Issue 1/2026
pp. 47-69

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Developing the three-dimensional integrative model of teacher competencies (TRI-model) through a systematic review of teacher competencies for twenty-first century education

Abstract: The teaching profession in the post-professional era confronts a paradox: the expectation to preserve pedagogical tradition while facing a challenging educational future. Fundamental pedagogical and didactic competencies are no longer sufficient; an enhancement with competencies for the digital age, globalisation and ecological crisis is imperative. This study combines a theoretical-analytical approach with a systematic literature review in accordance with Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. The Web of Science, Scopus, ERIC, Google Scholar and Croatian Research Information System (CRORIS) databases were searched for the period 2014–2025 to identify contemporary competencies (n = 85) and for the period before 2014 to identify traditional competencies (n = 23), resulting in a total of 108 relevant sources. The literature review analyses existing competency models identifying pedagogical (personal, communicative, analytical, social, emotional, intercultural, developmental and problem-solving) and didactic dimensions (curricular, organisational, assessment, classroom climate and partnership with parents). The analysis identifies several key trends: the permanence of fundamental competencies alongside the need for reconceptualisation, the emergence of new competency domains (digital, AI, global, sustainability and metacognitive) and the need for integrative approaches. This study's scientific contribution is a new three-dimensional integrative model of teacher competencies (TRI-model) that unifies the permanent core, contextual layer and reflective axis, enabling synergy between tradition and innovation through continuous reflective practice.

Keywords: teacher competencies, pedagogical competencies, didactic competencies, integrative model, reflective practice

UDC: 37.091

Scientific article

https://doi.org/10.63384/spB61z910a

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Introduction

Under the dynamic conditions of contemporary education, traditionally defined teacher competencies, whether pedagogical and didactic, appear increasingly insufficient and require conceptual reexamination and redefinition. While they remain the foundation of professional practice, they must be enhanced with competencies arising from contemporary demands, accelerated social, societal and technological changes and the evolution of how today's children and young people grow, mature and learn (Caena and Redecker 2019; European Commission 2020). Patterns of receiving and processing information, acquiring social competencies, socialisation and inculturation are changing; thus, teachers must respond to the needs of new generations of pupils (Voogt and Roblin 2012).

The redefinition of teacher competencies is not merely a professional necessity but the education system's strategic response to the challenges of the coming era (Barber and Mourshed 2007; Darling-Hammond 2017; Hattie 2012; Schleicher 2018; Simonović 2021). The post-professional era, as termed by Hargreaves (in Guerriero 2017), is characterised by uncertainty in teacher professionalism and is shaped by economic factors, globalisation and digital communication. Members of Generation Alpha include individuals born in 2010 or later. They are referred to as the »glass generation«, »screeners«, »digital natives« and the »connected generation« (Tootell et al. in Mehta and Giunchiglia 2025), and are growing up with technology as an integral part of their lives. They possess a different combination of cognitive skills compared to previous generations, and an understanding of the world shaped by algorithmic stimuli (Mikelić Preradović et al. 2018). These children have access to unlimited information in a world in which knowledge is created and shared at a pace that is difficult to follow (Mehta and Giunchiglia 2025).

One OECD report (2005) states that teacher quality is the most important factor affecting learning outcomes within the school system. The findings of the TALIS 2024 research confirm the need for continuous professional development of teachers, particularly in the areas of digital competencies, inclusive education and personalised approaches to learning. The research demonstrates that teachers who regularly participate in professional development achieve

significantly better outcomes in promoting critical thinking and pupil motivation. Additionally, TALIS 2024 highlights the challenges teachers face in managing heterogeneous classrooms, applying information and communication technologies in teaching and developing pupils' socio-emotional competencies. According to the OECD report (2025), the need to strengthen teachers' competencies for work in multicultural environments and for applying approaches oriented towards sustainable development and global citizenship is among the study's key findings.

The aim of this study is to develop an integrative model of teacher competencies that unifies fundamental pedagogical and didactic competencies with contemporary demands and needs of incoming generations, the digital age, globalisation and environmental crisis, grounded in a systematic literature review.

Methodology

In this work, a systematic literature review (SLR) was conducted according to PRISMA guidelines (Page et al. 2021) to identify, analyse and synthesise relevant scholarly works on teacher competencies. The search was conducted between January and March 2025 in the following databases: Web of Science, Scopus, ERIC, Google Scholar and CRORIS. The following combination of keywords was used: (teacher competencies OR pedagogical competencies OR digital competencies OR teaching competencies OR professional competencies AND (AI literacy OR artificial intelligence OR 21st century skills OR digital skills OR educational technology) AND (formal education OR teacher training OR teacher education OR professional development).

The study's inclusion criteria were as follows: (1) works published from 2014 to 2025; (2) peer-reviewed scholarly articles, books and reports from international organisations; (3) works written in English or Croatian; (4) works that focus on teacher competencies in formal education; and (5) works that have a clear methodological foundation. The initial search resulted in 1,247 potential sources. After removing duplicates (n = 834), a title and abstract analysis was conducted, after which 347 works were selected for full-text review. Two independent researchers participated in the selection process and chose works according to predefined criteria. In cases of disagreement, such as when one researcher included a work in the selection while the other did not, consensus was achieved through a subsequent joint analysis and review of the work's full text. After a detailed analysis of full texts, a total of 133 works were found to meet the inclusion criteria (Table 1). The full-text versions of these works were found and obtained for all references included in further analysis. The quality of empirical studies was assessed using CASP, JBI and MMAT checklists. A quality assessment was conducted and, 48 works of low quality were excluded from further analysis, resulting in a final SLR corpus of 85 sources for the development of the integrative model. Additionally, classical works (n = 23) from the period 1983–2013 were included in the theoretical framework. These works represent the study's theoretical foundation for understanding the development

of the concept of teacher competencies (Keuffer 2010; Korthagen and Vasalos 2005; Mishra and Koehler 2006; Rychen 2003; Shulman 1986; Weinert 2001), although they were not included in the systematic review covering the period 2014–2025.

