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Focus on
**Teachers
education
on the move**

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EDITORIAL

Teacher to Move. Mapping the Changing Landscapes of Teacher Education

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1. Teacher Education: Continuity and Change

The idea for this special issue was born in the spirit of such redefinition, inspired by the 2023 Association of Teacher Education in Europe Annual Conference in Budapest, which brought together scholars and practitioners to reflect on the future of teacher education in these troubled times.

Teacher education today is marked by a condition of accelerated and multidimensional transformation. Historical tensions around professionalism, autonomy, equity, and accountability have become entangled with emerging global challenges: pandemics, armed conflicts, digitalisation, artificial intelligence, and the climate emergency. These converging pressures have not only exposed the structural fragilities of education

systems but have unsettled the very concept of what it means to prepare, support, and sustain teachers in increasingly diverse, unstable, and complex environments (Day & Sachs, 2004; Flores, 2023; Ingersoll & Strong, 2011).

Amidst this turbulence, teacher education reveals a resilient, adaptive, and generative character. It moves – not in linear or predictable ways – through zones of critique, innovation, resistance, and recomposition. This motion is not incidental but structural: it reflects what Barnett (2011) calls a condition of ontological fluidity, in which the very foundations of educational knowledge, purpose, and professional identity are subject to renegotiation and redefinition.

We are therefore witnessing a dual dynamic. On the one hand, the intensification of globalising logics – such as standardisation, performance measurement, and curricular alignment – driven by international policy frameworks and market discourses (Rizvi & Lingard, 2010; Robertson, 2020). On the other hand, a proliferation of context-responsive practices, pedagogical experiments, and transdisciplinary dialogues that reclaim the plurality and cultural embeddedness of teaching (Zeichner, 2010; Nussbaum, 2011). Rather than collapsing under the weight of these tensions, teacher

education emerges as a field of productive contradiction, where innovation and uncertainty coexist.

This special issue is situated within this dynamic terrain. It does not seek to resolve the complexity of teacher education, but to map its epistemic contours, tracing its tensions, trajectories, and transformative potential. It invites readers to view teacher education not as a singular model to be implemented, but as a diverse, contested, and evolving set of practices, deeply entangled with the social, cultural, and political conditions of our time.

2. Teacher Education Trajectories: Reading the Field Through Six Movements

This special issue brings together twenty-one contributions that offer a plural, transnational, and theoretically grounded account of current trajectories in teacher education. These works, submitted in response to the call *Teacher to Move*, reflect the field's evolving dynamics – shaped by historical tensions, emerging global crises, and the constant reconfiguration of professional knowledge, identity, and responsibility.

To interpret the diversity of themes, methodologies, and institutional contexts, this editorial adopts a cartographic approach, organising the contributions along six “movements” or pedagogical trajectories. These trajectories are not rigid categories, but fields of dynamic interaction, where professional, epistemological, and cultural dimensions converge and collide (Bernstein, 2000; Nowotny, Scott & Gibbons, 2001). They represent the fault lines along which teacher education is currently being debated, problematised, and reimagined.

Each section begins with an analytical framing, followed by a critical engagement with the papers. The aim is not to summarise content, but to read each contribution as a response to shared concerns: transitions into teaching, global–local negotiations, digital reconfigurations, interdisciplinary intersections, interprofessional collaborations, and early-career vulnerability. These are not marginal issues, but structuring tensions in the very architecture of teacher education today (Zeichner, 2010; Biesta, 2013).

By clustering the papers according to these six trajectories, we do not seek to stabilise meaning, but rather to illuminate lines of flight, patterns of convergence and divergence, and the emergent pedagogical sensibilities that characterise the field. These six movements are:

- Moving in and out of the teaching profession;
- Moving back and forth between local needs and global trends;
- Moving into new modes of educating;
- Moving into and being invaded by other disciplines;

- Moving towards interprofessional development and learning;
- Moving into teaching: mentoring, induction, and early-career transitions.

Each movement reflects a distinct epistemic configuration, yet all are underpinned by a shared attention to teacher agency, ethical reflexivity, and pedagogical imagination (Priestley, Biesta & Robinson, 2015; Beauchamp & Thomas, 2009). Together, they offer a multi-perspectival lens through which to rethink teacher education not as a transmission of content, but as a transformative, relational, and culturally situated practice.

2.1. Moving in and out of the Teaching Profession

The act of becoming a teacher is never a neutral or linear transition. It entails crossing complex thresholds – emotional, institutional, epistemic – within a professional landscape increasingly marked by instability and intensifying expectations. Initial teacher education is not limited to the acquisition of pedagogical skills or the fulfilment of certification requirements; it represents a process of subjective and professional formation, in which future teachers encounter questions of identity, resilience, vulnerability, and agency (Beauchamp & Thomas, 2009; Kelchtermans, 2009). Across many education systems, these entry points are situated within fragile ecosystems characterised by high attrition rates, emotional exhaustion, and fragmented support structures. The movement “in and out” of the profession, then, is not merely about employment flows or career decisions – it is about the existential and ethical dimension of becoming a teacher, shaped by structural conditions, institutional cultures, and affective labour (Day & Gu, 2014; Ingersoll & Strong, 2011).

Within this framework, the article “*Mindfulness levels among pre-service English language teachers: a comparative analysis of KIMS and MAAS scales*” (Çelik et al., 2025) offers an insightful contribution by addressing the role of emotional regulation and self-awareness in the formative stages of teacher development. By comparing mindfulness dispositions through two validated scales, the study suggests that mindfulness is not a peripheral psychological trait, but a core condition for reflective engagement and emotional sustainability. Especially in under-supported or high-pressure contexts, mindfulness emerges as a protective factor for pre-service teachers navigating uncertainty and performance anxiety.

A complementary perspective is provided by “*Connecting the dots: the role and potential of portfolios in lifelong teacher development in Italy*” (Pettenati et al., 2025), which foregrounds the narrative and reflexive dimensions of teacher identity construction. Here, the portfolio is conceptualised not only as an assessment tool but as a space of epistemic self-formation. By enabling pre-service teachers to integrate experiences

across fragmented training pathways, the portfolio becomes a pedagogical device for articulating meaning, coherence, and orientation within the profession. It responds to the need for non-linear and identity-sensitive trajectories in professional preparation.

To this composite picture, the contribution “*Innovation in teaching and educational leadership: rethinking the role of teachers in twenty-first-century schools*” (Carletti, 2025) adds a dimension of institutional and cultural awareness. Framing teacher identity through the lens of educational leadership and innovation, the study reflects on how initial teacher education can empower professionals not only to adapt to changing contexts, but to lead and shape them. By rethinking the role of the teacher as an agent of transformation, Carletti emphasizes the need for teacher preparation programs to integrate vision-building, ethical engagement, and change-oriented dispositions into their pedagogical models. This perspective expands the idea of professional entry from adjustment to active positioning, equipping future educators to navigate ambiguity with reflective leadership and pedagogical intentionality.

The paper “*Teachers competencies in evaluating digital sources and tackling disinformation: implications for media literacy education*” (Bruno et al., 2025) underlines the necessity for teachers to acquire new skills, especially in media literacy for identifying and evaluating disinformation, including manipulated images, sponsored content, and dubious news sources. The study presents four distinct teacher profiles revealing a complex landscape and the need for targeted approaches to professional development.

Taken together, these contributions offer a composite picture of initial teacher preparation as a multidimensional process-emotional, narrative, performative, and institutional. They suggest that the transition into teaching should not be reduced to administrative onboarding or curriculum delivery, but should be supported through integrated, intentional, and person-centred practices. Whether through mindfulness, portfolios, digital simulations, or leadership-oriented formation, each study foregrounds a pedagogy of accompaniment, one that enables future teachers not only to survive the complexities of professional entry, but to make meaning of them, with dignity, purpose, and agency.

2.2. Moving Back and Forth Between Local Needs and Global Trends

One of the defining dynamics of contemporary teacher education is the tension between global trends and local specificities. In an era shaped by transnational policy flows, digital infrastructures, and cultural hybridity, educators are increasingly expected to navigate conflicting demands: the need to respond to globalised agendas – such as digitalisation, multilingualism, and quality assurance – while remaining grounded in local

pedagogical cultures, socio-political histories, and material conditions (Rizvi & Lingard, 2010; Robertson, 2020).

This movement “back and forth” is not simply spatial or geopolitical; it is profoundly pedagogical and ethical. Local contexts are not passive recipients of global models. Rather, they reinterpret, resist, and reconfigure them through situated knowledge, cultural values, and everyday practice. At the same time, global frameworks can offer both resources and constraints, opening possibilities for innovation while also imposing standardised expectations.

The article “*Time Perspectives and Career Anxiety Among Vietnamese teacher education undergraduates*” (Nguyen & Tran, 2025) explores how global uncertainty and educational transitions affect vocational identity formation. Drawing on Zimbardo’s time perspective theory, the authors examine how temporal orientations influence students’ sense of career anxiety. The study offers a psychologically grounded reading of how structural changes – such as economic precarity or global labour market shifts – are internalised by future teachers, especially in contexts of rapid development and systemic volatility. It brings to light the subjective and temporal dimensions of professional uncertainty in Southeast Asia.

From a European context, “*The orientation towards multilingualism of future Italian teachers: perceptions and attitudes in the Humanities and STEM fields*” (Baldo, 2025) provides a nuanced look at how language policy and disciplinary culture intersect. The findings highlight divergent stances toward multilingualism among pre-service teachers depending on their academic specialization – humanities or STEM – revealing how institutional and epistemological traditions mediate responses to global discourses on inclusion and internationalisation. The article questions the assumption that global educational values – such as linguistic diversity – translate seamlessly into national curricula or teacher attitudes.

A different kind of pressure is addressed in “*Evolving challenges in Ukrainian education: a comparative study of teacher perspectives*” (Avsheniuk & Seminikhyna, 2025), which captures the epistemic and emotional disruptions produced by armed conflict and institutional instability. Drawing from comparative data, the study highlights how teachers in Ukraine must redefine their roles, responsibilities, and pedagogical mission in real time, under the weight of systemic crisis. This contribution starkly reveals the limits of universal policy discourse in contexts where survival, care, and moral agency become urgent priorities.

Taken together, these studies suggest that globalisation in teacher education is neither unidirectional nor uniform. Instead, it unfolds as a dialogical process marked by tensions, reinterpretations, and creative adaptations. Teachers are not only content transmitters

but cultural mediators and ethical actors, who must negotiate between competing expectations and layered affiliations.

In this light, the movement “back and forth” becomes a productive space of friction – where local pedagogical traditions and global aspirations can collide, hybridise, or generate new forms of knowledge. Rather than a burden, it constitutes a site of pedagogical possibility, one in which teachers are called to develop contextual discernment, intercultural competence, and critical reflexivity.

2.3. Moving into New Modes of Educating

In the last two decades, education has undergone a profound reconfiguration driven by technological, cultural, and epistemological shifts. Teaching is no longer anchored solely in the transmission of disciplinary knowledge; it is now shaped by networked communication, participatory practices, and hybrid learning environments (Laurillard, 2012; Selwyn, 2016). The movement “into new modes of educating” reflects not a superficial trend, but a paradigmatic shift—one that calls for a rethinking of pedagogical frameworks, teacher roles, and learning ecologies.

This transition challenges teacher education systems to prepare professionals who are not only technically competent but also critically aware of how technologies shape knowledge, identity, and power. Digitalisation, in this sense, is not neutral: it operates within ideological frameworks and institutional priorities that must be interrogated pedagogically and ethically (Biesta, 2013; Selwyn, 2016). The contributions in this section explore diverse responses to this challenge – ranging from technological integration to pedagogical reinvention – foregrounding the complex interplay between digital tools and professional agency.

In “*Teacher training for the future: insights from a Needs Analysis on Digital Technologies and Artificial Intelligence*” (Cinganotto & Montanucci, 2025), the authors conduct an empirical mapping of teachers’ perceived needs regarding digital and AI integration. The study highlights a significant mismatch between policy discourses and classroom realities, revealing that many educators feel ill-equipped to address the pace and implications of technological change. Rather than proposing a technocentric response, the article advocates for a future-oriented, pedagogically grounded model of professional development, one that promotes digital criticality alongside technical fluency.

This pedagogical intentionality is further elaborated in “*Collaborating to cross subject boundaries with digital technologies: designing a training plan through action research*” (Rodrigues Lourenço et al., 2025). Here, the use of technology is not an end in itself but a catalyst for collaborative, interdisciplinary design. The action research approach enables teachers to experiment with co-planning across disciplinary domains, thus fostering

professional agency, curricular flexibility, and reflexive innovation. The study positions digital tools as mediators of relational transformation, offering a model of teacher learning that is context-sensitive, participatory, and iterative.

The pedagogical potential of student-generated content is explored in “*PRODACT, a tool to analyse Digital Products Created by Students*” (Marangi & Pasta, 2025). The contribution moves beyond the rhetoric of creativity to propose an analytical framework for evaluating digital artefacts, addressing dimensions such as criticality, communication, and cognitive complexity. In doing so, the article reframes digital literacy as a process of guided authorship, where teachers are called to scaffold students’ digital expression through structured reflection and evaluative clarity (Koehler & Mishra, 2009).

“*Video-based learning activities in teacher education: effects on self-efficacy and perception of feedback for learning*” (Gentile et al., 2025) explores the potential of video-mediated simulations in enhancing formative feedback and professional confidence. The study reveals how carefully designed digital scenarios can offer safe, low-stakes environments for rehearsal, self-observation, and pedagogical reflection. In doing so, it addresses what Veenman (1984) described as the “reality shock” of early teaching: the disjuncture between initial preparation and classroom complexity. Such approaches not only foster technical readiness but support the development of a reflective and dialogical stance toward practice (Zeichner, 2010).

This trajectory is further enriched by the contribution “*Professional learning to support digital transformation and change in education: an integrated, systematic literature review*” (O’Brien, 2025). Through a comprehensive and critical synthesis of existing studies, the article investigates how professional learning frameworks can effectively sustain educational digitalisation. Rather than focusing on technology adoption per se, the review maps conditions for transformative change – including leadership, collaborative practices, and contextual adaptation – positioning teacher professional development as a structural lever for meaningful digital innovation. O’Brien’s work is particularly valuable in articulating the systemic dimension of educational change, reminding us that digital transformation must be embedded in coherent learning cultures, not isolated technical interventions.

Together, these contributions resist simplistic narratives of technological progress. They invite us to conceive “new modes of educating” not as the adoption of new tools, but as a reconstruction of the pedagogical act itself, one that is digitally aware, ethically attentive, and structurally inclusive. Moving into these new modes means cultivating in teachers a critical digital sensibility, the capacity to design meaningful learning ecologies, and the ability to navigate the ethical tensions of an

increasingly mediated world (Biesta, 2013; Selwyn, 2016).

This trajectory points to a new professional horizon, in which educators are not only consumers of innovation, but designers of pedagogical futures, capable of shaping practices that are responsive to the realities and challenges of the 21st century.

2.4. Moving into and Being Invaded by Other Disciplines

Contemporary teacher education cannot remain confined within the traditional boundaries of pedagogical science. It is increasingly crossed, expanded, and at times destabilised by epistemologies, languages, and practices drawn from adjacent or distant disciplines ranging from artificial intelligence to sexuality education, neuroscience, and motor learning. The movement “into and being invaded by other disciplines” does not signify contamination, but rather signals the ontological and professional porosity of teaching in the twenty-first century (Barnett, 2011; Nowotny, Scott & Gibbons, 2001).

