. Consistent with SCT[44,45], AI-enhanced environments provided mastery cues, vicarious learning, and emotional regulation that reinforced teachers' confidence and sense of control.

Three recurrent mechanisms emerged:

(1) Mastery experiences—Successful completion of AI-enhanced microteaching or scenario-based learning yielded immediate reinforcement, improving self-efficacy and task persistence[46-48].

(2) Vicarious learning—Exposure to exemplary AI-enhanced outputs and comparative analytics enabled pre-service teachers to benchmark performance standards and articulate reflective self-positions[49-51].

(3) Affective regulation—Adaptive feedback reframed error as diagnostic information, transforming anxiety into motivation and resilience[26,52].

Cross-contextual evidence[53,54] indicates that AI functions less as an evaluator and more as a confidence-building partner, mediating the transition from dependence to autonomy. In longitudinal designs[50], sustained engagement with AI tasks promoted reflective persistence and global teaching awareness, while short-term interventions produced measurable gains in self-efficacy and reflective competence[46-48]. Collectively, these findings reaffirm that AI-enhanced mastery and feedback cycles reinforce agency through experience-based confidence.

4.3. AI literacy, ethical reasoning, and identity negotiation

AI literacy emerged as both a competence and a disposition, redefining teacher professionalism in cognitive, ethical, and reflective dimensions. Earlier digital-literacy research emphasized technical creativity and tool use[55,56]; recent work extends this to encompass AI ethics, epistemic judgment, and reflective integrity[57-60].

Within EFL teacher education, AI literacy functions as a mediating mechanism linking technical skill to identity growth[61]. Teachers with higher AI literacy demonstrated stronger adaptability, reflective depth, and ethical awareness[49,62]. Conversely, limited literacy correlated with algorithmic dependence and identity dissonance[26,63]. Expanding the TPACK framework into AI-TPACK[59]—an extension that incorporates AI-specific technological knowledge, embeds ethical and epistemic judgment into pedagogical reasoning, and

integrates AI project-based modules[57,58]—revealed that ethical reasoning and epistemic judgment are inseparable from pedagogical competence. When AI literacy training incorporated ethical dialogues, bias probes, and reflective debriefings, teachers demonstrated more stable professional judgment and autonomy[28]. Programs emphasizing tool fluency without ethical grounding risked producing technically skilled but pedagogically superficial practitioners[64]. Collectively, the evidence positions AI literacy as the interpretive bridge between cognition and conscience, transforming digital competence into an ethical and agentive identity resource.

4.4. Emotional, ethical, and relational tensions in AI integration

Beyond technical skill and cognition, AI engagement generates emotional ambivalence and ethical dilemmas that profoundly shape identity formation. Earlier digital-reflection studies foreshadowed such tensions through debates on authorship and collaboration ethics, while recent work has made them explicit[33,34].

Emotional dimension: Comparative exposure to AI outputs often induced self-doubt and performance anxiety[48]. Cross-national evidence also indicates that smartphone dependence and digital distraction vary across gender and academic disciplines, revealing potential risks to learners' digital well-being[65]. Conversely, teacher-focused research has shown that well-designed AI use can enhance perceived educational quality and reduce future-oriented anxiety among educators, suggesting that purposeful, human-supervised integration may alleviate rather than exacerbate emotional strain[66]. Emotion-sensitive scaffolding—such as AI voice journaling[67] and guided debriefings—transformed discomfort into curiosity and reflective resilience[26].

Ethical dimension: Concerns emerged regarding authorship, creativity, and data privacy[68]. Consequently, ethical AI literacy—addressing bias, attribution, and transparency—was proposed as a formal learning outcome in teacher education[69]. This approach resonates with widely recognized international frameworks that emphasize human-centered and ethically grounded AI practices in education, such as those advanced by UNESCO and the European Union.

Relational dimension: AI interaction reconfigured human—technology boundaries, prompting PSTs to redefine what it means to "be a teacher" in algorithmic environments[26].

When teacher education programs incorporated ethical debriefings and emotion-aware reflection, participants reported reduced anxiety, clearer authorship norms, and enhanced moral agency[40]. These affective-ethical engagements thus serve as catalysts, not peripheral experiences, in the maturation of professional identity.