Competency Area	Number of Works[1]	References
Conceptualisation of teacher competencies	12	European Commission 2020; Guerriero 2017; Hattie 2012; Jones et al. 2021; OECD 2018; Oberle et al. 2020; Schleicher 2018; Stronge et al. 2011; Tigelaar et al. 2004; Tootell et al. 2014; Vaillancourt et al. 2021; Weinert 2001
Fundamental pedagogical teacher competencies	15	Backfisch et al. 2020; Carbonell et al. 2014; Darling-Hammond 2006; Darling-Hammond and Bransford 2007; Gumus 2022; Hmelo-Silver and Barrows 2015; Jennings and Greenberg 2009; Koh et al. 2018; Korthagen and Vasalos 2005; Quobilovna 2023; Savina et. al 2025; Shulman 1986; Vangrieken et al. 2015
Fundamental didactic teacher competencies	26	Bearman et al. 2022; Daniel et al. 2021; Drake and Reid 2020; Egert et al. 2020; Epstein 2011; Florian and Camedda 2020; Fullan 2007; Gay 2018; Gikandi and Morrow 2020; Hammond 2020; Hornby 2011; Ishimaru et al. 2021; Murray et al. 2020; Nessipbayeva 2012; Panadero et al. 2020; Rapanta et al. 2021; Souto-Manning and Martell 2019; Starkey 2020; Tapani and Salonen 2019; Trust and Whalen 2020; Valdez et al. 2021; Voogt et al. 2023; Voogt et al. 2023; Waitoller and Thorius 2021; Wiliam 2021; Yan and Cheng 2023
Integrative models	13	Barrios Bulling 2022; Celik et al. 2022; Falloon 2020; Kim and Asbury 2020; Kim et al. 2021; Koehler et al. 2013; Mishra and Koehler 2006; Mishra and Koehler 2006; Ng et al. 2021; Pangrazio and Sefton-Green 2021; Thurlings et al. 2015; Touretzky et al. 2019; UNESCO 2024
Global competencies	5	Andreotti 2014; Gaudellia 2021; Parmigiani et al. 2022; Tarozzi and Torres 2016; Zhao and Watterston 2021
Sustainability competencies	6	Bianchi et al. 2022; Corres et al. 2020; Corres et al. 2020; Monroe et al. 2019; Pereira 2019; Tejedor et al. 2019
Digital competencies	7	Caena and Redecker 2019; Gudmundsdottir and Hatlevik 2018; Instefjord and Munthe 2017; Mandinach and Gummer 2016; Pettersson 2021; Redecker 2017; Scherer et al. 2021
AI competencies	3	Chiu et al. 2024; Holmes et al. 2019
Critical thinking	8	Bezanilla et al. 2019; Dwyer 2017; Ennisa 2011; Forawi 2016; Liu et al.a 2014; McGrew et al. 2018; Paul and Elder 2014; Roozenbeek and van der Linden 2020
Creativity and innovation	7	Craft 2020; Cremina 2015; Kampylis et al. 2015; Kettler et al. 2018; Sale 2020; Scheer et al. 2019; Vincent-Lancrin et al. 2019
Resilience	9	Bobek 2002; Johnson et al. 2014; MacIntyre et al. 2020; Mansfield et al. 2012; Mansfield et al. 2012; Mansfield et al. 2016; Papatraianou and Le Cornu 2014; Richards et al. 2016; Wosnitza et al. 2018
Managing the hidden curriculum	8	Alsubaie 2015; Kelly 2011; Kentli 2009; Margolis 2001; Portelli and Vibert 2001; Rossouw and Frick 2023; Tanner and Tanner 2007; Williamson 2017

Table 1: Thematic categorisation of literature by competency areas

1 Note: Some papers cover multiple competency areas

Results and Discussion

This study's systematic review of 86 peer-reviewed works reveals a complex landscape of teacher competencies characterised by three key phenomena: (1) the enduring centrality of fundamental pedagogical competencies that continue to form the professional foundation; (2) the rapid emergence of new competency domains driven by technological, social and ecological transformations; and (3) a paradigmatic shift from fragmented skill lists towards integrated, holistic frameworks that recognise the dynamic, context-dependent nature of teaching practice.

The analysis identifies 12 major competency domains that collectively define contemporary teacher professionalism. These domains can be organised into three interconnected dimensions: traditional pedagogical foundations (encompassing personal, communication, analytical, social-emotional, curriculum, organisational and assessment competencies), emerging contemporary domains (digital, AI, global and sustainability competencies) and integrative meta-competencies (critical thinking, creativity, resilience and managing the hidden curriculum). This organisational framework emerges from the literature itself, reflecting both historical continuities and contemporary innovations in conceptualising teacher expertise.

Traditional Pedagogical Foundations

Conceptualisation of Teacher Competencies

Teacher competency has been defined as the systematic integration of knowledge, skills, values and motivation at the functional level, offering an integrative approach that transcends the partial definitions of earlier periods (Jurčić 2014; Weinert 2001). These definitions make up the foundation for revising and operationalising contemporary models of teacher competencies. Since the quality of education systems is predominantly determined by the quality of teachers and their competencies, the development of teacher competencies is no longer an ideal but a necessity (Hattie 2012; OECD 2025; Schleicher 2018; Stronge et al. 2011).

The literature analysis demonstrates a scholarly consensus regarding the multidimensional nature of teacher competencies. Contemporary theoretical frameworks emphasise the dynamic interaction between dispositions (knowledge, beliefs and motivation), situation perception, decision-making and performance (Guerriero 2017). This holistic approach to teacher competencies is gaining increasing importance in international literature, reflecting a paradigmatic shift from skill-based taxonomies towards integrated competency frameworks that recognise the complex, context-dependent nature of teaching practice (European Commission 2020; González-Fernández et al. 2024). An analysis of fundamental pedagogical competencies across the reviewed literature reveals a remarkable consistency in their core elements coupled with significant a evolu-

tion in their manifestation and application. While personal, communicative and didactic competencies remain universally recognised as essential in recent didactic literature, their operationalisation has transformed in response to digital learning environments, diverse classrooms and changing societal expectations.

Core Pedagogical Competency Clusters

Personal and Communication Competencies

Personal competency includes empathy, flexibility, enthusiasm, professional ethos, patience, fairness and objectivity (Jurčić 2014) as well as problem-solving, self-regulation, motivation and the ability to learn – key components in the context of rapid social change (Barrios Bulling 2022). Binfet and Gaertner (2015) consider empathy as a fundamental trait in enabling better understanding of and connection with their pupils.

Communication competency implies a clear expression of ideas, effective speech, active listening and non-verbal communication (Gumus 2022; Quobilovna 2023). The literature consistently identifies communication quality as directly influencing student motivation, academic achievement and socio-emotional development, with effects documented across diverse cultural and educational contexts (Hattie 2012; Pianta and Hamre 2009; Roorda et al. 2011; Wubbels et al. 2016).