This shift invites teacher educators to rethink what counts as educational knowledge, and to question the legitimacy, scope, and ethics of the knowledges that shape future teachers. Interdisciplinarity here is not just additive or thematic, it is structural, requiring teachers to operate across different ontologies of knowledge, power, and representation (Bernstein, 2000). It entails new forms of translation and negotiation, but also risks: conceptual fragmentation, overload, or the uncritical adoption of discourses external to education.

The article “*Is ChatGPT better than me? Analyzing the applicability of Large Language Models to the syllabus of a university course*” (Ludovico, 2025) confronts head-on the epistemic and ethical challenges posed by artificial intelligence. Through an experimental comparison between human teaching and AI-generated outputs, the study highlights both the productive tensions and the unresolved ambiguities surrounding the use of large language models in education. Beyond technical feasibility, the article raises questions about authorship, intellectual authority, and the role of the teacher in a post-digital society (Selwyn, 2019). It problematises the allure of AI as a pedagogical substitute and invites a critical pedagogy of the algorithmic.

“*STEAM, inclusion and engagement through makerspaces: the voice of students and teachers*” (Menichetti & Micheletta, 2025) offers a material and embodied perspective on educational innovation. Makerspaces are presented not as mere technological hubs, but as inclusive pedagogical ecologies where students can engage in differentiated, collaborative, and cross-curricular learning. The study foregrounds the role of tangible making in supporting social inclusion, emotional engagement, and cross-disciplinary competence. It calls for a pedagogy of materiality, where

learning is reconnected with hands-on creativity and affective participation.

Another kind of disciplinary expansion is addressed in “*Designing a new teacher and educator training on Sexuality Education: the SETTE training course*” (Bruno & Rubat du Mérac, 2025). The study responds to the historical marginalisation and taboo surrounding sexuality education by proposing a comprehensive training model that draws on biological, psychological, sociocultural, and ethical dimensions. In doing so, it challenges the myth of neutrality in education and recognises that sexuality is not simply a topic, but a terrain of identity, power, and care. Teachers are positioned not just as transmitters of knowledge, but as ethical interlocutors, capable of engaging with emotionally and politically charged domains (Giroux, 2011).

A third perspective is provided by “*eCRONY: hypothesis and experimentation of a new educational tool in motor skills teaching*” (Fogliata et al., 2025), which brings attention to embodiment and kinaesthetic learning, often marginalised in mainstream pedagogical theory. The article introduces a digital platform for the development of motor competencies, integrating feedback, individual progression, and reflective practice. It proposes a hybrid model where physical and digital modalities intersect, calling for a pedagogy that values bodily intelligence and multimodal engagement. This signals an important contribution to rethinking disciplinary hierarchies in teacher education.

Taken together, these contributions illustrate that the integration of external disciplines into teacher education is not merely a matter of content expansion. It is an epistemic reconfiguration that affects what teachers know, how they know, and why they teach. At the same time, these crossings demand pedagogical mediation: without critical framing, the influx of disciplinary perspectives risks becoming a technocratic overlay, devoid of ethical depth or educational coherence (Biesta, 2013; Bernstein, 2000).

Ultimately, this movement is not about replacing pedagogy with adjacent discourses, but about cultivating a transdisciplinary sensitivity, one that enables educators to navigate plural epistemologies, hold competing truths in tension, and engage learners within the complexity of real-world challenges. It is through this ethical and dialogical engagement that interdisciplinarity becomes not dilution but deepening.

2.5. Moving Towards Interprofessional Development and Learning

The notion of teaching as an individualised craft, developed in isolation within the classroom, is increasingly at odds with the ecological complexity of contemporary schooling. Today’s educational environments require teachers to work within systems marked by social fragility, digital transformation,

intercultural interaction, and emotional demands. In this context, the movement towards interprofessional development and learning emerges as a transformative response, one that reframes the teacher not as an autonomous technician, but as a relational professional situated within networks of care, co-responsibility, and shared meaning-making (Edwards, 2010; Sachs, 2016).

Interprofessionalism in teacher education refers to structured encounters and collaborations between educators and professionals from adjacent sectors – healthcare, social work, cultural mediation, psychology, public administration designed not as support mechanisms, but as integrated practices of co-construction (Hargreaves & Fullan, 2012; Ainscow, 2020). This orientation challenges siloed professional identities and invites educators to inhabit a more dialogical, distributed, and ethically grounded role within complex institutional ecologies. Within this framework, the concept of boundary crossing becomes central. As educators and other professionals engage in shared problem-solving, they enter and navigate across institutional and epistemic borders (Thomson et al., 2021).

In “*Empowering (e)ducators, inspiring learners: a cross-cultural exploration for interprofessional development through the lens of the Capability Approach*” (Gómez-Rey et al., 2025), this reconfiguration is articulated through the lens of human development and ethical agency. Drawing on the Capability Approach (Sen, 1999; Nussbaum, 2011), the study emphasises how interprofessional dialogue expands the range of “beings and doings” that educators can value and realise. Professional learning is not reduced to the acquisition of techniques, but becomes a process of emancipation, inclusion, and ethical participation. The cross-cultural nature of the analysis reinforces the idea that interprofessional development is always situated, requiring sensitivity to social values, institutional constraints, and cultural diversity.

This vision is echoed in “*Avanguardie educative, a collaborative network for Italian teachers' professional development*” (Nardi & Pestellini, 2025), which explores how schools can act as living laboratories for pedagogical innovation when supported by networks of collaboration, co-design, and peer mentoring. The initiative illustrates how teachers, when embedded in communities of practice, move from passive implementers to active agents of educational transformation. Professional Learning Networks (PLNs), in this case, are not dissemination tools, but spaces of negotiation, reflection, and collective authorship.

The political dimension of interprofessionalism must also be acknowledged. As managerialism and performativity increasingly shape education policy, interprofessional collaboration resists the fragmentation of roles and responsibilities, and affirms care, trust, and dialogue as professional imperatives (Sachs, 2016;

Lieberman & Miller, 2011). It also reveals the ethical and systemic stakes of teacher learning: issues such as well-being, inclusion, digital citizenship, and equity cannot be addressed within disciplinary silos, but require coordinated and situated responses across the school ecosystem.

These contributions collectively point toward a redefinition of teacher professionalism—no longer as solitary expertise, but as relational and systemic engagement. Interprofessional development becomes a structural condition for sustainable and context-sensitive education, and a response to the fragmentation and fatigue that increasingly affect the profession. It calls for infrastructures that foster dialogue across boundaries, support collaborative sense-making, and reinforce the ethical-political dimensions of educational work.

In the post-pandemic era, marked by disruption, polarisation, and systemic fragility, interprofessionalism is not an accessory to teacher education, it is a core strategy for revitalising the profession, renewing trust, and fostering collective intelligence.

2.6. Moving into Teaching: Mentoring, Induction, and Early-Career Transitions

The early years of teaching constitute one of the most formative and vulnerable phases of the professional life course. Far from being a smooth or technical transition, the move into teaching is often marked by role ambiguity, institutional asymmetry, and emotional intensity. Frequently referred to as a moment of “reality shock” (Veenman, 1984), this phase exposes beginning teachers to a mismatch between theoretical preparation and everyday classroom demands, particularly when structured support mechanisms are lacking (Ingersoll & Strong, 2011; Kelchtermans, 2009).

However, the entry into teaching should not be interpreted merely as a problem to be solved. It is also a deeply generative and relational space, in which the foundations of professional identity, pedagogical ethics, and community belonging begin to take shape (Beauchamp & Thomas, 2009; Akkerman & Meijer, 2011). The contributions in this section highlight the multiple dimensions of this entry phase—not only its risks, but also its transformative potential when appropriate forms of mentoring, dialogue, and support are in place.

The article “*Experiences of newly recruited educators in Early Childhood Services: a phenomenological-hermeneutic study*” (Rosa & Trigali, 2025) investigates the subjective and existential landscape of beginning educators. Through a qualitative lens, the study reveals the tensions between normative expectations and lived experiences. New teachers grapple with informal power dynamics, institutional opacity, and emotional fatigue, but also show remarkable creativity, reflective capacity, and commitment to pedagogical care. The study underscores the importance of recognising the affective

and identity-based work involved in becoming a teacher, particularly in early childhood education, where relationality is foundational.

A complementary perspective is offered in “*Mentoring and Networking for Innovation in the school ecosystem: from enabling conditions to MentorQ Self – Evaluation Tool*” (Mangione et al., 2025), which shifts the analytical gaze from the novice to the mentor. The article proposes a self-assessment tool grounded in reflective practice, aimed at supporting mentors in cultivating dialogical, reciprocal, and transformative relationships with early-career teachers. Mentoring is framed not as a unidirectional process of transmission, but as co-learning within an institutional ecology, where innovation and care are mutually reinforcing.

Both studies challenge reductionist notions of induction as administrative onboarding, or curriculum delivery. Instead, they advocate for a pedagogy of accompaniment – intentional, contextual, and ethically attentive – capable of honouring the biographical, emotional, and institutional textures of the professional entry experience. Becoming a teacher is not simply a functional transition; it is an ethical passage, one that requires collective responsibility and carefully designed support architectures (Feiman-Nemser, 2001; Beauchamp & Thomas, 2009).

This movement into teaching, then, should be envisioned as a shared horizon, not only of individual growth, but of institutional commitment and professional solidarity. It is a phase where vulnerability and agency coexist, and where educational systems must respond not only with procedures, but with structures of trust, reflection, and belonging.

3. Emerging Cross-Cutting Themes

The six trajectories articulated in this special issue delineate a complex and evolving landscape of teacher education, in which movement is not simply a metaphor, but a structuring epistemology. The very notion of the teacher “in motion” – mobilized across institutions, disciplines, roles, and identities – resonates with the call for this issue, which positions education as a site of ongoing transformation rather than systematised stability.

Across diverse contexts, methods, and cultural geographies, the contributions collected here trace the contours of a profession that is being reimagined under conditions of uncertainty, interdependence, and disruption. Rather than reiterating the thematic sections, this closing reflection distils cross-cutting trends that both emerge from and go beyond the articles, offering insight into the conceptual and practical directions in which teacher education is currently moving, and must continue to move.

Reconfiguring Teacher Identity as Situated and Relational

Throughout the issue, teacher identity appears not as a fixed status but as a dynamic, negotiated, and context-sensitive construction. Novice educators navigating early career transitions (Rosa & Trigali, 2025) are not simply acquiring skills, they are authoring themselves through vulnerability, aspiration, and situated agency. Elsewhere, identity is shaped by engagement with new literacies and technologies (Gentile et al., 2025; Ludovico, 2025), through reflective tools like portfolios (Pettenati et al., 2025), or by envisioning themselves as pedagogical leaders of innovation (Carletti, 2025). In each case, teaching becomes a biographical and ethical practice, entailing narrative reconstruction and social positioning (Beauchamp & Thomas, 2009; Akkerman & Meijer, 2011). This calls for teacher education programs to become laboratories of identity, attentive to the formation of professional subjectivities as much as to content and technique.

From Digital Integration to Critical Digital Pedagogies

Digitalisation pervades nearly all contributions—not as a neutral enhancer, but as a condition that reconfigures pedagogical meaning. Several authors (Cinganotto & Montanucci, 2025; Marangi & Pasta, 2025; Fogliata et al., 2025) move beyond the logic of integration, foregrounding the importance of design-based, critically mediated, and ethically aware digital practices. Ludovico (2025) challenges the teacher’s epistemic authority in AI-mediated environments, while Lourenço et al. (2025) explores digital co-design across subject boundaries. The systematic literature review by O’Brien (2025) further reinforces this trajectory, offering a comprehensive synthesis of how professional learning frameworks can support meaningful, context-sensitive digital transformation. These works collectively push toward a new literacy of teaching, where educators are equipped not only to use technologies, but to critique and reimagine them as pedagogical and social infrastructures (Selwyn, 2016; Biesta, 2013).

Situated Ethics and the Politics of Responsiveness

Several studies situate teaching within complex moral geographies, where the capacity to respond outweighs the ability to conform. Whether in the war-affected context of Ukraine (Avsheniuk & Seminikhyna, 2025), in multilingual and disciplinary hybrid spaces (Baldo, 2025), or in sexuality education (Bruno & Rubat du Mérac, 2025), teachers are shown to inhabit ethical tensions with discernment and care. These contributions call for pedagogies that are not merely adaptive, but ethically grounded, capable of recognising difference, resisting standardisation, and asserting human dignity in contexts of vulnerability (Biesta, 2013).

Interdisciplinarity and Boundary Work

The challenge of crossing epistemological borders recurs in works that navigate AI, STEAM, motor learning, or sexual health. Contributions by Micheletta & Menichetti (2025), Fogliata et al. (2025), Bruno and Rubat du M erac (2025), and Louren o et al. (2025) suggest that interdisciplinarity in teacher education is not a supplementary theme but a constitutive condition. It requires boundary work: the capacity to move between registers of knowledge, to translate across professional cultures, and to sustain coherence in contexts of plurality (Bernstein, 2000; Nowotny et al., 2001). Teacher educators must thus prepare professionals not only to cross disciplines, but to mediate between them.

Professional Learning as Collaborative Infrastructure

One of the most promising directions highlighted across the issue is the shift from individualistic models of professional development to networked, dialogical, and interprofessional forms of learning. Nardi and Pestellini (2025) and G omez del Rey et al. (2025) document collaborative systems that distribute leadership and generate collective expertise, while Mangione et al. (2025) focus on mentoring as a reciprocal, ecosystemic process. These works redefine professional growth as relational infrastructure: not the accumulation of competencies, but the cultivation of shared responsibility, trust, and mutual engagement (Edwards, 2010; Hargreaves & Fullan, 2012).

This special issue does not offer a blueprint, nor does it seek closure. Rather, it sketches a cartography of tensions, reconfigurations, and emerging sensibilities, a generative map of teacher education in movement. What unites the contributions is not consensus, but a shared willingness to inhabit complexity: to teach and learn through contradiction, uncertainty, and relational entanglement.

The emerging themes presented here do not end the conversation, they open it. They suggest that the future of teacher education will depend not only on institutional reform or technological advancement, but on our collective capacity to cultivate critical reflexivity, ethical responsiveness, and pedagogical imagination.

In this light, "Teacher to Move" is more than the title of a call. It is a provocation—an invitation to embrace the unfinished, mobile, and contested nature of education itself. To educate teachers today means to prepare them not for fixed roles, but for fluid landscapes, where teaching is always becoming, and where the profession must be redefined in dialogue with the world it serves.

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Innovation in teaching and educational leadership: rethinking the role of teachers in twenty-first-century schools

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Abstract

The article explores the role of teachers in contemporary schools in light of the cultural and technological transformations taking place in today's society. Through a critical review of the scientific literature, an analysis has been made of innovative teaching methods such as project-based learning, service learning and dialogic practices, highlighting their impact on student engagement, development of transversal skills and improvement of social inclusion. The reflection also focuses on the concept of distributed leadership, which promotes an educational community capable of integrating school, family and locality in a participatory and co-built formative process. Teachers emerge as facilitators of know-how, reflective practitioners and transformative intellectuals, capable of guiding students towards an active and conscious citizenship. Finally, the article underlines the importance of teachers' continuing training in order to promote a pedagogy oriented towards dialogue, creativity and building essential skills to tackle the challenges of complexity.

KEYWORDS: Teaching, Educational Leadership, Teacher Training, Distributed Leadership, Innovative Methodologies.