4.5. Integrative synthesis—the emerging model of AI-enhanced teacher identity

Synthesizing evidence across the decade of research, this review proposes a multi-layered conceptual model illustrating how AI and digital mediation co-construct PSTs' professional identity (see **Figure 2**). The model depicts a recursive progression from digital mediation to AI partnership and ultimately to identity co-construction, integrating cognitive, emotional, and ethical dimensions.
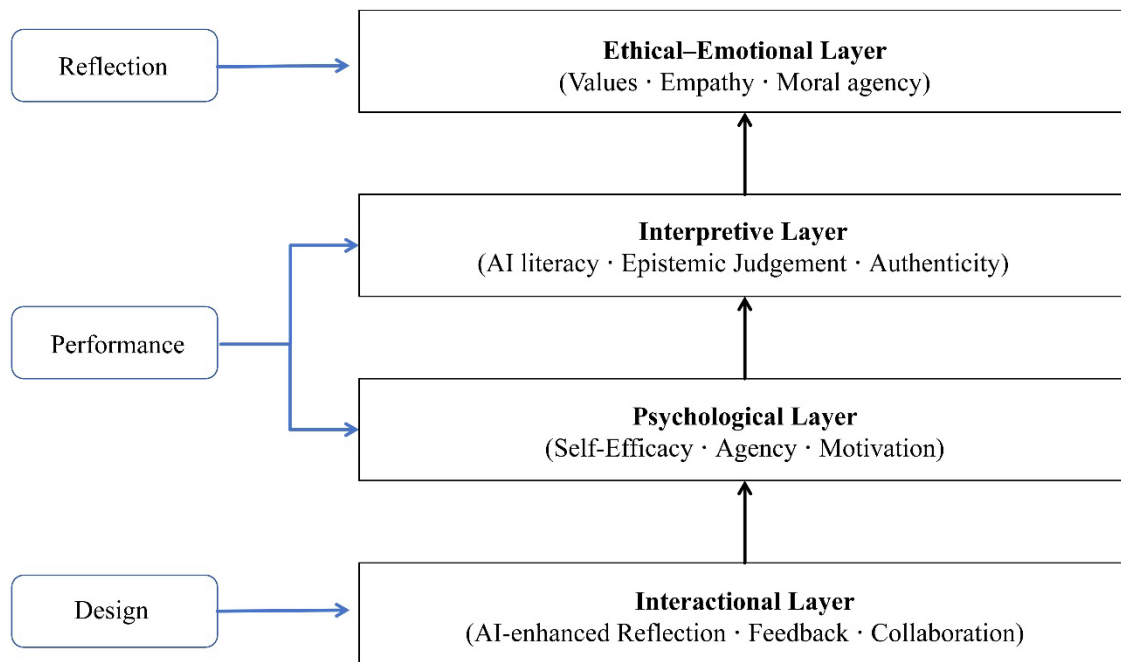
Figure 2. Conceptual Model of AI-mediated EFL Teacher Identity Formation.

Interactional Layer: AI-enhanced reflection and feedback drive iterative design—performance—reflection cycles[37,41,70].

Psychological Layer: Mastery, modeling, and affective regulation reinforce efficacy and agency, enabling confident and autonomous pedagogical decision-making[48,50,71].

Interpretive Layer: AI literacy and ethical reasoning sustain meaning-making and preserve human-centered pedagogy[57,72].

Ethical–Emotional Layer: Tension and reflection converge, transforming uncertainty into resilience and moral clarity[16,26].

These layers operate recursively—reflective engagement generates mastery cues that build confidence; confidence reinforces ethical responsibility; and ethical awareness renews reflective depth. Accordingly, effective teacher education requires AI-enhanced learning ecologies that integrate reflection, agency, literacy, and ethics as co-evolving dimensions of identity. Within this ecology, AI acts not as a substitute for teacher agency but as a relational and epistemic partner—a mirror and catalyst through which PSTs define, challenge, and reaffirm their professional selves.

5. Discussion

Building upon the synthesis presented above, this section interprets how the observed patterns align with established theoretical frameworks—SCT, CoP, and the TPACK model—to explain the mechanisms through which AI-enhanced experiences foster reflection, agency, and ethical reasoning, thus reshaping PSTs' professional identity. **Table 1** summarizes these theoretical linkages.

Table 1. Theoretical mapping of AI-enhanced teacher identity mechanisms.