Social-Emotional and Analytical Competencies

Social-emotional competency is a domain that is experiencing significant theoretical and empirical growth. Social competency involves, teamwork, tolerance, cooperation and developing quality relationships with pupils and colleagues (Jurčić 2014; Nessipbayeva 2012). Teachers who demonstrate higher social-emotional competence create more supportive classroom climates and achieve better student outcomes (Jennings and Greenberg 2009; Reyes et al. 2021) than those who do not demonstrate such competence. The post-pandemic context has elevated the importance of this competency. Evidence indicates a rise in socioemotional challenges among students, requiring teachers to strengthen their capacity for emotional recognition, regulation and support (Oberle et al. 2020; Savina et al. 2025; Vaillancourt et al. 2021)

Analytical competency integrates research skills, problem-solving, observation, documentation, pedagogical reflection and decision-making (Barrios Bulling 2022; Jurčić 2014; Nessipbayeva 2012). This competency has transformed from remaining in the periphery to being central in contemporary practice, as teachers must increasingly interpret assessment data, evaluate research findings and make informed pedagogical decisions based on evidence (Mandinach and Gummer 2016). This shift reflects broader movements towards data-driven instruction and accountability systems, although research reveals significant gaps between policy expectations and teacher preparation in this domain (ibid.).

Professional Ethics and Integrity

Professional ethics and integrity constitute a foundational dimension of teacher competence that encompasses teachers' orientation towards high standards of ethical conduct, professional commitments and responsibilities. This competency integrates moral reasoning, ethical decision-making in complex situations and commitment to professional standards that prioritise student welfare and educational equity (Darling-Hammond 2006; Guerriero 2017). Research emphasises that ethical competence extends beyond adherence to formal codes of conduct to include capacity for critical reflection on implicit biases, power dynamics in educational relationships and ethical implications of pedagogical choices (Korthagen and Vasalos 2005). Contemporary challenges in this regard, such as digital privacy concerns, algorithmic bias in educational technologies and equity issues in diverse classrooms, require sophisticated ethical reasoning and professional integrity as core teacher competencies (Falloon 2020; UNESCO 2024). Professional ethics also encompasses a responsibility to maintain public trust in the teaching profession and a commitment to continuous professional growth – an ethical obligation.

Didactic Competencies: Continuity and Transformation

Curriculum and Organisational Competencies

Curriculum competency encompasses subject content knowledge (Shulman 1986), pedagogical content knowledge, curriculum planning and defining educational objectives (Guerriero 2017; Jurčić 2014). Contemporary research extends this to include interdisciplinary integration (Drake and Reid 2020), alignment with 21st-century skills frameworks (Voogt and Roblin 2012) and capacity to manage both formal and hidden curriculum dimensions (Alsubaie 2015; OECD 2024). The hidden curriculum – implicit messages conveyed through school structures, practices and interactions – has emerged as a critical focus, with recognition that these implicit elements may exert equal or greater influence than formal curriculum content (Rossouw and Frick 2023; Williamson 2017).

Organisational competency encompasses selecting appropriate teaching methods, adapting content, effective classroom management (Nessipbayeva 2012; Tapani and Salonen 2019) and implementing discipline policies promoting learning (Guerriero 2017). Trust and Whalen (2020) and Rapanta et al. (2021) argue that teachers' actions in the classroom have twice the impact on pupils' achievement as school policies. Contemporary frameworks emphasise managing diversity and implementing inclusive practices as core organisational competencies (Florian and Camedda 2020; Waitoller and Thorius 2021), while also extending to managing hybrid and digital classrooms.

Assessment Competencies

Assessment competency has undergone substantial reconceptualisation, shifting from summative evaluation to formative, development-oriented approaches. Traditional elements – understanding school grades, applying fair criteria, continuous assessment, and the objective interpretation of results (Jurčić 2014; Nessipbayeva 2012; Tigelaar et al. 2004) – are now integrated with formative assessment strategies (Wiliam 2021), self- and peer-assessment facilitation (Panadero et al. 2020) and digital assessment tool utilisation (Gikandi and Morrow 2020). Yan and Cheng (2023) discuss the cultivating assessment cultures that promote growth rather than academic ranking, while Bearman et al. (2022) highlight emerging ethical considerations in algorithmic assessment systems. This transformation reflects fundamental shifts in educational philosophy from measuring learning to supporting learning processes.

Collaborative Competencies

Competencies for partnership with families and communities represent an expanding domain within the field, with research demonstrating the significant impacts these competencies have on student outcomes (Daniel et al. 2021; Epstein 2011). Effective family–school partnerships require specific teacher competencies, including communication across cultural contexts, building trust with diverse families and creating inclusive participation structures (Hornby 2011; Ishimaru et al. 2021). However, substantial barriers persist, including time constraints, cultural-linguistic differences and historical power imbalances (Hornby and Blackwell 2018).

Teachers' collaboration with their colleagues has emerged as an essential aspect of professional learning, innovation and organisational improvement (Vangrieken et al. 2015). Voogt et al. (2023) explore collaboration's centrality in curriculum design, while broader research identifies collaborative competency as fundamental to school effectiveness and teacher development yet often insufficiently developed in initial preparation programmes. Competence in professional learning and practice improvement represents an essential meta-competency that enables teachers to adapt to evolving educational demands. This includes the capacity for self-directed learning, engagement with research-informed practice, participation in professional learning communities and systematic reflection on teaching effectiveness (Darling-Hammond 2017; Fullan 2007). Contemporary research notes that professional learning is continuous, collaborative and embedded in practice rather than isolated professional development events (Carbonell et al. 2014; OECD 2025). Teachers demonstrating strong professional learning competence actively seek feedback, engage critically with educational research, experiment with innovative practices and contribute to collective knowledge development within their professional communities. This competency is particularly critical in contexts of rapid educational change, as initial preparation cannot encompass all the knowledge and skills teachers require throughout their careers.

Emerging Contemporary Competency Domains

The systematic analysis of literature reveals five emergent competency domains that have achieved prominence since 2015, each representing pedagogical responses to societal transformations.

Digital Competencies: From Technical Skill to Professional Foundation

Digital competencies demonstrate the most pronounced evolution over time, transforming from optional technical skills to fundamental prerequisites of teaching practice (Instefjord and Munthe 2017; Starkey 2020). The DigCompEdu framework (Caena and Redecker 2019; Redecker 2017) provides a comprehensive conceptualisation that transcends technical knowledge to emphasise digital pedagogy as a distinct discipline, integrating six competency areas: professional engagement, digital resources, teaching and learning, assessment, empowering learners and facilitating learners' digital competence.