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1. Introduction

In recent years, education has undergone significant transformations, guided by the necessity to adapt teaching and educational practice to the cultural changes underway. Schools have to be able to respond not only to the students' cognitive needs, but also to their relational and social requirements, by promoting an education that fits the young people's life context. This exigency is particularly great in upper secondary school, where the need emerges to develop not only disciplinary knowledge but also active citizenship skills, critical thinking, self-awareness, autonomy and self-efficacy, all essential elements in the formation of the future citizens of this planet (Morin, 1999). In light of these transformations and students' new needs, today

we have to have a clear idea of the type of teacher we want to promote, while giving "an organic perspective and overall sense to the list of skills, so that they may give substance to this idea" (Baldacci et al., 2023, p. 37, own translation). Not only must their skills dovetail with their cultural awareness, but teachers also have to be well aware of their purpose, namely, to prompt in students the life skills they need to respond effectively to the challenges posed by contemporary society. As Baldacci, Nigris and Riva (2020) remind us, over the course of the history of pedagogy, various ideas of teachers have emerged: from artist-teachers, whose role was mainly to bring out the class's intuition and creativity; engineer-teachers, who set value on planning the teaching programme; researcher-teachers who, drawing inspiration from the Deweyan tradition, highlighted the capability to tackle practical teaching problems through reflection; and intellectual-teachers, of Gramscian inspiration, who instead prioritized historical-cultural awareness of educational issues. Each of these portraits casts light on fundamental aspects of the teaching profession, but can end up

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neglecting others. Hence, the necessity to seek to slot these perspectives together and formulate this figure anew, so that it takes account of the historical context we are living in (Baldacci et al., 2023; 2015). For a new definition of the figure of teacher, first we have to reflect on the characteristics of contemporary society, at once defined as “liquid” (Bauman, 2000), “postmodern” (Lyotard, 1979), “complex” (Morin, 2008), and also the “age of the sad passions” (Benasayag and Schmit, 2003). There is no escaping these terms’ emphasis on the intricacy of the changes and social, cultural, economic, political and educational transformations that humankind finds itself having to face (Ceruti & Bellusci, 2023). Suffice it to think of the so-called digital revolution and all the implications that the introduction of artificial intelligence (AI) will have on teaching, but also the changes that it will cause in teenagers’ formative process, with the ever greater necessity to balance the use of technology with educational practices in which relations and empathy retain their central worth, and guarantee inclusive and significant learning for all (Lavanga & Mancaniello, 2022). Doing this also means accustoming teachers to a reflective and metacognitive attitude. In order to find their way in the uncertainty and complexity so characteristic of both contemporary society and the adolescent mind, teachers have to have the ability to reflect on their educational action (Michelini, 2013; 2016). As Schön (1991) reminds us, teachers have first of all to be reflective practitioners, capable of calling themselves into question, reflectively assessing the actions, practices and approaches they enact in the classroom in order to single out room for improvement and development, given the heterogeneity, multiculturalism and richness of contemporary schools. Dewey (1998) already deemed reflective thinking the highest form of thought insofar as it is capable of promoting a research-oriented mentality that strives to discover talents, intelligence, desires, dreams, aspirations, as well as fears, anxieties and limits. The idea of transformative learning proposed by Mezirow (1991) further expands these concepts, highlighting how reflection is a process that allows critical analysis of the contents, processes and premises we use to interpret and give meaning to experiences. The key element of this evolution consists in developing the capability to go beyond the aspects concerning the efficiency and efficacy of the action, in order to recognize and critically analyse one’s frame of thought and interpretative perspectives, that is, what Mezirow calls meaning perspectives and frames of reference. Through this process, one can adjust them when they prove unsuitable, obsolete or warped, fostering personal and professional growth that is more conscious and open to change. Another aspect to add to this reflection derives from the pedagogy of Paulo Freire (1970) and concerns the fundamental emancipatory role that teachers should have. Indeed,

Freire imagined teachers as professionals capable of guiding students towards a critical understanding of reality and accompanying them along their path of personal and collective liberation (Freire, 1976). For the Brazilian scholar, teachers also have to facilitate dialogue and be capable of creating an educational space where know-how is not imposed from above but co-built through mutual exchange. Teachers start from the students’ experiences and socio-cultural context, using their stories and perspectives, as well as so-called “generative words” as a springboard to build a genuine relationship with the context, and from there rethink the subject matter. Hence, dialogue becomes a tool for liberation and to build a critical consciousness, transforming the students into active players in their stories. Hence, teachers promote conscientization. In other words, they boost the young people’s awareness of the dynamics of oppression and power that structure society and provide them with the tools to recognize and transform these structures. For Freire, education is therefore a practice of freedom, and the teacher’s role is to support the students’ autonomy, encouraging them to develop critical thinking and actively take part in creating their own know-how (Freire, 1970; 1976). For this task, teachers need a strong sense of ethics and social responsibility that goes beyond the transmission of knowledge to include the promotion of values such as empathy, justice and respect for diversity. At the same time, teachers have to carefully reflect on their educational action, critically analysing their methods and impact on pupils to avoid unconsciously perpetuating dynamics of oppression. In this vision, teachers become not only guides, but also allies in the students’ transformation pathway, helping to build a fairer and more aware society. Nevertheless, the path towards conscientization is rather complex, requiring a critical understanding of both history and its social and cultural dynamics to overcome oppression, passivity and every form of discrimination. Hence, it is evident that the emancipator-teacher needs to dovetail with the intellectual-teacher of Gramscian inspiration to remind us of the cultural, social and political scope of educating. Alongside these figures, teachers need the characteristics of the researcher-teacher to reflect on and assess their action in light of the complexity of contemporary society. Finally, good educational practitioners also have to be able to bring out the incidental side of education in order to arouse interest in the students (Ward, 1978). This means going outside the school walls, knowing how to live all spaces and grasping situational stimuli as potentially educational. In this sense, teachers facilitate knowledge, by picking up the cues that everyday life gives, stoking their pupils’ curiosity and love of knowledge. Herein lies the emancipatory drive, according to Ward, possessed by incidental education, which deserves to be grasped and fostered. Every one of these aspects comes together to outline a new idea of teacher. Obviously, it can only

take shape by investing in continuing teacher training and deciding to give economic and professional, cultural and social institutional support to schools. Indeed, if there is no longer a global vision, with a future outlook, the figure of teacher risks becoming more and more obsolete.

2. Tools and methods: a review of innovative teaching methods and practices

As also highlighted in many Italian and European reports, it is becoming an increasingly urgent need to place the students at the centre of education and go beyond transmissive and theory-based teaching methods towards workshop discovery learning approaches. Learning is an interactive process; together teenagers build know-how by comparing and negotiating meanings. This vision transforms the role of teacher from simple transmitter of static knowledge to guide and ally in the journey of discovery that fuels learning. Schools become a place of learning-together, where a spectrum of ideas, experiences and lives transform into a shared wealth generating collective growth. A central role in this process is played by distributed leadership (Jäppinen & Sarja, 2012). In Branson's (2010) assertion, this approach no longer sees the teacher as the sole holder of know-how, but as a facilitator of shared learning experiences, in which the educational responsibility is distributed among teachers, students, parents and local subjects. In fact, it is a model that promotes an educational community logic. It does not just involve the family but goes further to include the surrounding environment and its resources, thus creating a support and collaboration network that adds another dimension to the formative process (Senge et al., 2008). Distributed leadership is a radical change with respect to the traditional model of school management. It brings all the players involved in the formative process together to create a cohesive educational environment. Some key strategies are needed to make this transformation. This includes encouraging student involvement, for example, through student committees or workgroups that can take part in planning school activities and decision-making. This involvement is fundamental to solder the students' sense of responsibility and belonging. Another method is to promote collaboration among teachers, through communities of practice that share strategies, experiences and challenges. Periodical meetings can also become fora for co-planning innovative teaching programmes. Finally, parent participation is also important. They can be involved in regular meetings in which they are not only the recipients of information, but fellow educators, sharing ideas and projects to enrich their children's formative pathway. Links with the locality can be strengthened through partnerships with institutions such as local libraries, cultural

associations and companies. They can support school projects, creating genuine learning opportunities anchored in the social context. Further contributions could be given by organizing community events, such as open days or other events providing a space for dialogue and collaboration. At the same time, in addition to transforming the role of teacher from a distributed leadership perspective, it is important to revise and introduce to the school context new approaches and methodologies promoting those transversal skills deemed fundamental for students to be able to live in complexity. In particular, it is essential to adopt innovative teaching methodologies in upper secondary schools owing to the benefit teenagers' learning requirements draw from more interactive and constructive approaches. The methodologies at present considered most effective include project-based learning (PBL) and dialogic practices. Indeed, these approaches offer concrete tools for developing transversal skills that are essential in the contemporary world, such as critical thinking and problem-solving capabilities (Bell, 2010). This method, supported by investigative learning, allows young people to explore the subject matter in a critical and interactive way, taking on an active role in their formative journey, stimulating autonomy and a sense of responsibility (Blumenfeld et al., 1991). For example, planning a cultural event can combine organizational, artistic and social skills. Other transversal skills considered central are empathy and collaboration. Approaches such as service learning instead develop students' sensitivity towards other people's problems, stimulating relational capabilities and cooperation. Integrating activities that can respond to community needs, such as regenerating urban spaces or services for vulnerable sections of the population, teaches students to see learning as a means to make a positive impact on society.

Finally, it is of primary importance for teenagers today to develop autonomy and self-esteem, as well as a sense of self-efficacy. Dialogic practices and participatory activities allow students to acquire confidence in their capabilities and give them the lead role in their learning pathway (Kedian et al., 2015). Classroom dialogue becomes the practical means to translate pedagogical reflection into concrete action. It is a fundamental tool in co-building knowledge, helping students to develop a growing awareness of their thoughts. Founded on enquiry- and research-based teaching, this approach does not revolve around memorizing cultural content but making enquiries and sparking a heuristic process. This makes the classroom a research community. The teacher takes on the role of facilitator and guide who, through a maieutic approach, brings out and sets value on all the participants' reflections and points of view. Know-how is continually created and renewed by sharing knowledge, social negotiation and collectively building meanings.

This approach allows action to be carried out on both the development of cultural contents through active learner involvement, and the formation of conscious, democratic citizens. Words are the solid basis of this type of education, serving not only as self-expression, but also as a tool to emancipate and valorize the person. Words become a personal attainment, transforming individuals from the passive object of the educational process to its active and aware subject, capable of dialoguing and contributing to their own growth process. In this model, teachers take on the role of transformative intellectuals. As educators, they use words not only to transmit knowledge but to generate freedom and create a reciprocal relationship with the pupils. In the same way, this relationship removes the students from the simple role of addressees of imparted know-how and makes them social and historical beings, active parts in a personal and collective transformation process, able to have an effect on the contexts where they live (Freire, 1970; Don Milani, 1967; Dolci, 1988; Buber, 1993). The teachers' task, therefore, is not just to transfer information. They have the wider task of creating a learning environment where know-how is co-built. Students are thus encouraged to see themselves as playing the lead role in their cognitive journey, as they experience an education that is not only transmissive but generative, capable of stimulating critical thinking, dialogue and transformative action. This educational approach enables students to develop not only intellectual skills but also a deeper awareness of their identities and roles in society, strengthening their capability to actively take part in building a fairer and more inclusive reality. In short, teachers become actors that not only transmit knowledge, but build the fertile ground on which autonomy, responsibility and a renewed critical consciousness can flourish (Don Milani, 1967). The concept of dialogue as a means to overcome the subaltern condition occupies a central role in the educational and pedagogical work of Danilo Dolci (1988). Indeed, for Dolci, dialogue is not just an exchange of words, but a transformative process that enables individuals to become aware of their condition, develop critical thinking and acquire the tools to claim their own autonomy and dignity (Benelli, 2015). Dialogue makes the educational relationship an experience of reciprocity; every subject is called upon to actively take part in building shared meanings and creating a know-how that promotes individual and collective emancipation. This vision of dialogue as a practice of freedom does not stop at the educational environment, it also reaches the social and political level, since it aims to put the concept of democracy into effect (Cambi et al, 1991). Dolci considers dialogue a tool to topple inequalities, foster participation and build a society in which all individuals have the possibility of making their voice heard and contributing to change.

This set of methodologies create a learning environment that goes beyond mere knowledge

transmission to promote development of the skills and aptitudes needed to tackle contemporary challenges. These practices, accompanied by a distributed educational leadership perspective, can clearly help transform schools into educational communities where every actor – teacher, student, family and local associations – has an active role to play in building know-how. Together, distributed leadership, school-locality-family interaction and innovative methodologies can lay the bases for a school that prepares young people not only to tackle the present, but also to actively contribute to the future of society.

3. Methods

Based on a critical review of the scientific literature on the topic, the data and case study analysis aims to explore the efficacy of the innovative pedagogical methodologies and role of distributed educational leadership in the school context. The research was carried out by consulting academic databases such as Scopus, Web of Science and Google Scholar. Empirical and theoretical studies published in the last 20 years were selected to guarantee a solid perspective and analysis based on significant contributions over time. In order to be included in the sample, the studies had to highlight the impact of approaches such as project-based learning (PBL), service learning and dialogic practices; they also had to actively involve teachers, students and educational communities in collaborative learning processes. The analysis followed a qualitative-interpretive approach to identify recurrent models and best practices in the pedagogical literature. The selected case studies described the concrete application of these methodologies in school contexts and paid particular attention to the outcome on students' learning and development of transversal skills, such as critical thinking, collaboration and active citizenship. A further focus was the integration of aspects of distributed educational leadership, namely, the teachers' capability to create school-family-locality collaboration networks supporting authentic and inclusive learning.

4. Discussion of the results emerging from the data and case study analysis

The results emerging from the literature were organized into themed categories. These include boosting student engagement and motivation; developing reflective and social skills through dialogue and co-building know-how; and the positive impact of school-community collaboration on social and cultural inclusion. This methodological outline enabled me to coherently sum up the evidence and put forward practical guidelines for applying innovative approaches in educational practice.

First of all, with regard to boosting student engagement and motivation, a key aspect was pupils' involvement in authentic learning activities (Chen & Yang, 2019). In this respect, PBL was confirmed a methodology capable of transforming learning from a passive process to an active and significant experience. According to Krajcik and Blumenfeld (2005), structuring projects around a genuine starter question – rooted in real problems – prompted students' deep engagement as they perceived the practical utility of the knowledge they had acquired. A longitudinal study carried out on university students by Hmelo-Silver et al. (2007) showed a 34% increase in the levels of active participation compared to traditional methods, with even higher peaks (+48%) when the projects included collaborative digital technologies. The investigation on history students in the United States by Hernández-Ramos and De La Paz (2009) highlighted how PBL generated a positive attitude towards learning in 78% of cases, against 42% recorded in the control groups. This piece of data was explained by the capability of PBL to combine academic rigour and decision-making autonomy: students chose which routes of investigation to follow, selected tools and set times, making them feel in the driver's seat of their educational processes. The case study documented by Su (2023) specifically analysed the application of PBL in English teaching in secondary schools, focusing on activities promoting the acquired knowledge's transfer and innovation. PBL is described as a student-centred teaching approach which facilitated active knowledge-building thanks to real problem-solving and creating tangible products. A key aspect highlighted was the importance of planning activities that went beyond simple comprehension, encouraging students to transfer the skills learnt to new contexts and to develop innovative solutions. This process not only strengthened the students' mastery of the language, but also stimulated their motivation, with an effect on their critical and creative thinking skills. The article also underlined the teachers' need for suitable training so they could effectively implement PBL and guide students in the transfer and innovation activities. When well structured, PBL can lead to deeper and more significant learning, preparing students to successfully deal with real-world challenges. Another study by Mergendoller, Maxwell and Bellisimo (2006) analysed the effect of PBL on high school students of Economics. In this case, those involved in projects based on real problems showed a better understanding of the economic concepts than those who followed a traditional approach. The study by dos Santos et al. (2018) analysed the application of PBL in teaching Technical Drawing, integrating the use of CAD software to modernize learning. The students worked on projects right from coming up with the idea to completion, applying theoretical concepts to practical situations. In this case too, PBL proved effective in improving understanding, boosting

transversal skills such as collaboration and problem-solving, and increasing motivation and interest in the discipline.