Theoretical Lens	Core Construct	Mechanism in AI Context	Illustrative Focus
Social Cognitive Theory (SCT)	Self-efficacy & regulation	AI provides mastery cues, modeling, and feedback that build confidence and sustain agency.	Reflective engagement transforms anxiety into inquiry, reinforcing motivation and professional resilience.
Communities of Practice (CoP)	Participation & belonging	AI-supported collaboration transforms individual reflection into shared inquiry and recognition.	Collaborative reflection strengthens professional identity through shared discourse and recognition.
TPACK (extended as AI-TPACK)	Pedagogical & ethical judgment	Teachers interpret and ethically adapt AI input within contextual teaching decisions.	Ethical literacy and reflective judgment sustain pedagogical coherence and teacher autonomy.

Together, these perspectives enable a shift from descriptive aggregation to explanatory integration, clarifying not only what changes occur but also why and under what conditions identity development is strengthened.

The collective evidence reveals a developmental trajectory in which AI evolves from a peripheral instructional aid into a reflective and ethical partner embedded within teacher-learning ecologies. Early digital initiatives such as e-portfolios and collaborative blogging enhanced access to artifacts and feedback but left identity mechanisms implicit[34]. More recent AI-based studies make these processes explicit by linking adaptive feedback and generative reflection to metacognitive awareness, self-positioning, and agency enactment[37]. Conceptual contributions further characterize this transformation as relational and ethical, reframing AI not as an external technology but as a co-constructive presence in identity formation[64,69]. Viewed through this theoretical lens, we can better account for both the enabling and constraining effects of AI-enhanced experience on professional growth.

From an SCT standpoint, AI-mediated environments provide continuous mastery cues, modeling opportunities, and regulatory feedback that enhance self-efficacy and perceived control[4,11]. These reciprocal interactions among cognition, behavior, and environment foster confidence and perseverance in teaching tasks. From a CoP perspective[5], AI-supported collaborative platforms create hybrid spaces in which PSTs rehearse disciplinary discourse, receive peer recognition, and engage in shared inquiry—cultivating belonging and collective responsibility. Extending Shulman's pedagogical reasoning[73] and the TPACK model, the emerging AI-TPACK framework adds ethical and epistemic judgment as essential components of pedagogical knowledge. Teachers who critically interrogate algorithmic suggestions—deciding when to accept, adapt, or reject AI input—demonstrate stronger ownership of practice and more coherent reasoning. Conversely, uncritical dependence on AI correlates with fragmented planning and reduced professional autonomy. Collectively, these frameworks complement one another: SCT explains how efficacy develops, CoP clarifies where belonging forms, and AI-TPACK specifies how knowledge negotiation sustains agency in the age of AI.

Beyond theoretical alignment, the reviewed studies delineate boundary conditions that moderate outcomes. Prior literacy consistently shapes developmental trajectories. Insufficient understanding of AI's pedagogical role can foster overreliance and anxiety, while targeted literacy integrating technical, ethical, and reflective dimensions supports confident and critical engagement[28]. Mentoring quality likewise determines learning depth: AI feedback without human facilitation often remains procedural, whereas blended mentoring—combining dialogue and analytics—fosters inquiry and identity articulation[68]. Assessment design exerts comparable influence. When institutional evaluation privileges polished output over reflective process, students tend to optimize for performance, weakening depth of learning; process-oriented rubrics counteract this tendency and enhance identity awareness[52]. Finally, contextual

expectations—including authority relations and tolerance for uncertainty—shape how teachers perceive co-agency and interpret shared decision-making[28]. Collectively, these contingencies confirm that AI functions as an amplifier rather than a determinant: it magnifies the existing quality of pedagogy, mentoring, and institutional culture. In environments valuing inquiry and dialogue, AI accelerates professional growth; in performance-driven contexts, superficiality persists.

The synthesis further elucidates the epistemic, affective, and ethical mechanisms through which AI-enhanced learning shapes identity. Epistemically, interpretable analytics and traceable generative outputs prompt teachers to justify pedagogical decisions[37]. Productive engagement involves using AI to explore alternatives, defend selections in relation to learner needs and curricular aims, triangulate suggestions with mentor feedback, and document reasoning through decision logs. Less productive practices—such as copying or concealing AI-generated content—undermine transparency and weaken professional ownership. AI thus transforms pedagogical knowledge from a static intersection of domains into a dynamic negotiation space where reasoning is continually enacted[59].