The COVID-19 pandemic dramatically accelerated digital competency development, with several studies confirming that these capabilities transitioned from desirable to existential necessary for educational continuity (Scherer et al. 2021; Zhao and Watterston 2021). However, significant gaps between technological availability and pedagogical integration persist, with many teachers feeling that they are inadequately prepared for digital teaching despite their increased experience (Kim and Asbury 2020; MacIntyre et al. 2020). Gudmundsdottir and Hatlevik (2018) find that newly qualified teachers demonstrate variable digital competence despite growing up as digital natives, highlighting the distinction between personal technology use and pedagogical technology integration.

AI Competencies: The Newest Frontier

AI competencies represent the most recent and rapidly developing domain of teacher competencies. UNESCO (2024) and Zou et al. (2025) developed the first systematic frameworks for teacher AI competencies, identifying several needs: understanding AI foundations, ethical application, pedagogical integration and critical evaluation of algorithmic systems. These frameworks explicitly position AI competencies not as isolated technical skills but as integrated elements of contemporary professional teaching practice, requiring connection with existing pedagogical knowledge.

Several works have revealed significant gaps between rapid AI technology advancement and slow teacher competency development (Chiu et al. 2024; Kim et al. 2021). One particularly concerning finding demonstrates that most teachers lack effective strategies for evaluating online sources and recognising disinformation (Breakstone et al. 2021) – a critical deficit in the contexts of generative AI and algorithmic content curation. Celik et al. (2022) and Holmes et al. (2019) identify both promises and challenges of AI in education, emphasising the need for critical, informed teacher engagement.

Global Competencies and Intercultural Understanding

Global competencies reflect how education's scope has expanded beyond national boundaries to include preparation for interconnected world citizenship. The OECD (2018) framework identifies four dimensions: examining local, global and intercultural issues; understanding and appreciating perspectives and worldviews of others; engaging in open, appropriate and effective interactions across cultures; and taking action for collective well-being and sustainable development.

The research reveals significant implementation challenges. Teachers often feel insufficiently prepared to discuss global issues with their students, particularly when these topics intersect with controversial political or social questions (Gaudelli 2021; Parmigiani et al. 2022). Andreotti (2014) distinguishes »soft« from »critical« global citizenship education, arguing that superficial approaches may reinforce rather than challenge global inequities. Effective global competency requires deep cultural knowledge, critical perspective-taking and capacity to facilitate difficult conversations – competencies often underdeveloped in teacher education (Gay 2018; Hammond 2020).

Sustainability Competencies

Competencies for sustainability education address urgent ecological crises and sustainable development needs. The GreenComp framework (Bianchi et al. 2022) identifies four interrelated competency areas: embodying sustainability values, embracing complexity in sustainability, envisioning sustainable futures and acting for sustainability. Brundiers et al. (2021) and Corres et al. (2020) provide comprehensive frameworks emphasising transformation, systems thinking and action competence.

However, several studies document substantial gaps between policy commitments and teacher capacity. Monroe et al. (2019) found that teachers frequently feel inadequately prepared to teach about climate change and sustainability due to insufficient initial education and ongoing professional development. Tejedor et al. (2019) identify several effective didactic strategies for promoting sustainability competencies; however, the implementation of these strategies remains limited. This domain faces broader challenges in translating competency frameworks into systematic teacher development.

Metacognitive Competencies: Critical Thinking, Creativity and Resilience

Critical thinking competency enables teachers to analyse information, evaluate arguments, recognise biases and make reasoned judgements – capacities essential for navigating complex, ambiguous educational contexts (Ennis 2011; Paul and Elder 2014). The literature finds that these are developable competencies rather than fixed traits, although systematic development requires explicit pedagogical approaches (Bezanilla et al. 2019; Liu et al. 2014).

Creative competency encompasses both teaching creatively and teaching for creativity (Cremin 2015; Sale 2020). Research shows that teachers often hold narrow conceptions of creativity and associate primarily with the arts rather than

recognising its relevance across disciplines (Kettler et al. 2018). While design thinking approaches offer frameworks for systematically developing creative capacity (Koh et al. 2018), they remain underutilised in teacher preparation.

Resilience – the capacity to maintain professional commitment and well-being amid challenges – has emerged as critical for career sustainability (Bobek 2002; Gu and Day 2013). The literature conceives of resilience as multidimensional and encompassing emotional, motivational and social resources that enable teachers to navigate stress, adapt to change and maintain effectiveness (Mansfield et al. 2012; Richards et al. 2016). Post-pandemic studies have highlighted the heightened importance of resilience amid increased professional demands and student needs (Oberle et al. 2020).

Managing the Hidden Curriculum

Competency for managing the hidden curriculum has gained prominence, with the OECD (2024) identifying it as »the next big turning point in transforming global education«. The hidden curriculum encompasses implicit messages conveyed through school structures, teacher behaviours, assessment practices and classroom interactions – elements that powerfully shape student identities, values and opportunities, oftentimes more substantially than formal curriculum content (Alsubaie 2015; Margolis 2001).

Research demonstrates that teachers often unconsciously transmit biases, reinforce inequities and communicate deficit perspectives through hidden curriculum elements (Rossouw and Frick 2023; Williamson 2017). Developing competency requires a critical awareness of implicit messages, the capacity to identify and interrupt problematic patterns, and skills for creating affirming, equitable learning environments. Portelli and Vibert (2001) propose that teachers should move from standardisation towards a »curriculum of life« that honours diverse experiences and ways of knowing.

Integrative Frameworks and Models

The most significant theoretical development in recent literature is the emergence of integrative frameworks transcending linear competency lists to emphasise dynamic interactions among competencies, contexts and developmental trajectories. These frameworks represent paradigmatic shifts from atomistic to holistic conceptualisation in recognition of the fact that teaching expertise emerges through the complex interplay of knowledge, beliefs, dispositions and context-responsive performance.

Competence as a Continuum Model

Guerriero (2017), the European Commission (2020) and González-Fernández et al. (2024) developed a comprehensive model that integrates cognitive, affective-motivational and situation-specific dimensions of teacher competencies. Their framework emphasises the dynamic interaction between

dispositions (knowledge, beliefs and motivation), situation perception, decision-making and performance. This holistic approach to teacher competencies has been gaining increasing importance in the international literature since 2015, reflecting a paradigmatic shift from skill-based taxonomies towards integrated competency frameworks that recognise the complex, context-dependent nature of teaching practice.

Technological Pedagogical Content Knowledge (TPACK) Model

The Technological Pedagogical Content Knowledge (TPACK) model (Koehler et al. 2013; Mishra and Koehler 2006) represents an influential approach that integrates content, pedagogy and technology. The approach's longevity (2006–2025) and continued application in research confirm its theoretical strength, which emphasises the intersection of different knowledges rather than their isolation. Th The model considers seven knowledge dommains: content knowledge, pedagogical knowledge and technological knowledge as well their four intersections – PCK, TCK, TPK and TPACK. Recent studies have integrated AI competencies within the TPACK framework, demonstrating its adaptability to emerging technologies (Backfisch et al. 2020; Kim et al. 2021).