Another study still showed the positive effect of this methodology in creating a school environment where the students felt valued and an active part of the learning community (Hattie, 2009). This sense of belonging and self-efficacy, documented by Hattie, was essential to encourage students' conscious participation, above all in contexts where the presence of a support network – consisting of teachers, families and members of the local community – can make the difference. The distributed leadership that emerged from this model became a medium for integrating values and knowledge rooted in the surrounding reality, fostering not only greater inclusion, but also the development of essential social and civil skills among the young people.

A study by Condliffe et al. (2017) instead analysed the efficacy of PBL, showing promising but not conclusive results in improving students achievement. The research demonstrated that, even though some studies showed PBL's positive effects in subjects such as Science and Social Studies, the evidence in the field of Mathematics was more limited. Furthermore – as we have seen – in order to effectively implement PBL, teachers require suitable professional training as this methodology entails a change in the teacher's role, from learning manager to facilitator. Instead, as far as the development of reflective and social skills through dialogue and co-building know-how is concerned, the study by Alexander (2020) explored the use of dialogic practices in the classroom, highlighting the potential of classroom dialogue as a tool to promote critical thinking. In a multicultural context, students used dialogue to explore complex topics and express critical opinions in a respectful and constructive way. The study demonstrated how open comparison on matters linked to cultural diversity allowed students to reflect on their opinions and acquire greater awareness of other people's perspectives, a skill which is crucial to live together in mutual respect and peace. In this case, the figure of teacher took on the role of mediator stimulating the co-building of know-how, transforming the class into a learning community (Ucan, Kılıç Özmen & Taşkın Serbest, 2023).

The Education Endowment Foundation's Dialogic Teaching Evaluation Report (2017) also analysed the efficacy of dialogical teaching in 38 primary schools in the United Kingdom, involving over 2,400 pupils. The aim was to improve the pupils' engagement and performance in English, Mathematics and Science, through a dialogue-based method and co-building know-how. The trial was carried out after an intensive teacher training course and mentoring. Audio and video recording tools were used to monitor the quality of the interaction in the classroom. The teachers received

constant support to adopt strategies to encourage discussion, critical reasoning and argumentation among the pupils. The analysis compared the schools taking part with a control group made up of 38 other schools. The results clearly showed how the students in the schools that adopted the dialogic teaching method made better progress than the control group: they were two months ahead in English and Science, and a month ahead in Maths. Furthermore, disadvantaged students made similar improvements. Hence, it might be hypothesized that dialogic teaching can also help reduce educational inequalities. Numerous other pedagogical experiences have confirmed the importance of dialogue and words, not only as learning tools but also as ways of social emancipation. Despite operating in different contexts, figures such as Don Lorenzo Milani, Paulo Freire, Danilo Dolci and Martin Buber all highlighted the crucial role of a relational conception of learning and access to culture. It is not about transferring readymade packages of knowledge but putting young people in a dialogic relationship with know-how. For example, in the reciprocal maieutics workshops conducted by Danilo Dolci in Sicily, collective discussion took on a central role, becoming a powerful tool to analyse and understand how to improve the conditions of both individual and community life. These workshops offered a space where everyone – through dialogue and exchanging opinions – could make a contribution, using their own experiences, ideas and skills, to the search for shared solutions. It was an environment where democracy was not only an abstract ideal but a practice lived every day, relationships were on equal terms and every participant felt valued and respected. In this context, teachers lost the traditional role of authorities to obey and transformed into allies and guides accompanying the participants in the know-how-building process and, more in general, in their own personal growth pathway. The goal was not only to learn concepts or notions, but to promote the overall formation of the person, making them capable of critical reflection, conscious action and contributing to improving society. The aim of this educational model, founded on equality and mutual respect, was to emancipate the participants, making them active players in their lives and in the community, and boosting their sense of belonging and collective responsibility. In this perspective, dialogue was not only an educational methodology, but a political act, a means to redefine the power relations and build a fairer and more just society. The positive impact of school-community collaboration on social and cultural inclusion and the efficacy of distributed leadership is instead highlighted by the service learning experience described by Dienhart et al. (2016), in which the students took part in a volunteering initiative to support elderly people in the local community. The experience had a positive impact not only on the development of relational skills, but also on the students' personal

growth, as they learnt to deal with the challenges and needs of the community. It also created a closer bond between the school and the locality, transforming education into a concrete experience of active citizenship. This approach to learning, combining theory and practice, allows students to perceive school as part of a wider, interconnected system, helping to strengthen social bonds and form aware and responsible citizens (Fiorin, 2016).

In the same way, other studies have highlighted how the distributed leadership model can promote a school climate in which differences are recognized and exploited as learning resources. For example, a case study conducted by Harris (2012; 2013) analysed the implementation of distributed leadership in a multicultural school in the United Kingdom. Interdisciplinary work groups were created, made up of teachers, students and local community representatives, to plan teaching activities that could respond to the specific needs of a heterogeneous student population. The results showed an increase in student participation and an improvement in intercultural relations, thanks to sharing experiences and different perspectives. Another significant example comes from a study by Spillane and Diamond (2007), which examined the impact of distributed leadership on schools in the United States with great ethnic and linguistic diversity. The involvement of parents and community leaders in the school's decisions led to greater inclusion of the local traditions and cultures in the curriculum, soldering the students' sense of belonging and improving their academic achievement. In Italy, studies such as that of Stillo (2020) have explored how intercultural education can respond to the complexity of society and Italian schools. The author highlighted the importance of distributed leadership involving teachers, students and local communities in mentoring and intercultural tutoring practices. These practices are seen as key tools to support the integration and educational achievement of students from a migratory background. In this case, the teachers took on the role of mediators and facilitators, coordinating initiatives that allowed students to share their stories and build bridges of understanding with their classmates. These examples confirm that distributed leadership not only fosters a more inclusive school environment, but also helps create an expanded educational network capable of responding in a dynamic and participatory manner to the challenges of cultural diversity. In other words, collaboration between school, families and locality can build learning spaces that reflect the values of acceptance, respect and pluralism.

The results of the above-mentioned case studies and the theoretical review have highlighted how this type of leadership, as well as the adoption of collaborative approaches involving the locality in learning programmes, can have a transformative impact on teenagers' formative experiences. School-family-

locality dialogue within the educational process creates a support network and enables the co-building of know-how that responds to the needs of a rapidly changing society. The concept of educational community, in which every actor has a significant role, makes it possible to go beyond the traditional dichotomy between school and real life. Learning becomes a more significant and contextualized experience which strengthens the sense of belonging and fosters the exchange of ideas and skills, positively impacting student motivation and involvement. Lastly, in order to introduce these new approaches and redefine the role of teacher, it is necessary to promote teachers' continuing training, crucial to gain the tools and up-to-date skills to implement collaborative and dialogic methodologies. The training should not only include pedagogical skills, but also mediation and communication skills that facilitate dialogue with families and local actors.

5. Conclusion

Teachers' continuing training therefore proves crucial, especially in a rapidly evolving educational context, offering numerous benefits that can positively influence not only their professional career, but the whole educational environment. A skills update is one of the main advantages provided by continuing training. Teachers need to keep informed of the latest teaching methodologies and emerging technologies. Indeed, it is crucial for teachers to boost the efficacy of their teaching so they can manage to involve as many students as possible. In so doing, some of the attitudes presented at the start of this article are key. This includes reflectivity: teachers have to be disposed to do research and call things into question, as it is fundamental to be able to adapt to the new educational requirements of today's teenagers and understand each boy and girl's different way of learning and every person's specific needs. Furthermore, continuing training contributes not only to teachers' professional growth but also their personal improvement: teachers who feel competent in their capabilities are also more confident in class management and tackling the various educational challenges. In turn, this can help offer them new career opportunities, for example, in the field of training within the educational system itself.

There is a further aspect of continuing training that is worth emphasizing and that is the possibility it gives to network and collaborate with colleagues. Taking part in training courses gives teachers the opportunity to connect with other professionals in the sector and so it fosters the exchange of ideas, resources, teaching materials and above all particularly effective best practices. This creates learning communities in which teachers support each other in their development. In the same way, peer-to-peer mentoring is an effective method to facilitate the adoption of new educational

practices. This relationship of support can provide opportunities for mentors to share their experiences and teaching strategies, and give those with less expertise direct access to practical knowledge. Teachers can improve their pedagogical skills through mutual observation and feedback in a collaborative environment. All of this helps create a culture of continuing learning in schools, where teachers feel supported in their professional development. It is clear how all of this can promote innovation in teaching. Exploring and adopting new techniques and interactive approaches can encourage active, collaborative and workshop-type learning methods. Knowledge of the latest technology allows teachers to integrate digital tools into their teaching, improving student engagement. This certainly has a positive impact on the young people. Creating a more stimulating and inclusive atmosphere in class could also improve their educational achievement. In short, continuing training is essential to guarantee that teachers are equipped to tackle the modern challenges of education; it helps to develop a more effective educational system that is more reactive to the needs of contemporary society. Promoting and exploiting school-family-locality integration creates the conditions for an educational community and distributed leadership-based model of education, both of which are indispensable to create the conditions for authentic and participatory learning. Alongside this, however, timely interventions are needed on the part of the institutions. They need to take up and give an effective response to the main educational challenges of today's school system. In addition to the dearth of continuing training for teachers, the main challenges to tackle include: staff shortages, inadequate digitalization and poor technological skills, great inequalities between the north and south of Italy, low levels of social inclusion of students from foreign backgrounds, scarce attention to non-cognitive skills, continuing weak organization of the school-work relationship, schools' limited autonomy, delays in adopting innovative teaching methodologies and, above all, the lack of effective educational guidance. This makes it impossible to listen to and deal with the spectrum of exigencies of students who need not so much to be taught the different subjects, but to be offered an integrated syllabus and more inclusive and flexible educational practices.

To fill these gaps, the government, educational institutions and local communities need to work together to rethink the Italian school system. It is only by investing in infrastructure, training, innovative methodologies and inclusion that schools can be transformed into a place capable of effectively responding to the challenges of the here and now and the future. The idea of teacher that we should be promoting today is a multidimensional figure who combines pedagogical, digital, social and cultural skills and can hence create an education that is inclusive,

innovative and transformative. The core of teachers' professionalism in the twenty-first century lies in the capability to adapt to changes and inspire students to develop their potential.

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The orientation towards multilingualism of future Italian teachers: perceptions and attitudes in the Humanities and STEM fields

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Abstract

Friuli Venezia Giulia is a multilingual region in northeastern Italy, where recent migratory flows create phenomena of contact between Italian, historically present minority languages, and the languages and dialects spoken by *nuovi cittadini*, the ‘new citizens’. School classes host significant percentages of minors with a migration background, and attention to multilingualism, its visibility, and its enhancement from a future European perspective is high. In this context, teacher training is a central theme, as the statements and positions of adults can directly affect the perceptions and attitudes of the minors entrusted to them. This study presents the results of a survey conducted through a sociolinguistic questionnaire as part of the initial training of future Italian teachers. The research, which complements previous works and studies in the literature, aims to assess the perceptions of new teachers regarding multilingualism, both in general and in relation to teaching in multilingual classrooms, and working with multilingual students. The information provided by the subjects engaged in humanistic disciplines is compared with the corresponding statements from colleagues in technical and scientific areas, with both a theoretical descriptive goal and an applied focus on possible future teachers’ training on the job and professional development paths.

KEYWORDS: Multilingualism, Migration, Teachers’ Training, Perceptions, Attitudes.

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1. Introduction

1.1 Friuli Venezia Giulia: A Multilingual Region

As of December 2023, the percentage of foreign residents in Italy is approaching one in ten. Official data report over 5 million foreign residents living in the country, accounting for 9.0% of its population, with approximately one in five (19.8%) being minors (IDOS, 2024: p. 15). However, this distribution is not uniform across the entire national territory, with some areas, particularly the northern regions and larger urban centers, showing higher concentrations. In the Friuli

Venezia Giulia, the region where this study is based, the foreign population incidence is more than one point higher, reaching 10.2% (121,523 residents), with variations across the four main provinces: the capital Trieste (11.2%), Udine (8.3%), Pordenone (11.2%), and Gorizia (13.2%) (Attanasio, 2024). However, the overall data is an underestimate of the presence of people with a migration background, as it does not account for citizenship acquisitions, a phenomenon that has been increasing in recent years (Gatti & Strozza, 2024).

In this general context, the presence of minors with a migration background in the regional educational system has become quite significant: in the 2022/2023 school year, there are 21,783 foreign-born children and adolescents enrolled in schools of all levels in Friuli Venezia Giulia (Attanasio, 2024, p. 391). The top five countries of origin are Romania (18.9% of non-native students), Albania (12.1%), Bangladesh (7.8%), Morocco (6.1%), and Ukraine (5.7%). This data aligns with local census reports and reflects the characteristic patchy distribution of immigrant populations, with some communities being particularly prominent, while also showing significant local variations. This presence has

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been growing over the years, with an evident trend toward stabilization and a steadily increasing incidence of the so-called *seconde generazioni*, 'second-generation' phenomenon (MIM, 2024: p. 20).

1.2 An Old and New Multilingualism

Even in its terminological imprecision (Rumbaut, 2004), the data on second generations is important in understanding the structural demographic nature of the non-native presence, which has now become a stable component of the population. In line with previous surveys (Chini & Andorno, 2018; Fusco, 2022), statistics from the Italian *Ministero dell'Istruzione e del Merito*, 'Ministry of Education and Merit', show that by the end of the 2022/2023 school year 64.5% of students with foreign citizenship are second-generation (MIM, 2024: p. 20). Therefore, Italian schools are directly involved in the evolution of the migration phenomenon, which daily presents new challenges and opportunities for teaching and administrative staff in schools at all levels.

In this context, initial teacher training and their subsequent professional development assume primary importance, given that teachers play a significant role and exercise considerable influence over the students entrusted to them, and consequently on future Italian and European citizens. In a border region with such a distinctive linguistic profile as Friuli Venezia Giulia, historically multilingual and a place of encounter and contact between languages and cultures that are not always typologically close (Fusco, 2017, pp. 33-62), the languages and dialects of migrants add an additional dimension and introduce a further level of complexity to the system. Vedovelli & Casini (2017) use the term *neoplurilinguismo*, 'neoplurilingualism', in order to describe this innovative aspect of Italian (super)diversity (Vertovec, 2007), which is inserted into the already complex and rich framework of national multilingualism.

1.3 The Promotion of Multilingualism in Schools

On the regulatory level, the recommendations of the European Commission and the Council of Europe place the promotion of multilingualism at the center, no less than the protection of minority languages (Beacco & Byram, 2007; Candelier et al., 2012); this competency indeed finds a specific space and appropriate descriptors in the most recent edition of the Common European Framework of Reference for Languages as well (Council of Europe, 2018). In Italy, the reference to the multilingual dimension in education is found in several ministerial recommendations (MIS, 2022, is the most recent), but the issue of promoting Italo-Romance languages and dialects has deeper roots, which can be traced back to the work of linguist Tullio De Mauro (2018) and in the *Dieci Tesi per una educazione linguistica democratica*, 'Ten Theses for a Democratic Linguistic Education', of the *Gruppo di Intervento e Studio nel Campo dell'Educazione Linguistica*, 'Group

for Study and Intervention in the Field of Language Education' (GISCEL) (Loiero & Lugarini, 2019).