Affectively, AI evokes mixed emotions of curiosity, apprehension, and challenge. Studies on AI-enhanced feedback and scenario-based learning show that comparative feedback coupled with guided debriefing enhances motivation and resilience[54]. Emotion-aware reflection allows teachers to reinterpret anxiety as diagnostic information, consistent with SCT's notion of self-regulation. The pedagogical goal is not to suppress emotion but to channel it toward inquiry—transforming tension into curiosity and experimentation.

Ethically, issues of authorship, bias, and originality have become central to identity discourse. Programs embedding ethical AI literacy—covering attribution, bias awareness, and human oversight—report more coherent identity trajectories[57]. Teachers capable of articulating what they will or will not delegate to AI exhibit stronger ethical agency and professional integrity. When ethics remain peripheral, students oscillate between skepticism and uncritical trust. Embedding procedural safeguards—such as explicit AI-use statements and reflective debriefs—operationalizes ethical principles and sustains integrity without constraining creativity. Conceptual analyses reinforce this view by positioning ethical literacy as the foundation of a human-centered professional identity[69].

Translating these mechanisms into pedagogical design, the reviewed studies suggest a progressive model of AI-enhanced teacher education. Programs typically begin with orientation and safety training—introducing data provenance and authorship principles—then move toward guided exploration, lesson co-design, and microteaching informed by AI feedback[37]. Subsequent stages integrate video-based analytics and public reflection forums, culminating in an "Identity-with-AI" portfolio that documents learning trajectories and ethical commitments. Throughout this process, assessment design remains pivotal: rubrics should foreground process transparency, reflective depth, pedagogical coherence, and ethical reasoning. These criteria reward reflective partnership rather than superficial polish, aligning teacher education with the humanistic values underpinning professional identity formation.

Future research should address several remaining gaps. Because most studies were conducted in higher-education contexts, generalizability to K-12 settings remains uncertain. The predominance of short-term interventions suggests that there must be longitudinal research examining the durability of identity and self-efficacy gains. Cross-cultural comparisons could illuminate how authority norms and collaboration styles mediate teacher–AI interaction[28]. Quantitative meta-analyses using shared measures of self-efficacy, reflection, and AI-TPACK would further clarify effect magnitudes and moderators[52]. Such studies will strengthen the empirical base for theoretically informed program design.

Ultimately, AI's most enduring contribution to teacher education lies not in automation but in identity work—bridging action and understanding, providing cognitive and social mirrors, and translating ethical reflection into practice. When teacher-education programs humanize and contextualize AI, PSTs engage with it not as an authority but as a co-inquirer—a collaborative presence that sharpens judgment, sustains agency, and keeps the teacher's professional self recognizably human. Several limitations of this review should be acknowledged. Methodologically, most included studies relied on short-term interventions or self-reported perceptions, constraining our ability to assess the durability of identity development. Contextually, the evidence is concentrated in higher education programs in East Asian and Middle Eastern settings, limiting generalizability to K–12 or cross-regional contexts. Temporally, the sharp increase in AI-related studies after 2022 means that long-term longitudinal evidence remains scarce, and the field is still in an early formative stage. These limitations suggest caution in interpreting causal relationships and highlight the need for more diversified and robust research designs.

6. Implications and conclusions

Building upon the preceding synthesis, this integrative review examined how AI technologies shape the professional identity development of EFL PSTs. The analysis, which synthesizes 31 empirical studies published between 2015 and 2025, reveals a paradigmatic shift in the conceptualization and operationalization of AI in teacher education. Rather than functioning as a technical supplement, AI has emerged as an ecological and dialogic partner in teacher learning—mediating reflection, cultivating agency, and co-constructing evolving professional identities.

Through the combined theoretical lenses of Social Cognitive Theory (SCT), Technological Pedagogical Content Knowledge (TPACK), and Communities of Practice (CoP), this review articulates a comprehensive model of identity ecology in the AI era—a recursive system in which cognitive, affective, and ethical processes continuously interact through reflective engagement with intelligent systems. This model connects interactional, psychological, interpretive, and ethical-emotional dimensions of teacher growth, linking micro-level classroom practice with macro-level professional formation.