DigCompEdu and AI Frameworks

The DigCompEdu framework (Redecker 2017) and the Teacher Digital Competency framework (Falloon, 2020) offer comprehensive approaches to digital competencies. Falloon (ibid.) extends this through the TDC framework integrating personal-professional, personal-ethical and pedagogical-professional dimensions of digital competencies. The newest UNESCO AI Competency Framework (2024) and the framework by Zou et al. (2025) integratively connect technical understanding of AI with ethical, pedagogical and educational policy dimensions. These frameworks explicitly emphasise that AI competencies cannot be isolated from existing pedagogical competencies and must instead be integrated into the professional profiles of contemporary teachers.

Synthesis and Implications

This comprehensive review reveals that teacher competencies are simultaneously stable and evolving. Fundamental pedagogical competencies – personal, communicative, didactic – maintain their centrality while transforming in manifestation and application. Emerging domains – digital, AI, glob and sustainability – reflect teachers pedagogical responses to societal change. Metacognitive competencies – critical thinking, creativity, resilience, hidden curriculum awareness – enable adaptive, reflective practice.

The shift from fragmented lists towards integrated frameworks marks a significant theoretical milestone; however, substantial challenges in implementation persist. Gaps between competency articulation and systematic development reveal the need for a (1) comprehensive reconceptualisation of initial teacher education; (2)

sustained, coherent professional development systems; (3) educational policies that support rather than constrain competency development; and (4) continued research examining competency development processes and effective development strategies.

The three-dimensional integrative model of teacher competencies (TRI-model), which is detailed subsequent sections, emerges from this analysis as an integrative response attempting to honour both traditional foundations and contemporary innovations while recognising competencies' dynamic, developmental nature.

Trends in the Contemporary Conceptualisation of Teacher Competencies

This study's analysis of 86 peer-reviewed works reveals three key trends in the conceptualisation of teacher competencies: (1) the permanence of fundamental pedagogical and didactic competencies as an essential foundation of professional practice, (2) the expansion of competencies in response to technological, social and ecological changes and (3) the growing need for integrative approaches that holistically connect traditional and contemporary dimensions.

1. Permanence of fundamental competencies – Jurčić's (2014) model of pedagogical and didactic competencies remains an important theoretical foundation dominating Croatian pedagogical discourse; however, it requires significant expansion to respond to contemporary educational and social challenges. The analysis conducted in this study demonstrates that personal, communicative, analytical, social and emotional competencies remain central to teaching practice (Barrios Bulling 2022; Savina et al. 2025; Villena-Martínez and Muñoz-García 2025). However, their content and the way in which they manifest evolve in accordance with the changing context. For instance, communication competency has expanded from interpersonal interaction to digitally mediated communication (Gumus 2022; Murray et al. 2020), while emotional competency has gained a new dimension in the context of post-pandemic education and the increasing prevalence of socio-emotional difficulties among pupils (Oberle et al. 2020; Vaillancourt et al. 2021). Curricular, organisational and assessment competencies maintain their fundamental importance at the didactic level; however, their operationalisation must be adapted to digital and hybrid classrooms (Rapanta et al. 2021; Trust and Whalen 2020). Furthermore, interdisciplinary approaches must be integrated (Drake and Reid 2020; Voogt et al. 2023). Additionally, a transition from summative to formative and pupil development-oriented assessment must occur (Wiliam 2021; Panadero et al. 2020; Yan and Cheng 2023). This finding confirms that while fundamental competencies are not obsolete, they require reconceptualisation and contextualisation.

2. Emergence of new competency domains – The study's literature review identifies five new domains: digital competencies, AI competencies, global competencies, competencies for sustainability and metacognitive competencies (critical thinking, creativity, resilience, and managing the hidden curriculum, which can also be considered as a fundamental didactic competency).

Digital competencies demonstrate the most pronounced evolution among the five domains, transforming from a technical skill into a fundamental

prerequisite of the teaching profession (Instefjord and Munthe 2017; Starkey 2020). The DigCompEdu framework (Caena and Redecker 2019; Redecker, 2017) offers a comprehensive framework that transcends technical knowledge and highlights digital pedagogy as both a specific discipline and a competency. Studies have confirmed that digital competencies in the post-pandemic era are no longer optional but an existential necessity for ensuring educational continuity (Scherer et al. 2021; Zhao and Watterston 2021).

AI competencies represent the newest and most rapidly growing competency domain. Identifying the need to understand AI foundations, apply them ethically, integrate them pedagogically and critically evaluate algorithm systems, UNESCO (2024) and Zou et al. (2025) developed the first systematic framework of AI competencies for teachers. A a significant gap between rapid AI technology development and the slow development of teacher competencies (Kim et al. 2021) requiring urgent systematic intervention has been identified in the literature. A particularly concerning finding by Breakstone et al. (2021) demonstrates that most teachers have not developed effective strategies for evaluating online sources and recognising disinformation, which, in the context of generative AI, is a critical deficit.

Global competencies and competencies for sustainability reflect the growing need for education that transcends national boundaries and responds to global crises. The OECD (2018) and UNESCO (2017) position these competencies as key goals of 21st-century education. However, research reveals a significant gap between policies and practice: teachers often feel insufficiently competent to teach about climate change, global inequalities and sustainable development due to a lack of initial education and continuous support (Monroe et al. 2019).

Metacognitive competencies such as critical thinking, creativity, resilience and managing the hidden curriculum represent an additional level, enabling teachers to act reflectively in complex and ambiguous situations. The literature finds that these competencies are not merely individual characteristics but can be systematically developed through targeted interventions (Bezanilla et al. 2019; Mansfield et al. 2016; Richards et al. 2016). The growing interest in managing the hidden curriculum, which the OECD (2024) identifies as »the next big turning point in transforming global education,« is particularly notable: The implicit messages conveyed by schools can be equally or more important than their formal curricula (Alsubaie 2015; Williamson 2017).