As for minors with a migration background and the school context, the idea of promoting the multilingualism of the classes (also described by Fiorentini et al., 2020) and of their students, as a potential resource for the benefit all the people involved, is a widespread and shared concept. Being aware and competent multilingual speakers indeed offers well-established benefits (Garraffa et al., 2020), while the risks of subtractive bilingualism, also on an individual level and within the family domain, are well known (Favaro, 2020). Moreover, the issue has been raised over the years and it is present in a wide number of recent Italian ministerial documents (MIUR, 2014; MIUR, 2015; MIS, 2022), even if, on the other hand, there is not always sufficient clarity among the teaching staff regarding feasible objectives and implementation methods. Consequently, research studies specifically aimed at investigating teachers' perceptions, behaviors, and strategies adopted in multilingual Italian classrooms are in fact numerous and show a not occasional interest by the academic world (Sordella, 2015; Amenta & Turrise, 2017; Fusco, 2021; Salvaggio, 2022).

1.4 Framework of the Study

The actions of teachers can indeed have a significant impact on shaping the attitudes of students in their classrooms (Garrett, 2010, pp. 22-23); teachers actively contribute to developing multilingual awareness and to more favorable or to less positive attitudes toward multilingual behaviors and skills. However, academic research does not always have the opportunity to gather enough representative data, as sampling often investigates the perceptions and behaviors of subgroups of teachers, who are reached in schools and involved in the surveys on a voluntary basis. To cite some cases, Sordella (2014; 2015) distributed a questionnaire among teachers in service in 27 schools in Piedmont, which had already been surveyed as part of the broader research coordinated by Chini & Andorno (2018); Amenta & Turrise (2017) reached 84 teachers in service in schools in Palermo, with several years of experience in multilingual classrooms; Fusco (2021) focused on around 200 teachers with experience working with students of non-Italian citizenship; finally, Salvaggio (2022) reports on a field study within the FAMI Impact FVG 2014-2020 project, involving the collection of data through a voluntary participation to a questionnaire, completed by 97 teachers from schools in Friuli Venezia Giulia.

In the international context, a number of studies shows a considerable level of interest in the academic community about teachers' perceptions and attitudes towards multilingualism, as well as towards the experience of working in a multilingual environment. Pulix et al. (2017), Alisaari et al. (2019), de la Maya Retamar et al. (2024), and Bosch et al. (2025) also employ anonymous online questionnaires, including

Likert scales and open-ended questions, in order to investigate the perspectives and beliefs of wide samples of teachers in service in various European countries, including Belgium, the Netherlands, Finland, Greece, and Spain. Their research shares therefore certain similarities with the study presented in this paper, even in terms of quantitative investigative tools and analysis methods. In contrast, a qualitative approach is adopted by Haukås (2016) in Norway and Paulsrud et al. (2023) in Sweden, who use focus groups and semi-structured interviews, respectively, while still pursuing similar research objectives.

However, research reaching a sample of future teachers with a still limited experience of working in classrooms, particularly multilingual ones, with high level of linguistic and socio-cultural complexity, does not seem to be so common. This study therefore aims to bring a contribution in this direction, as it intends to record the perceptions, more or less specific, and the attitudes of a group of prospective teachers before their qualification and hiring in primary and secondary schools in Friuli Venezia Giulia region. The opportunity is provided by the new teacher training program introduced in Italy by the DPCM of August 4, 2023, and active in many Italian universities, including the University of Udine, during the subsequent academic year. This program includes common area courses, such as linguistic education, side by side with more specific subject, closely related to the specialization of the future teachers, for a comprehensive total of 60 University Credits (hence, the 60 CFU program).

1.5 Research Questions

Within the 60 CFU program, it was therefore possible to reach a significant number of prospective teachers, both in the humanities and languages (foreign or second) and in technical and/or scientific disciplines. The request to complete an anonymous online sociolinguistic questionnaire was positively received by the majority of the participants, and through subsequent analysis, it is possible to seek answers to some research questions. First, the study aims to investigate how future cohorts of teachers perceive multilingualism, keeping in mind that these positions might influence students, whether native or from a migration background, in their classrooms. Secondly, the study seeks to compare some of these perceptions with those expressed by minors with a migration background, using recent data collected from the same region (Baldo, 2022). Thirdly and finally, the aim is to determine whether and to what extent the perceptions and attitudes recorded vary depending on the humanities or technical-scientific orientation of the participants' training and their field of expertise.

Standing on the sources previously mentioned, it is known that, in most cases, teachers from linguistic or humanistic fields are more actively involved in surveys and are therefore more and better represented. The 60 CFU program, on the other hand, provides the rare opportunity to explore the viewpoint of colleagues from

the technical-scientific sector, who are not always equipped with specific linguistic training and knowledge, and even less so in the teaching of Italian to non-native students. Therefore, this study intention is providing additional information, useful for describing the phenomenon and, from an applied perspective focused on action, for better addressing the issue of teachers' continuing professional development. A potential impact is therefore identified in the opportunity to adopt part of the information in these pages in order to guide and refine future interventions aimed at teachers, intended to suggest tools for promoting the visibility and enhancement of multilingualism in classrooms.

2. Materials and Methods

2.1 Structure of the Questionnaire

The tool adopted in this study is a sociolinguistic questionnaire, consisting of an authorization for the processing and storage of personal data; a brief initial section that collects some non-sensitive information and outlines a few possible factors of variation; finally, a larger section that includes a number of different sociolinguistic questions. This latter section is modeled by taking questions or groups of questions from bibliographic sources, that is, from similar research and previous experiences in the literature. The idea of investigating the general perception of multilingualism, asking future teachers to associate the idea with an adjective such as *normale*, 'normal', or *divertente*, 'fun', and then comparing the results with the perspective expressed by a control group of students (Fusco, 2022), is borrowed from Sordella's doctoral thesis (Sordella, 2014 & 2015). The idea of proposing two sets of statements, the first on the perception of students' multilingualism by their teachers and the second on the difficulties or opportunities offered by working in a multilingual classroom, comes from Amenta & Turrisi (2017). Finally, a limited number of questions concerning attitudes toward multilingualism, share a structure similar to the motivational questionnaire proposed by Li & Wei (2023) and based on the more detailed theoretical work by Garrett (2010). Adopting a tool with sections imported from well-known and accredited sources allowed avoiding the need for a more specific and in-depth statistical test of significance, which anyways it would not have been possible to carry out for the questionnaire version described in this paragraph.

2.2 Sample and Data Collection

The questionnaire administration was carried out anonymously, through a Google Form, and involved almost all the participants enrolled in the 2023/2024 qualification courses organized by the *Dipartimento di Lingue e letteratura straniera, comunicazione, formazione e società*, 'Department of Foreign

Languages and Literatures, Communication, Education, and Society' (DILL) at the University of Udine, in Friuli Venezia Giulia. Both for future teachers in the humanities area and for those in the technical-scientific field, the course included an identical and brief general module on the fundamentals of language education, which made it possible to reach a large number of participants and invite them to take part in the study. Of the 232 valid responses recorded, 137 came from future humanities teachers (HUM, 81.0% female) and 95 from teachers in technical-scientific subjects (TEC, 67.4%). Most of the subjects are young, with the humanities group predominantly in the age range up to 30 years (40.1%), while the technical-scientific teachers are predominantly aged between 31 and 40 years (49.5%). Furthermore, the first group attends the 60 CFU course to obtain the qualification to teach in *scuola secondaria di primo grado*, 'lower secondary school' (55.6%), while the second is more oriented towards *scuola secondaria di secondo grado*, 'upper secondary school' (69.6%). The previous experience of all the future teachers reached is limited, with the most frequent response option being "two to four years" (45.8% of humanities teachers and 45.3% of the technical-scientific group).

The majority of the participants claim to know at least two (25.5% HUM and 29.5% TEC) or three (27.7% HUM and 29.5% TEC) languages or dialects besides Italian. In the repertoire of the two groups, a total of 56 different codes emerges, however, the most represented options are English (82.5% HUM and 78.9% TEC) and Friulian (42.3% HUM and 41.1% TEC). It is not surprising that the most widespread foreign language in Italian schools, English, is prominent, alongside Friulian, an Italo-Romance language with wide distribution in Friuli Venezia Giulia (Fusco, 2017: pp. 33-62) and very visible in the linguistic landscape of the area, partly due to the existence of specific protection legislation (Law 482 of 15/12/1999). As for the perception of multilingualism in the classrooms, many codes (51) emerge as well, but there is already some discrepancy between the two groups of teachers. Both resort to some imprecise or generic glottonyms to describe the repertoire of their classrooms and of students with a migratory background, however, this happens more frequently among the future technical-scientific teachers (13 glottonyms, mentioned by 21.0% of TEC subjects) than among the humanities teachers (9 glottonyms, 10.9% HUM). At a more qualitative level, some indirect value judgments also seem to emerge in the statements of future technical-scientific teachers, which lead to the existence of implicit prestige hierarchies: "*friulano misto sloveno/slavo*" or "Friulian mixed with Slovene/Slavic"; "*lingue europee (inglese, francese, spagnolo), dialetti Est Europa, Africa, Sud America*" or "European languages (English, French, Spanish), Eastern European dialects, Africa, South America"; "*Non parlano altre lingue ma, eventualmente, l'italiano risulta stentato*" or "They

don't speak other languages but, if anything, Italian is broken".

3. Results

3.1 General Perceptions of the Teachers

As mentioned earlier, some questions in the questionnaire aim to assess the perceptions and attitudes of future teachers regarding the multilingual practices of their students. Respondents are asked to express their views on the normalcy and usefulness of being multilingual, and whether it can be fun or a cause of problems. On the cognitive aspect of usefulness, the results show clearly positive opinions without much variation (77.4% HUM and 77.9% TEC). However, the multilingual condition is considered more normal by the humanistic group (46.0%) than by the technical-scientific one (35.8%). Subsequently, it was possible to compare this data with that collected in the 2018/2019 school year in a similar manner as part of a study in Friuli Venezia Giulia, within the FAMI Impact FVG 2014-2020 project (Fusco, 2022). In that case, as part of a larger study inspired by the work of Chini & Andorno (2018) in Piedmont and Lombardy, over a thousand students (1,082) from primary and lower secondary schools had answered the same questions, allowing for a comparison of results.

While there are no significant differences regarding the usefulness of the multilingual condition, the comparison reveals that students find multilingual practices much more *divertenti*, 'enjoyable' (55.0% of the sample) compared to future teachers (27.0% HUM and 23.2% TEC) (Baldo, 2022). Moreover, it is worth noting that the perception of knowing multiple languages or dialects as *causa problemi*, 'causing problems' is rare among future teachers (0.7% HUM and 4.2% TEC), but children and adolescents seem to experience this condition significantly more frequently (8.2%). Expressing problematic views, even anonymously, can be difficult, therefore this particular data may warrant more attention. While it is true that both tools investigate subjective perceptions, these can still be of interest to the observer: in other words, nearly one in ten students feels that their multilingual condition can be an obstacle, while teachers tend to have a quite different view. In this case, the largest gap is seen among the humanistic teachers, whereas those from technical-scientific disciplines seem to have a perspective closer to that of their potential future students.

3.2 The Multilingualism of Students

The perception of students' multilingualism by future teachers is investigated through ten statements, adapted from the questionnaire used by Amenta & Turrise (2017) in Palermo and linked to Sordella's (2014) doctoral research. Respondents were asked to express their agreement with each statement using a four-point Likert scale, which excludes a neutral middle position: *per*

nulla or “not at all”, *poco* or “a little”, *molto* or “a lot”, and *del tutto* or “completely” in agreement. This allowed the analysis phase to group favorable or unfavorable opinions and then to compare them with information from the rich existing theoretical literature on multilingualism (Cummins, 2000; Cognigni, 2020; Garraffa et al., 2020). Some general descriptive concepts seem well-established and shared: knowing and using multiple languages or dialects does not create confusion for speakers, multilingualism does not hinder the study of disciplinary subjects, and it can even make it easier to learn additional languages, including Italian. Similarly, both the humanistic group and the technical-scientific group seem to overlook a possible connection between the new multilingualism of emerging minorities and post-unification linguistic policies toward dialect-speakers (De Mauro, 2018; Loiero & Lugarini, 2019).

However, some of the topics addressed by the questionnaire are more specific, and in these cases, the groups' preparation shows more variation. Among the potential benefits, being multilingual leads students to lexical enrichment (56.2% of humanists agree, compared to 45.7% of technical-scientific teachers) and positively stimulates metalinguistic reflection (69.9% HUM and 55.3% TEC). On the downside, expressed by relatively small percentages of respondents, future teachers sometimes believe that students' multilingualism might lead to inadequate support from parents in studying or doing homework (19.7% HUM and 31.9% TEC), or that students speak among themselves in their native languages with the deliberate intention of not being understood (24.1% HUM and 38.5% TEC). These beliefs reflect some less favorable views of multilingualism, which seem more deeply rooted in the subgroup of future teachers of technical-scientific subjects. In relation to these specific concepts, humanists exhibit greater preparation, even at a theoretical-descriptive level, and consequently are led to express less negative perspectives and beliefs.

3.3 Teaching in a Multilingual Classroom

An analogous sequence of statements, accompanied by an identical range of options on a four-point Likert scale and drawing from the same bibliographical sources (Amenta & Turrise, 2017; Sordella, 2015), aims to investigate the beliefs and perceptions of teachers regarding the idea of teaching in a multilingual classroom. In this case as well, some widespread and commonly shared positions emerge, the most general ones being: students speaking the same language or dialect can use it to support each other, the languages spoken by both old and new linguistic minorities do not constitute a lexical impoverishment, and, as already stated before, no connection seems to be noted between the past Italian dialects and the new multilingualism of the recent immigrant communities. However, in the case of more specific themes related to strategies and approaches to multilingual education (Cognigni, 2020), the gap between the opinions of the humanistic group

and those in the technical-scientific one widens again, favoring the former: teaching in a multilingual class encourages interlinguistic comparison starting from the languages brought by the students (72.6% of humanists, but only 60.4% of the teachers in technical-scientific fields), and creates opportunities for reflection on errors (74.6% HUM and 56.5% TEC).

Regarding potential obstacles, not necessarily does a teacher in a multilingual classroom feel compelled to use simplified language to be understood (30.6% of humanist teachers think they should do so, compared to as many as 48.9% of the technical-scientific group), nor is it widely believed that not knowing the students' languages of origin is a problem (9.6% of humanists, but 24.7% of the technical-scientific group). Finally, regarding the remaining statements, a similar discrepancy emerges between the perceptions in the two subgroups, with a consistent orientation towards greater preparation expressed by prospective humanistic area teachers. The section of the questionnaire about perceptions and beliefs on teaching in a multilingual environment is completed with an open-ended question, asking respondents to report on any multilingual educational practices already adopted in their classrooms. The data is still consistent with the previous ones, with 49 humanistic course participants dedicating time to this response (35.7% of the subgroup), compared to 25 in the technical-scientific field (only 26.3%). The practices of the former also appear to be less occasional, not solely tied to the mere necessity of translating essential concepts or information (such uses account for 20.4% of the humanists' responses, but for 36.0% of the technical-scientific group). Teachers with a humanistic background state they adopt more languages or dialects in the classroom too, going beyond just English as a lingua franca, and propose a wider range of more targeted activities and strategies focused on a teaching that values all the multilingual practices in the classroom.