At the theoretical level, this synthesis reframes teacher professional identity as a dynamic and negotiated construct, continually reconstructed through reflection and interaction rather than defined by static attributes. Within the SCT framework, AI-mediated environments provide recurrent mastery cues, vicarious learning opportunities, and regulatory feedback that enhance self-efficacy and perceived control[11]. Across the reviewed studies, these experiences cultivate competence, persistence, and autonomy, anchoring identity consolidation. From a CoP perspective[5], AI integration transforms isolated learning into participatory professionalism. Through AI-facilitated feedback and collaborative reflection, PSTs engage in shared reasoning and community recognition, extending Wenger's notion of identity-as-participation into hybrid, technology-supported communities. From a TPACK perspective, AI introduces a new epistemic and ethical dimension to pedagogical knowledge. Teachers are now required to exercise AI pedagogical judgment—interpreting, adapting, and ethically moderating algorithmic input within context-sensitive instructional reasoning[59]. This reframes TPACK as a model of negotiation rather than integration, demanding continuous recalibration among technological affordances, pedagogical purposes, and humanistic values. Taken together, the triadic framework—SCT (efficacy), CoP (belonging), and AI-TPACK (judgment)—functions as a mutually reinforcing system: efficacy motivates participation; participation provides the context for judgment; and ethical judgment sustains reflective efficacy. Thus, identity growth under AI mediation is simultaneously cognitive, social, and moral. Emotional and ethical tensions—such as anxiety, authenticity

concerns, or moral dilemmas—are not disruptions but productive dissonances that catalyze reflection, resilience, and ethical agency[3].

Pedagogically, this synthesis underscores that AI integration must occur within reflective, dialogic, and ethically grounded pedagogies rather than through isolated technical training. AI-enhanced microteaching, generative lesson design, and chatbot-mediated reflection provide fertile contexts for metacognitive development when accompanied by human mentorship and ethical scaffolding. Teacher educators therefore bear dual responsibilities: to understand AI affordances and to mediate their use through critical dialogue on creativity, authorship, and accountability. AI literacy courses should embed data ethics, algorithmic transparency, and affective reflection as core learning outcomes. At the program level, institutions should design hybrid learning ecologies—physical and virtual—where AI acts as a co-inquirer and cognitive mirror, supporting experimentation and professional dialogue without undermining autonomy. Evidence across studies confirms that humanized AI integration—where technology amplifies rather than replaces teacher judgment—fosters deeper reflection and more coherent identity formation[37]. Teacher educators should design AI-enhanced reflective tasks that foreground identity negotiation rather than technical skill alone. Programs should incorporate ethical AI literacy as a core learning component, including attribution, transparency, and responsible tool use. Assessment rubrics should prioritize reflective depth, process documentation, and pedagogical reasoning. To translate these insights into actionable program design, teacher education curricula should incorporate sequenced AI-supported activities that explicitly target identity development. For example, microteaching modules can embed AI-enabled video analytics that prompt candidates to justify pedagogical choices, while reflection journals can require structured comparison between human and AI feedback to cultivate ethical judgment. Courses on instructional design should include guided tasks where pre-service teachers iteratively revise lesson plans using AI suggestions and document their reasoning. Embedding these structured interactions ensures that identity growth is systematically supported rather than occurring incidentally.

At the institutional level, these findings call for curricular redesign and ethical governance in teacher education. Competency-based curricula integrating digital fluency, reflective practice, and ethical reasoning should replace fragmented course structures. While AI analytics can facilitate the continuous monitoring of teacher development, such systems must remain transparent, participatory, and human-supervised. Institutional leaders should ensure equitable access to AI tools, prevent algorithmic bias, and promote multilingual inclusivity in EFL contexts. Cultivating sustainable professional identity in the AI era therefore requires not only technological infrastructure but also a cultural ethos of "AI with humanity"—educators who are technologically competent, ethically grounded, emotionally literate, and pedagogically adaptive. Only through such balance can teacher education respond to the epistemological, moral, and cultural complexities introduced by AI.