3. Integrative approaches: Towards holistic conceptualisation – The most significant theoretical contribution of literature from 2015 to 2025 is the development of integrative models that transcend linear lists of competencies and emphasise their dynamic interaction. The TPACK model (Koehler et al. 2013; Mishra and Koehler 2006) remains the most influential integrative framework for understanding the complex interaction between content, pedagogy and technology. The approach's longevity (2006–2025) and continued application in research confirms its theoretical strength, which emphasises the intersection of different knowledges rather than their isolation. Falloon (2020) further extends this approach through the TDC framework integrating personal-professional, personal-ethical and pedagogical-professional dimensions of digital competencies. The newest UNESCO AI Competency Framework (2024) and the framework by Zou et al. (2025) integratively connect technical understanding of AI with ethical,

pedagogical and educational policy dimensions. These frameworks explicitly emphasise that AI competencies cannot be isolated from existing pedagogical competencies but must instead be integrated into the professional profiles of contemporary teachers.

From Fragmentation to Integration

Despite extensive research on teacher competencies, several key gaps and unresolved tensions in the literature have been identified. First, fragmentation in research is evident. Although the literature continues to identify an expanding array of competencies, empirical studies examining how teachers integrate multiple, sometimes conflicting, competency demands in practice remain scarce. Most research focuses on individual domains, while a holistic approach examining how teachers synergistically mobilise different competencies in real conditions is lacking. Second, the potential paradox of overload between the growing list of competency expectations and teachers' real capacities is rarely addressed. Richards et al. (2016) cautions against the individualisation of responsibility for competencies requiring structural changes; however, this critical perspective remains rare in the literature. Third, a significant gap exists between theory and practice: theoretical frameworks developed in international literature are rarely operationalised and empirically examined in different national contexts (Simonović 2021). Fourth, the literature insufficiently considers the developmental dimension of competencies through different phases of professional development (i.e. longitudinal research tracking competency development through teaching careers is lacking). Finally, most frameworks were developed in Western European or North American contexts, and evidence of their contextual applicability to different cultural and educational systems is limited.

The literature synthesis identifies six key principles for developing an integrative model of teacher competencies. First, the model must recognise the duality of tradition and innovation: Fundamental pedagogical and didactic competencies provide a stable foundation for integrating new dimensions that does not involve binary opposition but is instead a dynamic relationship. Second, the model must articulate the dynamic interactions of different dimensions that complement each other and act jointly in complex teaching situations, thereby transcending the linear listing of competencies. Third, contextual adaptability is necessary for different educational levels, subject areas and cultural contexts, although the framework's theoretical structure must be retained. Fourth, a developmental perspective must recognise that different competencies develop at different paces and in different phases of professional development. Fifth, the literature consensually identifies reflective practice as a meta-competency enabling continuous integration, adaptation and development of all other competencies (Korthagen and Vasalos 2005). Reflectivity is not an additional competency but a vertical axis permeating all dimensions. Finally, the model's systemic perspective recognises that teacher competencies are not exclusively an individual's responsibility – they require systematic support through initial education, mentorship, continuous professional development, organisational culture and educational policies.

This literature synthesis provides a theoretical foundation for developing the three-dimensional integrative model (TRI-model) of teacher competencies,

connecting insights from international literature with the context of Croatian educational practice, providing both theoretical coherence and practical applicability.

Integrated Model of Teacher Competencies for the 21st Century: Three-Dimensional Integrative Model (Tri-Model)

Contemporary education requires a redefinition of the scope and nature of teacher competencies (Gumus 2022; Tootell et al. 2014). The traditional understanding of competencies as a static set of knowledge and skills has proven insufficient for meeting the dynamic demands of contemporary practice. Instead, a framework is needed that integrates fundamental professional values with contextual adaptability and reflectivity. Research has confirmed that teacher effectiveness arises from the interaction of different competency domains (Guerriero 2017; Hattie 2012). While pedagogical and didactic competencies have long been recognised as the foundation of the teaching profession (Darling-Hammond 2006; Jurčić 2014; Shulma 1986), today's context requires an expansion of this set through development of additional competencies.

The digital transformation of education has sparked the need for technological pedagogical competencies (Falloon 2020; Mishra and Koehler 2006) and global challenges, highlighting the importance of competencies for sustainability and global citizenship (Corres et al. 2020; OECD 2018). The emergence of artificial intelligence opens new questions about the ethical application of technology and the evaluation of algorithmic systems (Chiu et al. 2024; UNESCO 2024). Maintaining A balance between stability and change as well as between permanent competencies such as empathy, communication and reflection (Jennings and Greenberg 2009; Savina et al. 2025) and the adaptability needed in accelerated social and technological changes (Carbonell et al. 2014; Fullan 2007) remains a key challenge. Since competencies operate in dynamic interaction with one another (Tigelaar et al. 2004; Weinert 2001), reflective practice becomes the central meta-competency enabling continuous professional growth and responsible action in changing contexts (Korthagen and Vasalos 2005).

The TRI-model is proposed (Figure 1) based on this literature review, which includes existing models of pedagogical and didactic competencies and analysis of similar models (Gumus 2022; Jurčić 2014; Nessipbayeva 2012), the TPACK framework (Mishra and Koehler 2006), UNESCO AI Competency Framework (UNESCO 2024) and the TDC framework (Falloon 2020). The model is structured to recognise the ontological status of fundamental pedagogical and didactic competencies as the unchanging core of the profession. It also simultaneously enables the dynamic integration of contextually conditioned competencies. The permanent core explicitly pinpoints professional ethics and integrity as foundational to all pedagogical practice, recognising that competent teaching requires not only technical skill but also moral reasoning and commitment to professional responsibilities. Reflective practice, as the third dimension of the framework, permeates and connects all levels of the model, enabling continuous adaptation and professional development. This dimension inherently encompasses competencies for ongoing professional learning, collaborative

practice and systematic improvement – capacities that enable teachers to develop throughout their careers and function effectively within professional learning communities. This approach aligns with the contemporary understanding of competencies as a continuum (Blömeke et al. 2015) and responds to the need for a holistically integrated framework that can guide teacher education in the 21st century (González-Fernández et al. 2024).