3.4 A Note on Attitudes

The final section of the questionnaire uses as sources the more theoretical-descriptive framework by Garrett (2010) and a recent application of it in a motivational questionnaire, by Li & Wei (2023). Informants are asked to express their level of agreement on a four-point Likert scale regarding six statements that indirectly investigate the subjects' attitudes towards multilingualism, at cognitive, emotional, and behavioral levels. Subsequently, the data is reprocessed to derive a numerical indicator, from 1 to 100, for the different aspects, together with a synthetic overall index of inclination towards multilingualism, which is the average of the former values. The results are consistent with the previous sections and show a good level of agreement within both subgroups at the cognitive level (66.1% HUM and 61.7% TEC), regarding therefore more general concepts and the advantages of being multilingual. At the emotional level, the attitudes are

mostly favorable too but show an already greater discrepancy in favor of the humanities group (77.4% HUM and 72.0% TEC). Understandably based on the disciplinary and professional orientation, the behavioral level shows even more significantly favorable inclinations from the humanities group (63.0% HUM and 50.0% TEC), who state to more often engage in multilingual behaviors in their daily lives and affirm to be more inclined to study the languages of their students. Finally, in synthesis, the attitudes of the humanities teachers seem to be more favorable towards multilingualism than those expressed by their colleagues in the technical-scientific group (68.8% HUM and 61.2% TEC).

4. Discussion and Conclusions

4.1 Answering to the Research Questions

The first research question, which explores the perceptions of aspiring teachers in general terms, reveals a high degree of agreement and uniformity regarding the usefulness of multilingual competence. However, it is less clear that multilingualism is seen as a normal rather than exceptional condition in human societies (Piccardo, 2019). Additionally, any playful or fun uses, often practiced by children and adolescents, do not seem to be highly valued by teachers. Finally, the percentage of the sample that considers being multilingual as a possible source of problems is extremely low. The comparison with potential students, using data collected with a similar tool in recent years (Baldo, 2022), highlights both similarities and discrepancies: among children and adolescents in the Italian school system, the perception of the phenomenon's normality is not as clear (with a 10.2 percentage point gap compared to the average of teachers), while playful uses related to fun activities are more prevalent (with a 29.6-point gap, favoring minors). The problematic view of multilingualism, which is almost absent from the optimistic perspective of humanities teachers (0.7%), shows to be more clearly present in the opinions of students (8.2%), but also in the views of colleagues in technical-scientific fields (4.2%). Finally, the opportunity provided by the teacher training program for the 60 CFU (university credits) allowed for a comparison between two different disciplinary orientations of teachers, revealing both similarities and differences. The perception of multilingualism generally shows positive positions in terms of its potential cognitive benefits, as well as regarding some key concepts – such as the idea that being multilingual does not create confusion in speakers' minds (Garraffa et al., 2020) – seem widely shared. However, at a deeper level, the expertise of humanities teachers appears to offer them an advantage, and these subjects show more positive perceptions, associated with proactive attitudes and a general orientation toward action. Regarding the more specific strategies and techniques adopted for multilingual education, humanities teachers' repertoire

shows to be also richer, involving both a higher number of languages and a more targeted inventory of educational strategies. On the one hand, technical-scientific teachers admit to primarily use English as a lingua franca for mutual understanding, in Content and Language Integrated Learning (CLIL), and in comparisons regarding the specific language of their disciplines. On the other hand, humanities colleagues introduce the students' native languages, Friulian, Latin, and the all the languages of instruction taught at school; they also invite to metalinguistic reflection activities, they use the students' native languages or dialects in order to engage and motivate them, they seek lexical or etymological comparisons, and in some cases propose more creative or autobiographical activities.

The findings of the present study, and the responses to the research questions, align with the primary bibliographic references (Sordella, 2015; Amenta & Turrise, 2017; as well as Alisaari et al. 2019; de la Maya Retamar et al. 2024 in the international context) and highlight generally positive perceptions of both students' multilingualism and the teacher's work in a multilingual classroom. However, certain aspects seem to merit further reflection, especially in the perspective of possible future educational interventions and professional requalification, in implementation of Italian ministry recommendations (MIS, 2022) and European guidelines (Beacco & Byram, 2007; Candelier et al., 2012; Council of Europe, 2018). Here, it might be interesting to consider how the beliefs, perceptions, and attitudes of humanities teachers diverge on more specific topics and in classroom communication and educational practices from those expressed by their colleagues in technical-scientific fields. While this divergence might be partially reconnected and attributed to the nature of the subjects taught, future teacher training interventions should nevertheless take this diversity into account.

What emerges with sufficient clarity, even from the relatively few responses to the open-ended question about multilingual activities introduced in the classroom, is a difficulty in translating descriptive concepts or beliefs into concrete educational actions. In other words, despite generally positive perceptions and attitudes regarding the benefits of multilingualism, there seems to be a lack of resources or perhaps just of the right ideas to translate these feelings into action (Sordella, 2015). As a concluding remark, the reviewed literature and the field data examined in these pages can provide some valuable suggestions for policymakers, trainers and future teachers' educators. First, the findings highlight the importance of a training that is more firmly rooted in everyday practice and that takes into account the reality of classroom work, therefore with a more authentic and situated approach (Amenta & Turrise, 2017). However, the effort should not end with teachers' entry into the national education system, but it should instead be considered as an ongoing, rather than occasional, commitment (Pulix et al. 2017; Bosch et al., 2025). The most immediate objectives could include, on the one hand, fostering a wider recognition of

multilingualism as a resource available to both teachers and their students (Amenta & Turrise, 2017; Alisaari et al., 2019), and on the other, investing part of the resources in developing a greater awareness and, consequently, more favorable attitudes toward the opportunities offered by multilingual the contemporary and future school environments, particularly for the individuals who still struggle to leave behind their monolingual ideology (Piccardo, 2019; de la Maya Retamar et al., 2024). Finally, as research and data are in line showing how the awareness of multilingualism, together with attitudes and beliefs, may differ from one group of teachers or school to another (Pulix et al., 2017), the professional training should consider these differences, in order to be able to address the specific needs of such a heterogeneous social group.

4.2 Limitations of the Study and Future Perspectives

The study described in these pages explores the perception of multilingualism in the initial teacher training from a point of view not so often addressed in the literature, which generally focuses more on reaching teachers already in service and with experience in multilingual classrooms. Even if the tool adopted, while using questions and structure borrowed from solid sources in the literature (Sordella, 2015; Amenta & Turrise, 2017; Li & Wei, 2023), has not undergone statistical testing and might therefore have collected information that is not always precise, the results seem to be consistent with existing external sources. Additionally, the analysis of both general perceptions towards multilingualism and more specific attitudes highlights a quite uniform orientation, especially when comparing the two subgroups of aspiring teachers from the humanities and technical-scientific fields.

The analysis of individual perceptions and attitudes can reveal beliefs and perspectives that are not easily noticed through direct observation (Garrett, 2010), and these aspects are nevertheless significant from the observer's point of view. Therefore, a possible future development of the investigation could involve a more thorough reworking of the data, with greater attention to statistical variation and significant correlations, as well as an extension of the data collection, possibly reaching teachers enrolled in the teacher training programs for the 60 CFU of the 2024/2025 academic year, this way enriching the database with new and directly comparable information. Furthermore, considering the orientation of some of the open responses provided to questions aimed at describing the individual and classroom linguistic repertoires, as well as those intended at exploring multilingual strategies already implemented by the aspiring teachers, it could be useful to turn to qualitative sociolinguistic research methods, such as semi-structured interviews or focus groups (Hennink, 2014; Corrao, 2020).

In conclusion, this study reveals that future teachers share sufficiently positive perceptions and attitudes towards the multilingualism of their students and

towards working in a multilingual environment. In line with many Italian ministerial recommendations and European guidelines, being multilingual and possessing a multilingual competence are considered enriching, offering advantages rather than posing obstacles, and can therefore become a valuable resource in order to promote diversity in educational contexts with high degree of social and cultural complexity. However, in comparison to the perspectives expressed by the students, some differences emerge, and in particular, there is a somewhat concerning discrepancy between the optimistic view of teachers and the fact that, on the contrary, some children and adolescents seem to have a more problematic view of their multilingual condition.

Regarding the comparison between the humanities and technical-scientific cohorts, while there is some general agreement, the different disciplinary focus and the training received seem to exert a greater influence when dealing with more specific linguistic concepts or when moving from the theoretical-descriptive level to the practical application in the classroom. These results, which invite further exploration due to the potential limitations of the study, could nonetheless suggest the need for more tailored professional training paths, focusing on specific aspects of multilingual competence and education. For example, it might be useful to invest energy and resources in targeted on the job programs, in order to offer the opportunity of bridging gaps and helping teachers who lack specific formation to contribute more effectively to the linguistic education of the children and adolescents in their classes, aiming for greater alignment not only with academic scientific literature but also, and especially, between colleagues from different and sometimes not enough communicating disciplinary fields.

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Collaborating to cross subject boundaries with digital technologies: designing a training plan through action research

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Abstract

This study aimed to understand teachers' conceptions and practices concerning collaborative work around planning pedagogical strategies with digital technologies. And to help design a training plan based on the F@R Model (Training-Action-Reflection). This is an innovative piece of work, in terms of methodology, in this area of study and intervention, and corresponds to the first of three action-research cycles designed. The participants were five teachers from the 2nd cycle of basic education in Portugal (equivalent to ISCED 2). Data collection was centred on interviews, with a focus on content analysis. In this study, the importance attributed by the participants to collaborative work, as well as to inter- and transdisciplinary practices, was verified. However, it turned out that these practices have only taken place informally and without planning. Structural and personal challenges and favourable factors for integrating digital technologies were highlighted. Difficulties related to access to technology were the main ones, with the highest number of references. The participants prioritised a collaborative and practical approach to training. In this way, it was confirmed that the approach followed was a promising strategy for planning the work to be done, which supported the design of the training plan.

KEYWORDS: Action Research, Collaboration among Teachers, Inter- and Transdisciplinary Pedagogical Strategies, Digital Technologies, Training Plan.

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1. Introduction

There has been a growing interest in learning processes associated with collaborative models, perhaps because organisations have been under some pressure to change and adapt to the times of digital development and curricular innovation. The answer to these challenges could be encouraging organisational learning, which has been seen as a component of school effectiveness

(Fernandes et al., 2022). In this sense, a constructivist approach is favoured, in which learning as a result of interaction among teachers is seen as a collective movement that is essential for the growth and progress of educational organisations.

At the same time, using digital technologies is seen as a means of amplifying meaningful pedagogical experiences, which the collaborative work of professionals with different disciplinary backgrounds can enhance. As Nóvoa and Vieira (2017) suggest, strengthening the collaborative dimension, through the joint intervention of teachers in the search for the best ways to act is an investment of paramount importance for building work networks and training practices. Also, in line with the idea of knowledge built in networks (Salgado et al., 2022), inter- and transdisciplinary pedagogical proposals appear as opportunities for teachers to reconfigure their practices to educate students from an integral perspective. The aim is to

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broaden the focus of pedagogical approaches in a holistic, integrative and meaningful way to prepare students for the challenges of the future (Atkinson-Toal, 2024).

This conjuncture is also set out in the European Framework for the Digital Competence of Educators (Lucas & Moreira, 2018; Redecker & Punie, 2017), which presents professional collaboration as one of the digital competences for educators in the context of professional engagement. It involves using digital technologies to collaborate with other teachers, share and exchange knowledge and experience, and innovate teaching practices in a collaborative way.

Despite the growing space that collaboration among teachers has taken on, and the diversity of work that validates its benefits (Bendtsen, et al., 2022; Díaz-Sacco & Muñoz-Salinas, 2024; Lavonen et al., 2020; Oliveira et al., 2020; Santos et al., 2019; Seabra et al., 2022; Valverde-Berrocoso et al., 2021), recent research reveals that teachers mainly work alone or in small groups, with collaborative experiences being limited to sharing ideas and teaching materials, and on ways to adopt common rules of operation. This pattern is opposed to other deeper dynamics of collaboration, which involve more interdependence among teachers, such as teamwork, reflection on practice, collaborative design of strategies, joint planning, and providing observation-based feedback to colleagues (Flores et al., 2025; OECD, 2020; Rempe-Gillen, 2018; Toikka & Tarnanen, 2022). On the other hand, the scarcity of studies linking collaborative practices among teachers with the planning of pedagogical strategies aimed at integrating digital technologies, particularly in Portugal, highlights the need for scientific production in this area (Lourenço et al., 2023).

To fill these gaps, this work, which is part of a broader research project, aims to contribute to a deeper understanding of how teachers collaborate and learn from each other in their professional contexts, fostering collaborative planning practices that aim to articulate the work of various subject areas with digital technologies.

In this sense, a training programme was planned to involve teachers in working together. Teachers are seen as agents of change, moving in different directions, and it is necessary to provide them with more or less structured moments of work and learning.

Following the F@R Model - Training-Action-Reflection (Costa & Viseu, 2008), one of the strategic objectives of the training is to help create a collaborative attitude among teachers, through communication and sharing, as well as joint reflection on the use of digital technologies.

In this respect, the study by Rodrigues (2020) observed an increase in the participants' technological competencies, as well as opportunities for them to create their own knowledge and reflect on their teaching practices. This emphasises the importance of developing professional development actions in the participants' practice, based on the context and structured holistically,

with a view to making significant changes (Bendtsen et al., 2022; Toikka & Tarnanen, 2022).

Therefore, it is assumed that through action research, each teacher can be a researcher and an observer of praxis, through a process centered on critical reflection and practices, which are the starting point for the emergence of possible theories (Coutinho, 2018; Efron & Ravid, 2013; Goodman et al., 2025; Stringer, 2007).

Although the process developed is part of a work plan comprising three cycles of action research (Diagnosis, Intervention and Evaluation), this article only describes the first one. Cycle I sought to understand the teachers' conceptions and practices before the actual training intervention. Cycle II set out to develop a training plan with the teachers, seeking to contribute to a deeper understanding of how teachers collaborate and learn from each other in their professional contexts, fostering collaborative planning practices that aim to articulate the work of the various subject areas with digital technologies. Cycle III aimed to analyse and understand the effects of the plan after six months of intervention.

2. Materials and Methods

This work is anchored in the assumptions of the qualitative and critical paradigms, with action research being the central methodological option. In this way, it aims to understand how participants construct and interpret their experiences, and what meanings and significance they attribute to them (Bogdan & Biklen, 1994; Creswell, 2007).

Like any participatory methodological approach, action research is a dynamic process that takes place with the collaboration of various actors (Kemmis et al., 2014; Stringer, 2007; Stringer, 2024). This study used action research to promote collaborative working dynamics, orientated towards planning pedagogical strategies that include integrating digital technologies in the classroom.

To operationalise the empirical component, the initial cycle, called 'Diagnosis', was guided by two research questions: 1) How do teachers perceive collaborative work with their peers in general and, in particular, when it comes to planning inter- and transdisciplinary pedagogical strategies?; and 2) To what extent and for what purposes do teachers use digital technologies in their teaching and learning practices, particularly when planning collaboratively? The answer to these questions followed a plan structured in four stages - Planning, Action, Observation and Reflection, as described below.

2.1 Planning

At this stage, we started by considering the participants to be involved, namely teachers from the 2nd cycle of basic education in Portugal, corresponding to the International Standardised Classification of Education - Level 2 (ISCED 2), which covers students aged 10-12. As a selection criterion, they had to be from the same

subject group and cover at least two of the subjects Mathematics, Natural Sciences and Citizenship and Development, using an interdisciplinary logic.

It was essential to collect evidence through diagnostic interviews, planning, informal conversations and field diaries, the latter two being complementary information-gathering processes. However, the work here focuses exclusively on analysing the interview. The choice of a semi-structured interview (Amado, 2014) seemed the most appropriate given the diagnostic function inherent in this cycle. To this end, an interview script was devised.

2.2 Action

The invitation to participate in the study was launched at this stage, and five teachers accepted. Data was collected on the characterisation of the participants, with four aged between 41 and 50 and one aged between 26 and 30. In terms of gender, four were female, and one was male. In terms of teaching experience, three had between 7 and 25 years of experience and two between 1 and 3. Regarding academic qualifications, four had a bachelor's degree and one a master's degree. About the years they had been at the same school, two had been there for up to a year, two for between 1 and 3 years, and one for more than 10 years.