Despite its comprehensive synthesis, this review acknowledges several limitations. The analyzed corpus is predominantly derived from higher education and language teacher preparation programs, limiting generalizability to K-12 or vocational contexts. Moreover, the temporal clustering of studies between 2022 and 2025 reflects AI's rapid adoption but restricts understanding of long-term identity trajectories. Methodologically, most studies relied on short-term interventions or self-report measures, leaving the durability of identity gains uncertain. Future research should adopt longitudinal, cross-cultural, and mixed-methods designs to trace how sustained AI engagement influences teacher identity over time. Meta-analytic studies could further quantify effect magnitudes across identity dimensions such as self-efficacy, agency, and reflection[59]. Additionally, underexplored areas—including emotional labor, ethical decision-making, intercultural variation, and teacher–AI relational dynamics—warrant systematic investigation. These

directions will consolidate the empirical foundation for designing AI-enhanced yet human-centered teacher education worldwide.

Across the 31 studies reviewed, a consistent principle emerges: AI strengthens teacher professional identity most effectively when embedded within reflective, ethically grounded pedagogy. The emerging paradigm positions AI as both mirror and catalyst for teacher growth. The central question is no longer whether AI should be integrated but how it can enhance humanistic learning and moral discernment rather than mechanistic efficiency. AI's enduring pedagogical value lies not in automation but in its capacity to amplify reflection, agency, and ethical awareness. When purposefully designed and critically implemented, AI becomes a medium for cultivating resilient, self-aware, and ethically responsible educators—professionals who are technologically adept yet profoundly human in judgment, empathy, and purpose. In this light, the age of AI continually redefines the professional identity of EFL pre-service teachers through reflective practice, agentic participation, and ethical partnership with intelligent systems.

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Conflict of interest

The authors declare no conflict of interest.

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Appendix A.

Table 1. Quality evaluation framework for studies on AI-enhanced EFL teacher education.

	Evaluation Dimension	Appraisal Focus (developed for this review)
1	Relevance and Conceptual Alignment	Each study was examined for its explicit focus on pre-service or novice teachers in EFL contexts and its conceptual alignment with professional identity, reflective practice, or self-efficacy. Studies addressing AI merely as a technical tool without pedagogical relevance were excluded.
2	Methodological Transparency	Clarity of research purpose, appropriateness of design (quantitative, qualitative, or mixed), and adequacy of sampling and data collection were evaluated. Studies were expected to report instruments, participants, and data-gathering procedures with sufficient detail to permit replication.
3	Analytical Rigor	The transparency and appropriateness of analytical procedures were assessed, including the description of coding or statistical methods, evidence of validation or triangulation, and alignment between research questions and data interpretation.
4	Ethical and Procedural Soundness	Studies were reviewed for ethical statements, informed consent, and confidentiality safeguards. Attention was also given to whether data use and reporting reflected respect for participants and institutional guidelines.
5	Interpretive Coherence and Reporting Quality	The overall logical connection among aims, methods, findings, and implications was evaluated. Studies were expected to present results clearly, support claims with data (e.g., quotes, tables, or figures), and acknowledge limitations.

Note. The evaluation framework was adapted from MMAT (Hong et al., 2018) and cross-referenced with the JBI critical appraisal checklists (Aromataris & Munn, 2020) to ensure coverage of methodological, ethical, and interpretive dimensions relevant to AI-mediated EFL teacher education. Two reviewers independently applied the criteria, reaching 87% agreement (Cohen's κ = 0.82).

Table 2. Summary of studies included in the integrative review (2015–2025).

Study	Participants	Methodology	Research Focus	Identity-related Outcomes
2025 [26]	24 pre-service teachers (China, Asia)	Qualitative (interviews)	Perceptions and self-efficacy in AI-integrated education	Limited AI understanding constrained pre-service teachers' identity, making it necessary to reconceptualize teachers as AI collaborators.
2024 [28]	216 teacher trainees; 15 teachers (China, Asia)	Mixed methods (survey + qualitative case analysis)	AI-enhanced teacher training—TPI tensions and motivations	AI integration revealed identity tensions—groupness vs individuality, humanity vs technology, and continuity vs openness—reshaping teacher identity negotiation.
2016 [32]	31 pre-service teachers from three courses (Taiwan, Asia)	Qualitative (multi-source data from interviews and project artifacts)	Cloud computing and social media—culturally responsive teaching and collaboration	Cloud-based collaboration enhanced pre-service teachers' cultural awareness, reflection, and confidence in integrating culturally responsive teaching into their professional identity.
2019 [33]	83 pre-service teachers from two universities (USA, North America)	Qualitative (two-phase study with blog analysis and questionnaires)	Collaborative blogging—Technology integration and peer learning	Online collaboration through blogging enhanced pre-service teachers' digital confidence, reflection, and sense of professional community, strengthening emerging teacher identity.
2021 [34]	325 first-year education students (Australia, Oceania)	Quantitative (survey-based pilot study)	E-Portfolio-based reflection—Assessment improvement and reflective practice	Regular e-Portfolio use strengthened reflective habits and accountability, fostering development of a reflective professional identity.
2021 [35]	61 in-service teachers (Estonia/Netherlands, Europe)	Mixed methods (questionnaires and interviews)	Learning analytics–enhanced e-portfolio—Peer feedback and reflection	Learning analytics–supported e-portfolios improved feedback literacy and reflective engagement, fostering collaborative professional identity.
2025 [37]	48 pre-service teachers (China,	Quantitative (quasi-	AI-powered teacher dashboard—Video-	The AI-powered dashboard enhanced pre-service teachers' cognitive reflection and professional