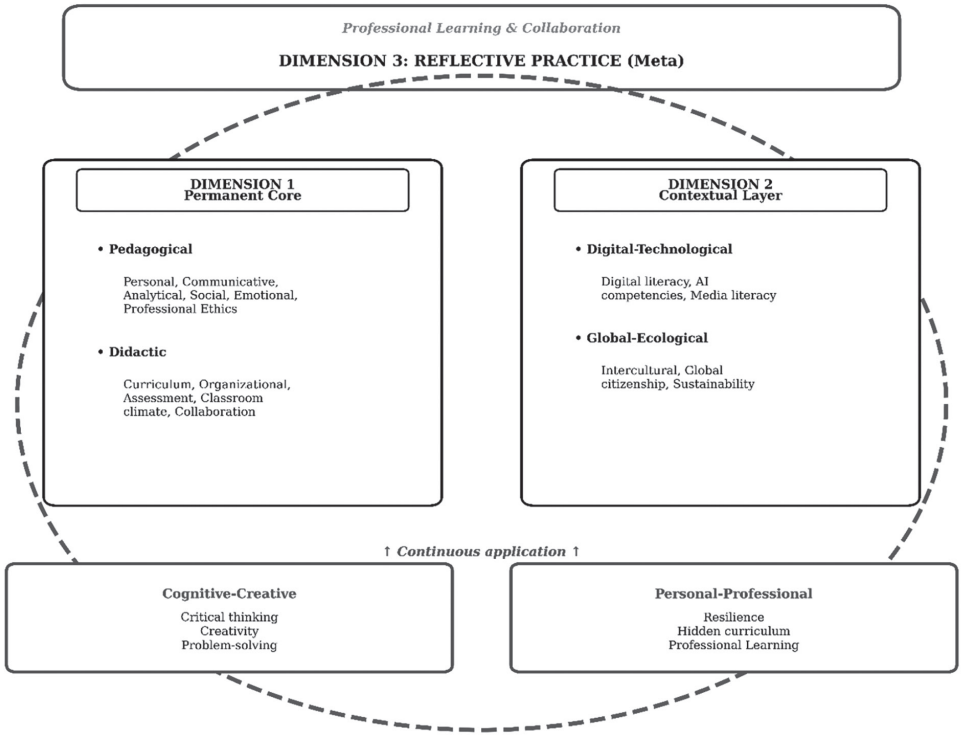

Figure 1: Three-dimensional integrative model of teacher competencies (TRI-model)

The key innovation of the TRI-model lies in its ability to integrate seemingly opposing paradigms in the conceptualisation of teacher competencies. Unlike linear models, which treat tradition and innovation as separate or opposing categories, the TRI-model establishes dynamic synergy through a reflective axis permeating all levels of competencies. The permanent core of pedagogical and didactic competencies provides stability and continuity of professional identity, the contextual layer enables flexibility and adaptation to changing conditions, and the reflective axis ensures continuous adjustment and integration of both aspects (Korthagen and Vasalos 2005). This three-layered approach facilitates the reinterpretation of the traditional dichotomy between essentialist and constructivist understandings of competencies, simultaneously recognising both their ontological stability and epistemological fluidity (Weinert 2001).

The model integrates key contributions of existing theoretical frameworks and overcomes the limitations of individual approaches. The permanent core is adopted from Jurčić's (2014) model of pedagogical and didactic competencies, which establishes the fundamental dimensions of Croatian pedagogical tradition.

The dynamic interaction between content, pedagogy and technology is derived from the TPACK model (Mishra and Koehler 2006), which revolutionised understanding of technological pedagogical competencies but was limited to the technological domain. The holistic approach to digital and AI competencies is incorporated from the UNESCO AI Competency Framework (UNESCO 2024) and Falloon's (2020) TDC framework, while reflective practice, a meta-competency, is positioned as the integrative mechanism enabling continuous adaptation and professional development (Guerriero 2017). This synthesis enables the TRI-model to be both theoretically grounded and pragmatically applicable.

Collective Dimension of Competencies and the Concept of Distributed Expertise

The explicit recognition of the collective dimension of competencies is a significant methodological innovation of the TRI-model. A competent teacher is no longer understood exclusively as an individual possessing the complete repertoire of all necessary competencies but as a professional capable of functioning within a collaborative community of practice in which competencies can be realised and distributed at the school level (Vangrieken et al. 2015; Voogt et al. 2023). Different teachers can develop different strength profiles. One may be an expert in digital technologies, another in intercultural competencies and a third in curricular planning; their collective collaboration constitutes a holistically competent organisation (Carbonell et al. 2014).

This approach has significant implications for school organisation and teacher education. First, distributed expertise enables a more realistic approach to professional development, as individual teachers are not expected to be highly skilled at all competencies. Second, the collective dimension promotes a culture of collaborative learning and mutual support, contributing to the development of professional learning communities (Fullan 2007). Third, it enables the strategic allocation of resources for professional development, focusing them on the specific needs and potentials of individual teachers rather than on universal programmes. Fourth, distributed expertise strengthens the organisational resilience of schools, reducing their dependence on individuals (Mansfield et al. 2012).

Contextual Adaptability and Localisation of the Model

The TRI-model incorporates the notion of contextual adaptability, recognising that competencies do not function in a vacuum but are always situated in specific educational, cultural and socio-economic environments. The model can be adapted to different educational levels: preschool, primary, secondary and higher education. The bases of individual competencies can be selectively highlighted depending on pupils' developmental characteristics. Furthermore, the model enables adaptation to different types of schools, such as comprehensive, vocational or specialised schools, and the contextual layer can be adapted to specific needs. Socioeconomic context also plays a crucial role in this regard: Schools in resource-limited environments may prioritise core pedagogical competencies and partnerships with parents, whereas institutions with more developed infrastructures are better equipped to advance digital and AI competencies. Cultural context further shapes the model, particularly in the area of intercultural competencies and global

citizenship, which must be adapted to the specific cultural and linguistic diversity of the pupil population (Gay 2018; Hammond 2020).

Operationalisation through Reflective Practice

Unlike static lists of competencies dominating existing frameworks, the TRI-model operationalises its theoretical structure through reflective practice – an active, continuous process. Reflective practice is not an additional competency positioned alongside others; it represents a metacognitive mechanism enabling dynamic integration and adaptation of all competencies in concrete situations of teaching practice (Korthagen and Vasalos, 2005). The three levels of reflection – reflection-in-action (immediate adaptation during teaching), reflection-on-action (critical analysis after teaching) and reflection-for-action (proactive planning) – constitute a spiral process of professional development enabling continuous improvement.

This operationalisation has far-reaching implications for teachers' education and lifelong professional development. Emphasis shifts from knowledge accumulation towards developing reflective intelligence and adaptive expertise (Carbonell et al. 2014), and the evaluation of teacher competencies becomes a process rather than a result. Professional development transforms into a continuous, practice-grounded process of reflective learning. Moreover, reflective practice enables teachers to autonomously identify their own developmental needs and adapt their professional development to the specific contexts and challenges they face.

Ultimately, the TRI-model represents a shift from an instrumental understanding of competencies as technical skills towards their understanding as dynamic, contextually situated and collectively realised capacities for professional action. This approach corresponds with contemporary theoretical insights into the complexity of the teaching profession (González-Fernández et al. 2024; Guerriero 2017) and provides a framework for guiding systematic reforms in teacher education within the changing context of the 21st century.