At the same time, the research questions were aligned with the planned interview script. Which was operationalised in thematic blocks, objectives, and questions/guidelines. To validate the script, a pilot interview was conducted with a teacher who was not included in the study but whose profile was similar to that of the participants. This instrument underwent a series of revisions and was supported by the scientific coordination team, whose role can be likened to that of judges (Huberman & Miles, 1991).

Once validated by the experts, the interview script was organised into six thematic blocks (Appendix A). The interviews were conducted with five participants online using the *Zoom* platform, recorded and transcribed for interpretation and analysis.

The transcripts were emailed to the participants for ratification, and only one teacher asked to add a sentence to his speech, which was granted.

2.2.1 Ethical issues

This study complied with the General Data Protection Regulation (GDPR), in accordance with Law n. 58/2019 of 8 August (Diário da República, n. 151/2019, Serie I), in line with European Union regulations. In this regard, the participants were asked for their free, informed consent; authorisation was also requested from the institution where the research took place; and an advisory authorisation was sought from the Ethics Committee, which after analysis, considered that the ethical principles, as well as the ethical guidelines for research, are respected.

2.3 Observation

This stage supported the analysis and understanding of the information gathered in the previous stage, favouring content analysis (Bardin, 2011; Esteves, 2006). A matrix was drawn up and dimensions of analysis emerged, and in a linear sequence, each dimension was broken down into categories and each category into indicators. The matrix evolved (Huberman & Miles, 1991) and included categories in line with the literature reviewed and new emerging categories, which were validated by three experts.

This stage culminated in a plan organised into four analytical dimensions: Collaborative work; Inter- and transdisciplinary practices; Integration of digital technologies; and Expectations and suggestions. In turn, 16 categories of analysis and 46 indicators were identified. This content analysis plan can be found in a table in the Appendix B.

2.4 Reflection

In the 'reflection' stage, we started with the material gathered and systematised, and opted to carry out an interpretative, inductive and descriptive analysis of the interview data (Bogdan & Biklen, 1994; Creswell, 2007). The content was analysed using categories and frequencies. For ethical reasons, the five participants were identified by codes, consisting of the capital letters A, B, C, D and E.

For each dimension of analysis, the results were organised in frequency distribution tables - absolute (N) and relative (%), of the units of meaning (UM) by category and indicator. The table was also structured considering the position of each of the participants (P - Participants).

For each category of analysis, by dimension, the distribution of coded units of meaning was also analysed Absolute frequency (N), and the respective percentages, by indicator, in relation to the overall total of indicators Relative frequency (%). The relative frequency (%) shown in the 'UM' column (units of meaning) was calculated by reference to the partial total of units of meaning (N Partial total), by category. The relative frequency (%) shown in the 'P' column was calculated by reference to a total of five participants.

3. Results

From an action research perspective, the results were derived from the processing of data carried out throughout the research process, inform subsequent cycles. It therefore resulted in four dimensions, as mentioned above.

3.1 Collaborative work

Regarding how teachers think about, define and value collaborative work, this dimension was organised into five categories: 'understanding', 'valuing',

‘implications’, ‘applications’ and ‘effects at school level’. Table 1 shows the distribution of meaning units.

With regard to the distribution of units of meaning by category, the analysis revealed that the majority of participants (N=5) presented views related to ‘understanding’ the concept of collaborative work (with 35.82% of the total references), followed by aspects related to ‘implications’, which refer to changes and gains on a personal level (with 22.39% of the references), and closely followed by aspects related to ‘applications’, which translate into changes in working practices and methods (20.90% of the references). The remaining references, fewer in number, were grouped together in the ‘valuing’ category (with 13.43%), and in the ‘effects at school level’ category (with 7.46% of the references). Teachers’ perceptions about the ‘understanding’ category, were mainly related to the understanding given to collaborative work as ‘sharing’ (45.83% of references). This was followed by references to ‘joint work’ (33.34%). Also noteworthy, with 20.83%, were the references to collaborative work as ‘learning’. In the five interviews, references (units of meaning) were found to collaborative work as ‘sharing’ and ‘joint work’. Four participants also highly emphasised collaborative work as ‘learning’ (80%).

In the ‘valuing’ category, the importance of collaboration among teachers was emphasised (100% of references in this category). All the participants (100%) gave indications that referred to ‘valuing collaboration’.

In the ‘implications’ category, references to gains in terms of ‘self-reflection’ stood out (with 26.67% of references), on par with references to ‘mutual influence’ (26.67%). This was followed by references to ‘professional knowledge’ (20%). The remaining references, fewer in number, were related to gains in terms of ‘trust’ and ‘motivation’ (both 13.33%). Most participants, four of them (80%), emphasised ‘self-reflection’. ‘Mutual influence’ and ‘professional knowledge’ were other implications highlighted by three participants (both 60%), as were ‘trust’ and ‘motivation’, which were mentioned by only two (40%).

In the ‘applications’ category, references to changes in terms of the ‘time organisation’ necessary for the use of digital technologies stood out (42.85%). This was followed by changes in terms of diversifying ‘work strategies’ (with 28.57% of references). In smaller numbers, the remaining references related to changes in terms of ‘space organisation’, and to contributions to supporting the transition to ‘new pedagogical approaches’ (14.29% in both cases). References to changes in terms of ‘time organisation’ were mentioned by four participants (80%). ‘work strategies’ were also emphasised by three participants (60%). The indicators ‘new pedagogical approaches’ and ‘space organisation’ were mentioned by two participants (40% in both cases).

Although fewer references were made, the ‘effects at school level’ category emerged, referring to ‘improving results’ (with 60% of references). On the other hand, they pointed to ‘initiatives’ seen in terms of the school

itself (with 40%). We should also highlight the emergence of the indicators ‘initiatives’ and ‘improving results’, which were mentioned by two teachers (both with 40%).

3.2 Inter- and transdisciplinary practices

This dimension resulted in four categories: ‘curriculum articulation’, ‘planning’, ‘challenges’ and ‘favourable factors’. Table 2 shows the distribution of units of meaning regarding work strategies, challenges and favourable factors.

In terms of the distribution of meaning units by category, the participants mostly addressed aspects related to ‘challenges’ (with 47.92% of references). This was followed by views related to ‘curriculum articulation’ (with 27.08% of references). The remaining references, fewer in number, were grouped in the ‘favourable factors’ category (with 18.75%), and in the ‘planning’ category (with 6.25% of the references).

About the category ‘curriculum articulation’, the participants made a lot of reference to aspects related to ‘articulation among subjects’ (with 76.92% of the references); ‘articulation within the subject group’ was also mentioned, but to a lesser extent (with 23.08% of references). All five participants (100%) emphasised ‘articulation among subjects’. Three participants (60%) also emphasised ‘articulation within the subject group’.

Regarding the ‘planning’ category, only references to ‘planning’ appeared (100% of references). The emergence of this indicator was noteworthy, although it was only mentioned by two teachers (40%).

Regarding the ‘challenges’ category, teachers’ perceptions referred to challenges related to ‘time’ (43.48% of references). This was followed by references to challenges arising from individual ‘attitudes’ in establishing interpersonal relationships (30.43%), and there were also challenges that referred to the ‘specificities of each class’ (26.09% of references). In this category, the most prominent difficulties were related to ‘attitudes’ and the ‘specificities of each class’, both of which were mentioned by four of the participants (80%). The ‘time’ factor was mentioned by three participants (60%).

In the ‘favourable factors’ category, references to the ‘working environment’ (55.56% of references) stood out, followed by ‘co-teaching’, where two teachers are in the classroom (with 33.33% of references). Fewer references were made to ‘remote working’ (11.11%). The potential of the ‘working environment’ and the role of ‘co-teaching’ were emphasised by three teachers (60% in both cases).

It should also be noted, although only mentioned by one teacher (20%), that ‘remote working’ was highlighted as a facilitator of inter- and transdisciplinary practices. As for the indicators most often mentioned by the participants in this category, the ‘articulation among subjects’ (N=5), ‘attitudes’ (N=4) and ‘specificities of each class’ (N=4) stood out.

Table 1 – Distribution of meaning units relating to the ‘Collaborative work’ dimension. Source: Elaborated by the authors.

Categories	Indicators	Participants					UM		P	
		A	B	C	D	E	N	%	N	%
1.1. Understanding	1.1.1. Sharing	4	2	2	2	1	11	45.83%	5	100%
	1.1.2. Learning	1	1	2	1	0	5	20.83%	4	80%
	1.1.3. Joint work	2	1	3	1	1	8	33.34%	5	100%
	Partial total						24	35.82%	-	-
1.2. Valuing	1.2.1. Valuing collaboration	2	2	2	2	1	9	100%	5	100%
	Partial total						9	13.43%	-	-
1.3. Implications	1.3.1. Self-reflection	1	1	0	1	1	4	26.67%	4	80%
	1.3.2. Trust	1	0	1	0	0	2	13.33%	2	40%
	1.3.3. Motivation	1	0	0	1	0	2	13.33%	2	40%
	1.3.4. Mutual influence	1	1	0	2	0	4	26.67%	3	60%
	1.3.5. Professional knowledge	1	1	1	0	0	3	20%	3	60%
	Partial total						15	22.39%	-	-
1.4. Applications	1.4.1. New pedagogical approaches	0	0	1	1	0	2	14.29%	2	40%
	1.4.2. Work strategies	2	1	1	0	0	4	28.57%	3	60%
	1.4.3. Space organisation	1	1	0	0	0	2	14.29%	2	40%
	1.4.4. Time organisation	1	0	1	2	2	6	42.85%	4	80%
	Partial total						14	20.90%	-	-
1.5. Effects at school level	1.5.1. Initiatives	1	0	1	0	0	2	40%	2	40%
	1.5.2. Improving results	0	1	0	2	0	3	60%	2	40%
	Partial total						5	7.46%	-	-
	Grand total						67	100%	-	-

Table 2 – Distribution of meaning units relating to the ‘Inter- and transdisciplinary practices’ dimension. Source: Elaborated by the authors.

Categories	Indicators	Participants					UM		P	
		A	B	C	D	E	N	%	N	%
2.1. Curriculum articulation	2.1.1. Articulation among subjects	2	4	1	1	2	10	76.92%	5	100%
	2.1.2. Articulation within the subject group	1	1	0	0	1	3	23.08%	3	60%
	Partial total						13	27.08%	-	-
2.2. Planning	2.2.1. Planning	2	0	0	1	0	3	100%	2	40%
	Partial total						3	6.25%	-	-
2.3. Challenges	2.3.1. Attitudes	3	2	1	1	0	7	30.43%	4	80%
	2.3.2. Time	0	1	5	0	4	10	43.48%	3	60%
	2.3.3. Specificities of each class	1	0	2	2	1	6	26.09%	4	80%
	Partial total						23	47.92%	-	-
2.4. Favourable factors	2.4.1. Working environment	1	0	2	2	0	5	55.56%	3	60%
	2.4.2. Co-teaching	1	1	0	1	0	3	33.33%	3	60%
	2.4.3. Remote working	0	1	0	0	0	1	11.11%	1	20%
	Partial total						9	18.75%	-	-
	Grand total						48	100%	-	-

3.3 Integration of digital technologies

Given the results, this dimension was organised into four categories: 'attitudes', 'use', 'potential' and 'challenges'. Table 3 shows the distribution of meaning units about teachers' use of digital technologies, their use, potential and challenges.

About their experiences of using digital technologies, most of the participants (N=5) responded in terms of 'challenges' (with 50.57% of the total references). In second place came mentions of the aims and objectives of these practices ('use' category), with 26.44% of the references. This was followed by references to the 'potential' of digital technologies (with 13.79% of references). With a residual value of just 9.20%, references to attitudes towards digital integration emerged (category 'attitudes').

Regarding the 'attitudes' category, references to teachers' 'attitudes' towards digital integration stood out (100% of the total references in this category) and come from the discourse of the five interviewees (100% of the teachers).

In the 'use' category, references to the use of digital media to work on 'curriculum content' and to develop 'transversal competences' (both with 39.13% of references) stood out in equal measure. In the first case, the references came from the discourse of five participants (100% of the teachers). In the second case, they came from four of them (80%). Also noteworthy, with 21.74% of the references to 'use', is the view that expresses the use of digital technologies as a 'motivational' purpose, presented by four participants (80%).

In the category 'potential' of digital technologies, aspects of 'pedagogical innovation' (41.67% of the references in this category), 'motivation' students to learn (33.33% of the references) and 'integral development' (25% of the references) were highlighted, each resulting from the discourse of three participants (60%).

In the 'challenges' category, most of the constraints encountered were at the level of 'access to technology' due to limited access to equipment (43.18% of all references in this category), mentioned by all the participants. Some distance away, there were references to challenges around the 'vision of digital technologies' at pupil level (13.64% of references), in the discourse of three participants (60%). This was followed by challenges relating to 'time management' and challenges relating to 'school strategies', both with 11.36% of references. In the first case - 'time management' - the references came from the discourse of all the participants (100%). In the second case - 'school strategies' - the references came from the words of four teachers (80%).

The indicators 'teachers' knowledge', which refers to the degree to which teachers are aware of digital technologies (9.10% of references), and 'support' (6.82% of references), both found in the speeches of two

participants (40%), had lower values, but were very close.

Although fewer references were made, the emergence of challenges relating to 'resource selection' and challenges relating to 'technological progress' were noteworthy, both with 2.27% of references in this category, and mentioned by the same teacher (corresponding to 20% of participants in both cases).

3.4 Expectations and suggestions

This dimension was organised into three categories: 'pedagogical aspects', 'social aspects' and 'organisational aspects'. Table 4 shows the distribution of meaning units, which reflect the results on expectations and suggestions for the training intervention.

Most teachers mentioned 'social aspects' (with 47.62% of the total number of references), although this was closely followed by 'pedagogical aspects' (30.95% of references) and to a lesser extent, 'organisational aspects' (21.43% of references).

In terms of pedagogical aspects, the teacher's expectations for a 'link to the curriculum' (53.85% of all pedagogical references) were most visible in the speeches of four participants (80% of them). This was followed by references to expectations regarding the 'diversification of strategies' that digital can enable (30.77%), made by two participants (40% of the participants). Also noteworthy were the references to expectations of 'pedagogical isomorphism' (15.38%), expressed by two participants (40% of participants).

In the social category, the teachers' expectations regarding 'professional development' in context (45% of all social references) were the main ones, which were accepted by all (100% of the participants). This was followed by expectations of 'collaboration with colleagues' (35% of the references), presented by four participants (80% of the participants). The remaining references, fewer in number (20%), were related to suggestions for implementing school dynamics with digital (indicator 'stimulus'), from the speeches of three teachers (60% of the participants).

In the organisational category, suggestions related to the indispensability of access to 'equipment' stood out (100% of all organisational references), made by three participants (60%).

4. Discussion

To address the question -'How do teachers perceive collaborative work with their peers in general and, in particular, when it comes to planning inter- and transdisciplinary pedagogical strategies?', the results revealed the value placed on collaborative work by the teachers themselves. They considered it essential, a form of development where, together, they can plan, observe and reflect on practices (Flores et al., 2025; Remp-

Table 3 – Distribution of meaning units relating to the ‘Integration of digital technologies’ dimension. Source: Elaborated by the authors.