Study	Participants	Methodology	Research Focus	Identity-related Outcomes
	Asia)	experimental)	based reflection	identity growth.
2025 [38]	6 student teachers (Sweden, Europe)	Qualitative (thematic analysis of interviews)	AI-powered Question Bot—Reflective practice and feedback	AI tools enhanced pre-service teachers' noticing, reflection, and agency, reinforcing identity through self-directed learning.
2024 [39]	8 Iranian EFL teachers (4 novice, 4 experienced) (Iran, Asia)	Qualitative (transcendental phenomenology)	ChatGPT-driven collaborative reflection—Professional development	ChatGPT-supported reflection enhanced teachers' self-awareness, confidence, and sense of belonging, reinforcing professional identity growth.
2025 [40]	8 pre-service English teachers (Türkiye, Middle East)	Qualitative (content analysis of AI-generated voice journals)	AI-powered voice journaling—well-being and reflective practice	AI voice journaling enhanced pre-service teachers' emotional awareness, reflection, and self-understanding, deepening their professional identity.
2025 [41]	39 pre-service English teachers (Türkiye, Middle East)	Qualitative (action research)	Triadic reflection framework with peer, ChatGPT, and faculty advisor	AI- and peer-supported reflection enhanced pre-service teachers' reflection, collaboration, and professional identity.
2025 [42]	80 pre-service teachers (China, Asia)	Quantitative (quasi-experimental post-test design)	Generative AI-assisted digital storytelling—reflective thinking skills	GenAI-assisted storytelling enhanced pre-service teachers' reflection, self-awareness, and adaptive teaching growth.
2021 [46]	77 pre-service teachers (China, Asia)	Quantitative (quasi-experimental pre–post design)	Flipped classroom pedagogy—Learning achievement, motivation, and self-efficacy	The flipped classroom model improved pre-service teachers' self-efficacy and motivation, enhancing confidence and engagement as developing teachers.
2021 [47]	238 pre-service teachers (Australia, Oceania)	Quantitative (experimental with three intervention groups)	Online scenario-based learning—Feedback, reflection, and self-efficacy	Integrating feedback and reflection in online learning enhanced pre-service teachers' self-efficacy and readiness, strengthening early professional identity formation.
2024 [50]	1 pre-service teacher (Iran, Asia)	Qualitative (narratives, interviews, and demos)	Engage–Study–Activate model—Teacher identity formation	The ESA model fostered belief formation, confidence, and global citizenship, strengthening evolving teacher identity.
2021 [51]	Teacher trainees from two universities (Spain, Europe)	Mixed methods (pre–post design with surveys and qualitative data)	Telecollaboration in CLIL environments—Development of Learning to Learn competence	Integrating technology and telecollaboration enhanced reflection and goal-setting, fostering self-regulated and reflective professional identity.
2025 [52]	30 pre-service teachers (China, Asia)	Mixed methods (pre-post experimental + interviews)	ChatGPT-supported feedback training—Feedback quality and self-efficacy	ChatGPT-assisted feedback enhanced pre-service teachers' confidence, reflection, and professional competence in giving feedback.
2024 [53]	4 MA student teachers (Saudi Arabia, Asia)	Qualitative (appreciative inquiry with journals and forum data)	AI tool integration in ELT microteaching—professional development	AI tool use in lesson design enhanced pre-service teachers' confidence, agency, and reflection, supporting professional identity growth.
2025 [54]	18 pre-service teachers (12 primary, 6 post-primary) (Ireland, Europe)	Mixed methods (exploratory with embedded quantitative elements)	GenAI-enhanced scenario-based learning—Self-efficacy and AI literacy	GenAI-supported SBL enhanced pre-service teachers' confidence, AI literacy, and adaptability, strengthening their emerging teacher identity.