Implications for Practice

The proposed practical implications, which are based on the research findings, are designed to support the development and acquisition of teacher competencies defined by the TRI-model. The early and systematic integration of theory and practice in initial education to promote experiential learning in authentic educational contexts is necessary. The study emphasises the development of reflective practice as a meta-competency enabling the connection of theoretical knowledge and practical experience and the application of mentorship models strengthening the professional preparedness of future teachers. Moreover, shifting from formal and administrative approaches to authentic and contextually relevant learning grounded in teachers' real needs is essential in continuous professional development. A personalised approach to professional development is recommended, as this enables choice according to interests and work contexts while promoting collective learning and experience exchange in professional communities. Professional development should be recognised as an integral part of teachers' working time and professional

responsibility. Furthermore, it is necessary to develop realistic expectations about the level and scope of teacher competencies within educational policies, and systematic support must be provided through adequate resources, time and working conditions. Schools should invest in mentorship and collaborative developmental models, and they must adopt a participatory approach to policy formation that actively incorporates teachers' voices. Such measures contribute to the sustainable professionalisation of the teaching role and comprehensive development of competencies in accordance with the TRI-model.

Conclusion

The TRI-model is a conceptual contribution towards understanding the teaching profession in the context of the post-professional era, which is characterised by accelerated technological changes, global ecological challenges and the emergence of new generations of pupils with different attitudes towards knowledge and technology (Mehta and Giunchiglia 2025; Tootell et al. 2014). Unlike the dominant approaches, which offer static, unidimensional taxonomies, the TRI-model establishes a dynamic, multidimensional framework that simultaneously recognises the enduring value of fundamental pedagogical and didactic competencies, integrates contextually conditioned contemporary demands and operationalises synergy between tradition and innovation through reflective practice as a metacognitive axis. Findings from the TALIS 2024 research provide empirical support and confirm the need for an integrative approach to developing teacher competencies connecting professional needs, reflective practice and contextual adaptability.

The model's key innovations are reflected in several diverse aspects. First, instead of proposing a dichotomy between tradition and innovation, the TRI-model establishes a dynamic synergy between the two through a reflective axis enabling continuous integration of new competencies without abandoning fundamental professional values. Second, the recognition of the integrative dimension of competencies represents a departure from individualistic understanding, thereby enabling a more sustainable approach to professional development. Third, the model's contextual adaptability facilitates its application across different educational levels, types of schools and socioeconomic contexts. Fourth, the model's operationalisation through reflective practice positions it as a framework for continuous professional development.

The TRI-model is not a final or fixed solution to the question of teacher competencies but an open framework for continuous adaptation and further research. Its value lies precisely in its ability to adapt to new challenges and contexts while simultaneously maintaining coherence and theoretical grounding. The successful implementation of the TRI-model in educational practice presupposes thorough reforms of initial teacher education, the redesign of continuous professional development, the reconceptualisation of educational policies and the creation of a culture of collaborative learning and reflective practice (Fullan 2007).

Future research should focus on several key questions. First, the TRI-model should be empirically validated by longitudinal studies examining how teacher competencies evolve in different contexts and career phases. Second, mechanisms for realising competencies within educational practice must be investigated.

Third, comparative international research is necessary to examine the model's cultural adaptability in different educational systems and traditions. Fourth, validated instruments for assessing competencies within the TRI-model should be developed. Furthermore, given rapid AI technology development, longitudinal research on the evolution of teachers' AI competencies and their integration with pedagogical and didactic competencies is needed. Finally, the question of teacher competencies transcends professional and scientific frameworks and represents a fundamental social query about the future we wish to create for future generations (Darling-Hammond and Bransford 2007; OECD 2024).

Competent teachers are not merely curriculum executors – they are crucial in social transformation, as they shape critical thinking, ethical values, ecological awareness and the democratic citizenship of future generations (Corres et al. 2020). In this sense, investing in the development of teacher competencies is not an administrative necessity but a strategic imperative for societies aspiring to achieve sustainable development, social cohesion and democratic vitality. The TRI-model offers a conceptual framework that can guide this transformation by integrating the strengths of pedagogical tradition with innovative thinking and reflective adaptability.

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RAZVOJ TRIDIMENZIONALNEGA INTEGRATIVNEGA MODELA KOMPETENC UČITELJEV SKOZI SISTEMATIČNI PREGLED KOMPETENC UČITELJEV ZA IZOBRAŽEVANJE V 21. STOLETJU

Povzetek: Poklic učitelja v postprofesionalni dobi se sooča s paradoksom: na eni strani se od njega pričakuje, da ohrani pedagoško tradicijo, na drugi strani pa se sooča z izzivi, ki jih prinaša prihodnost izobraževanja. Temeljne pedagoške in didaktične kompetence ne zadostujejo več; treba jih je dopolniti s kompetencami za digitalno dobo, globalizacijo in ekološko krizo. Ta študija združuje teoretično-analitični pristop s sistematičnim pregledom literature v skladu s smernicami PRISMA. Poizvedbe so bile opravljene v podatkovnih bazah Web of Science, Scopus, ERIC, Google Scholar in CRORIS (za obdobje 2014–2025 za identifikacijo sodobnih kompetenc: n = 85; in za obdobje pred letom 2014 za identifikacijo tradicionalnih kompetenc: n = 23), kar je prineslo skupno 108 relevantnih virov. V pregledu literature so bili analizirani obstoječi modeli kompetenc, ki opredeljujejo pedagoške dimenzije (osebne, komunikacijske, analitične, socialne, čustvene, medkulturne, razvojne dimenzije, reševanje problemov) in didaktične dimenzije (kurikularne in organizacijske dimenzije, ocenjevanje, vzdušje v razredu, sodelovanje s starši). Analiza je ugotovila pet ključnih trendov: trajnost temeljnih kompetenc s potrebo po ponovni konceptualizaciji, pojav novih področij kompetenc (digitalne, umetna inteligenca, globalne, trajnostne, metakognitivne) in potreba po celostnih pristopih. Znanstveni prispevek te študije je nov tridimenzionalni integrativni model kompetenc učiteljev (TRI-model), ki združuje trajno jedro, kontekstualno plast in refleksivno os, kar omogoča sinergijo med tradicijo in inovativnostjo prek stalne refleksivne prakse.

Ključne besede: kompetence učiteljev, pedagoške kompetence, didaktične kompetence, integrativni model, refleksivna praksa

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Priloga 1 (*Študije, vključene v sistematični pregled*) je dostopna le v elektronski verziji članka.
Appendix 1 (*Studies Included in the Systematic Review*) is available only in the electronic version of the article.