Study	Participants	Methodology	Research Focus	Identity-related Outcomes
2015 [55]	234 pre-service primary mathematics teachers (Hong Kong, Asia)	Mixed methods (survey with SEM + interviews)	Technology acceptance in teacher education—Attitudes and influencing factors	Positive attitudes and the perceived usefulness of technology enhanced pre-service teachers' readiness and confidence to integrate digital tools, reinforcing a technologically adaptive teacher identity.
2020 [56]	Turkish pre-service EFL teachers (Türkiye, Asia)	Qualitative (interviews and thematic analysis)	Digital literacy in teacher education— Conceptions and practices	Pre-service teachers viewed digital literacy as evolving from basic to critical and creative use, highlighting guided digital engagement for professional identity growth.
2025 [57]	91 teacher educators (Denmark, Europe)	Mixed methods (survey + GenAI-assisted analysis)	Perceptions of GenAI's pedagogical, ethical, and literacy potentials in teacher education	Engaging with GenAI fostered AI literacy, ethical awareness, and reflective identity among teacher educators.
2025 [58]	Graduate-level student teachers (Cyprus, Europe)	Qualitative (analysis of project artifacts)	Data-driven and ethical reasoning in AI education	Data-driven and ethical AI projects enhanced pre-service teachers' technical fluency, ethical awareness, and pedagogical identity.
2025 [59]	520 pre-service TCSL teachers (China, Asia)	Quantitative (EFA, CFA, SEM)	AI-TPACK framework — Self-efficacy, AI attitudes, and pedagogical knowledge	Higher self-efficacy and positive AI attitudes enhanced pre-service teachers' AI-TPACK, reinforcing their identity as technologically competent teachers.
2024 [60]	Pre-service teachers enrolled in asynchronous ChatGPT courses (South Korea, Asia)	Qualitative (discussion analysis using Diffusion of Innovations framework)	GenAI integration in teacher education — Awareness and adoption attitudes	ChatGPT use increased AI awareness and reduced anxiety, though uncertainties limited confidence and full identity alignment.
2019 [61]	Pre-service teachers and course tutors (Australia, Oceania)	Qualitative (exploratory case study with reflexive accounts and focus groups)	Technology integration and digital equity — Learner and professional identity formation	Pre-service teachers' attitudes toward technology shaped learner and teacher identities, underscoring the need to cultivate positive digital identities to prevent future inequity.
2025 [63]	5 pre-service English teachers (Hong Kong, Asia)	Mixed methods (multiple-case study)	GenAI literacies in L2 teacher education — Identity investment and affordances	Pre-service teachers negotiated learner, writer, and teacher identities through GenAI use, developing critical literacies that shaped professional identity.
2025 [64]	Conceptual paper (no empirical participants)	Theoretical (posthumanist and phenomenological synthesis)	Integrated AI-Oriented Pedagogical Model — Pedagogical and identity shifts	Teacher identity reconceptualized as evolving from knowledge-holder to co-creator through ethical engagement with AI.
2025 [68]	18 pre-service English teachers (Korea, Asia)	Qualitative (thematic analysis)	GenAI-enhanced lesson design — Teacher agency and responsible AI use	GenAI-enhanced lesson design strengthened pre-service teachers' agency, reflection, and responsible identity development.
2025 [69]	Conceptual paper (language teacher education)	Theoretical (framework development)	Technology-enhanced reflection — Human-centered integration of AI tools	Technology conceptualized as a reflective partner fostering metacognitive, emotional, and professional identity growth.
2024 [70]	Pre-service teachers online course (Australia, Oceania)	Mixed methods (comparative design)	AI chatbot support — Differentiated lesson planning and inclusion	AI chatbot interactions improved pre-service teachers' self-efficacy and reflection, supporting inclusive and adaptive identity development.

Table 2. (*Continued*)