Categories	Indicators	Participants					UM		P	
		A	B	C	D	E	N	%	N	%
3.1. Attitudes	3.1.1. Attitudes	2	1	1	2	2	8	100%	5	100%
Partial total							8	9.20%	-	-
3.2. Use	3.2.1. Curriculum content	3	2	1	1	2	9	39.13%	5	100%
	3.2.2. Transversal competences	1	2	5	0	1	9	39.13%	4	80%
	3.2.3. Motivational	1	1	0	1	2	5	21.74%	4	80%
Partial total							23	26.44%	-	-
3.3. Potencial	3.3.1. Pedagogical innovation	3	0	1	0	1	5	41.67%	3	60%
	3.3.2. Motivation	2	0	0	2	0	4	33.33%	3	60%
	3.3.3. Integral development	0	1	1	1	0	3	25%	3	60%
Partial total							12	13.79%	-	-
3.4. Challenges	3.4.1. Access to technology	5	3	1	3	7	19	43.18%	5	100%
	3.4.2. Support	1	0	0	2	0	3	6.82%	2	40%
	3.4.3. Teacher' knowledge	0	1	3	0	0	4	9.10%	2	40%
	3.4.4. Resource selection	0	0	1	0	0	1	2.27%	1	20%
	3.4.5. Technological progress	0	0	1	0	0	1	2.27%	1	20%
	3.4.6. Time management	1	1	1	1	1	5	11.36%	5	100%
	3.4.7. School strategies	1	0	1	1	2	5	11.36%	4	80%
	3.4.8. Vision of digital technologies	2	3	0	0	1	6	13.64%	3	60%
Partial total							44	50.57%	-	-
Grand total							87	100%	-	-

Table 4 – Distribution of meaning units relating to the ‘Expectations and suggestions’ dimension. Source: Elaborated by the authors.

Categories	Indicators	Participants					UM		P	
		A	B	C	D	E	N	%	N	%
4.1. Pedagogical aspects	4.1.1. Link to the curriculum	3	2	1	1	0	7	53.85%	4	80%
	4.1.2. Diversification of strategies	3	1	0	0	0	4	30.77%	2	40%
	4.1.3. Pedagogical isomorphism	0	0	1	1	0	2	15.38%	2	40%
Partial total							13	30.95%	-	-
4.2. Social aspects	4.2.1. Collaboration with colleagues	1	3	2	0	1	7	35%	4	80%
	4.2.2. Professional development	2	1	2	2	2	9	45%	5	100%
	4.2.3. Stimulus	0	0	1	2	1	4	20%	3	60%
Partial total							20	47.62%	-	-
4.3. Organisational aspects	4.3.1. Equipment	6	0	0	1	2	9	100%	3	60%
Partial total							9	21.43%	-	-
Grand total							42	100%	-	-

Gillen, 2018). They also saw it as an exchange of knowledge and experiences, acting as a mutual influence and an opportunity for critical reflection (Flores et al., 2025; Kellner & Attorps, 2024; Nipyrakis et al., 2023).

In addition, collaborative practices have been seen as effective in building professional knowledge (Calderón & Tannehill, 2021; Carroll et al., 2023; Díaz-Sacco & Muñoz-Salinas, 2024); Gueudet et al., 2021; Hendrickx et al., 2025; La Fleur & Dlamini, 2022; Lavonen et al., 2020). And also, a contribution to promoting self-efficacy, in line with the classic work of Rosenholtz (1991) and more current literature (Calderón & Tannehill, 2021; Carroll et al., 2023; Sexton, 2020), as well as enhancing motivation, as participant D said:

...I think that when we work collaboratively we also motivate each other, and I think this is extremely important, because if a teacher doesn't feel motivated, then a lot of things won't go well. I'm talking a bit about myself, aren't I? If I'm not motivated, fortunately I always am. And I think that working collaboratively also helps us in this sense, it also motivates us. Because if I can't find a solution to a problem. If my colleague works collaboratively with me, and helps me in that sense, the work will flow and go better. (pp. 7-8)

The definitions attributed to collaborative work were based on sharing, joint work and learning, and were identified with the seminal study by Little (1990). In terms of effects, the association between improved student results and pedagogical innovation initiatives is noteworthy.

Inter- and transdisciplinary practices have been valued, and there has been a conscious effort to integrate various disciplines into projects, valuing the integration of different types of knowledge (Leite & Relvas, 2022; Salgado et al., 2022).

In turn, structural and personal challenges and favourable factors for inter- and transdisciplinary practices were revealed. The most significant challenges are related to the organisation of time within the curriculum structure, which translates into limited time for collaborative practices (Green, 2024; La Fleur & Dlamini, 2022).

As for favourable factors, they revealed the existence of a good working environment, as well as co-teaching and remote working. Co-teaching, with the presence of two teachers in the classroom, was seen as facilitating these practices, as exemplified in participant A's speech:

...it's much easier for two teachers to be able to carry out this activity than just one, because having a group of twenty students with ten or fifteen computers, and only one teacher, becomes very complicated, due to the dynamics that the activity itself requires... (pp. 2-3)

It was recognised that digital tools could be essential resources for overcoming time constraints and promoting communication among teachers and online collaboration, as participant B expressed it:

The factors... The conditions, the conditions we have, not physical, but through Zoom, through e-mail, through computer programmes, through Teams, there are many ways, there are many things that can contribute to this collaborative work, even if we're not there. (p. 6)

In relation to the question 'To what extent and for what purposes do teachers use digital technologies in their teaching and learning practices, particularly when planning collaboratively?', it was observed that digital technologies were integrated for various aims, such the consolidation of curricular content, the development of transversal competences and motivational issues.

As for opportunities, the transition from traditional teaching methods to innovative methodologies stood out. And challenges were observed, mainly in terms of access to technologies, as participant B revealed:

The use of technology can also be a challenge, because the material isn't always available, isn't always the most appropriate, isn't always easily accessible. Sometimes it's a challenge. And the conditions themselves, the state of the equipment, the computer equipment, is also sometimes a big challenge. And there are some limitations, like today, for example, I had to change a lesson because the projector went down, I couldn't project anymore. (pp. 6-7)

The initial questions also guided the expectations and suggestions for the training intervention, where the teachers prioritised a collaborative and practical approach to training. The model was expected to be centred on digital technologies are closely connected to the curriculum. Also noteworthy is the intention of pedagogical isomorphism, in the sense of transposing the learning that came from the collaborative training context into the classroom. The expectations of professional development in context were unanimously confirmed.

Finally, the teachers suggested that we should discuss together how school organisations could ensure access to the equipment needed to work with digital technologies. One solution was to provide places in the school to store students' personal computers safely.

5. Conclusions

This work analysed the main aspects for understanding teachers' conceptions and practices in relation to collaborative work, around the planning of pedagogical strategies with digital technologies. This helped support

the design and refinement of a training plan to be implemented in the next action research cycle.

The teachers valued collaborative work, as well as inter- and transdisciplinary practices. However, there is a need for intervention, as it was found that these practices have only taken place informally. What's more, the development of pedagogical strategies needs proper planning, with formality and regularity.

As for the integration of digital technologies, it was discovered that the presence of two teachers in the classroom is essential for working together. In this way, it was emphasised that the planning and implementation of strategies of this nature is facilitated with the direct collaboration of another teacher, which could be a determining condition for the continued integration of these tools. This is in line with the work of Valverde-Berrosco et al. (2021), who concluded that mutual support among teachers facilitates innovation with digital technologies.

For future applications, at the level of school organisation, it is suggested that co-teaching time be considered for inter- and transdisciplinary projects with digital technologies. The proposal is that there should be regular monitoring by a teacher who would become the project coordinator, in some cases taking on the role of e-tutor, to support the integration of digital tools.

The conclusions made it possible to gather information to design the training plan, and to rethink teacher training in the light of changes towards digital development and curricular innovation.

The main limitation of these conclusions is the small number of teachers interviewed, and it is suggested that future studies extend the research to other participants.

As a final point, we would like to emphasise that this study responds to the movement between contextual needs and global trends, showing that reflection in training processes can lead to new needs and new depths, and serve as a lever for social change.

Datasets and reproducibility

The analysis data will be made available to other researchers who wish to replicate the study, upon request, in accordance with the document submitted, and with a favourable opinion from the Ethics Committee.

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Appendix A - Diagnostic Interview Guide (semi-structured interview)

Blocks	Interview objectives	Questions/guidelines
Block 1 Legitimising the interview	- Create a favourable environment for the interview and emphasise the importance of the interviewee's participation in the study.	- Inform the interviewee about the subject and objectives of the interview. - Emphasise the importance of their contribution to the development of the research.
Block 2 Forms of collaboration	- To explore how teachers define and value collaborative work in general terms and in the context of planning pedagogical strategies.	- In very general terms, what comes to mind when we talk about collaborative work among teachers? - How do you see collaborative work among teachers, particularly when it comes to planning pedagogical strategies? What importance do you attach to it? - What place does collaboration among teachers occupy in your school? What forms of collaboration are practised? Can you describe a practice? - Under what circumstances do the collaborative practices you mentioned take place? - How do you see yourself in the collaborative practices in which you participate?
Block 3 Inter- and transdisciplinary pedagogical strategies	- To identify practices, strategies and challenges faced by teachers when working on pedagogical planning, individually and/or collectively, verifying what is done specifically in the inter- and transdisciplinary field.	- What is your experience of planning teaching strategies in collaboration with other teachers? Can you share a specific practice in which you have collaborated with other teachers to plan inter- or transdisciplinary teaching strategies? - What do you see as the potential of collaboration among teachers when it comes to jointly planning teaching strategies? And what are the challenges arising from these practices? - What factors could be favourable to collaboration among teachers in the context of joint planning of teaching strategies? And what are the factors that hinder or prevent these practices?
Block 4 Integration of digital technologies	- Recognise teachers' experiences of using digital technologies in their teaching and learning practices, especially in the collaborative context of pedagogical planning, including the aims and objectives of these practices.	- How would you describe the importance and usefulness of digital technologies in the context of teaching and learning practices? - What digital technologies do you usually use in your professional context? - What kind of use do you make of digital technologies in your teaching practices? What are your practices with digital tools? - What aims and objectives do you try to achieve when using digital technologies, especially in collaborative planning practices? - When planning inter- or transdisciplinary teaching strategies, how do you think we could consider using digital technologies? - What potential, difficulties and/or challenges do you see in integrating digital tools into teaching and learning practices? - What problem situations do you identify (or have you experienced) when planning pedagogical strategies aimed at integrating digital technologies into student learning?
Block 5 Expectations and suggestions	- To consider needs, desires and suggestions for change related to the curricular integration of digital technologies in the planning of inter- and transdisciplinary pedagogical strategies.	- In a training context, what issues would you like to see addressed during this project, related to the curricular integration of digital technologies in the planning of inter- and transdisciplinary pedagogical strategies? - What specific needs do you feel when integrating digital technologies into the planning of pedagogical strategies? - What are your main wishes or expectations regarding the curricular integration of digital technologies in this context? - What suggestions or ideas do you have for improving the effectiveness or efficiency of integrating digital technologies into inter- and transdisciplinary pedagogical planning? - What learnings, developments and/or changes do you hope to achieve by taking part in this research project?
Block 6 Finalising the interview	- To capture the meaning that the interviewee attributes to carrying out this research.	- What do you think this research can bring you? - Is there anything you'd like to add that hasn't been covered here?

Source: Elaborated by the authors

Appendix B - Content analysis plan for the diagnostic interview

Dimensions	Categories	Indicators
1. Collaborative work	1.1. Understanding	1.1.1. Sharing
		1.1.2. Learning
		1.1.3. Joint work
	1.2. Valuing	1.2.1. Valuing collaboration
	1.3. Implications	1.3.1. Self-reflection
		1.3.2. Trust
		1.3.3. Motivation
		1.3.4. Mutual influence
		1.3.5. Professional knowledge
	1.4. Applications	1.4.1. New pedagogical approaches
		1.4.2. Work strategies
		1.4.3. Space organisation
		1.4.4. Time organisation
	1.5. Effects at school level	1.5.1. Initiatives
		1.5.2. Improving results
2. Inter- and transdisciplinary practices	2.1. Curriculum articulation	2.1.1. Articulation among subjects
		2.1.2. Articulation within the subject group
	2.2. Planning	2.2.1. Planning
	2.3. Challenges	2.3.1. Attitudes
		2.3.2. Time
		2.3.3. Specificities of each class
	2.4. Favourable factors	2.4.1. Working environment
		2.4.2. Co-teaching
		2.4.3. Remote working
	3. Integration of digital technologies	3.1. Attitudes
3.2. Use		3.2.1. Curriculum content
		3.2.2. Transversal competences
		3.2.3. Motivational
3.3. Potencial		3.3.1. Pedagogical innovation
		3.3.2. Motivation
		3.3.3. Integral development
3.4. Challenges		3.4.1. Access to technology
		3.4.2. Support
		3.4.3. Teacher' knowledge
		3.4.4. Resource selection
		3.4.5. Technological progress
		3.4.6. Time management
	3.4.7. School strategies	
	3.4.8. Vision of digital technologies	
4. Expectations and suggestions	4.1. Pedagogical aspects	4.1.1. Link to the curriculum
		4.1.2. Diversification of strategies
		4.1.3. Pedagogical isomorphism
	4.2. Social aspects	4.2.1. Collaboration with colleagues
		4.2.2. Professional development
		4.2.3. Stimulus
	4.3. Organisational aspects	4.3.1. Equipment

Source: Elaborated by the authors

Teacher training for the future: insights from a Needs Analysis on Digital Technologies and Artificial Intelligence

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Abstract

This study aims to contextualize the pressing need for an updated framework in teacher training that responds to rapid technological advancement, particularly in Artificial Intelligence (AI), and the resulting shifts in educational practices. In today's evolving landscape, teachers are expected to increasingly adopt the role of facilitators, guiding students in a learning process that is responsive to digital innovation and interdisciplinary knowledge. Consequently, the structure of teacher training must be realigned to prioritize students' needs and core learning objectives of digital literacy. This contribution provides an in-depth analysis of the skills and competencies currently required by educators to effectively fulfill this evolving role. Through a comprehensive survey, the authors investigated the training needs of a sample of teachers, with a particular focus on digital literacy and Artificial Intelligence. The data gathered highlight the gaps and opportunities within existing training programs, offering insights that are essential for adapting teacher education to align with the demands of a digitally driven student-centered educational environment. The paper concludes with a reflection on the implications of these findings for future teacher training programs, emphasizing the necessity of a flexible, context-responsive, and technology-integrated training framework to equip educators with constructive, meaningful, and future-oriented learning.

KEYWORDS: Teacher Training, Artificial Intelligence, Student-Centered Learning, Digital Literacy, Educational Innovation.

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1. Introduction

In recent years, the educational landscape has undergone profound transformations driven by the rapid evolution of digital technologies and Artificial Intelligence (AI).

Digital literacy has emerged as a fundamental competency critical for navigating the demands of contemporary professional and societal contexts. As technological advancements reshape industries, most professions require continuous upskilling to effectively integrate these innovations. This aligns with the directive to develop the skills required for green and

digital transitions through education, training, upskilling, and reskilling (Council of Europe, 2023, p. 1). Additionally, The European Pillar of Social Rights Action Plan proposes clear targets for adult participation in training (60% by 2030), including digital skills (European Commission, 2021). Accordingly, the need for both digital and AI literacy among educators has become increasingly urgent.

Teachers, as key facilitators of learning, must not only foster innovative pedagogical practices but also play a crucial role in promoting digital literacy and AI literacy, as well as through the critical implementation of AI within formal educational contexts. The importance also relies on countering, among students, the proliferation of disinformation and promoting its ethical and responsible use (European Commission, 2022).

From this perspective, a fundamental framework for the development and assessment of digital skills is the Digital Competence Framework for Citizens (DigComp), which serves as a key reference for educational, training, and certification initiatives (Vuorikari et al., 2022). Similarly, the Council

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Recommendation on improving the provision of digital skills and competences in education and training (Council of Europe, 2023) identifies confident, critical, and responsible use of digital technologies as a key competence essential for education, work, and societal participation. Teaching digital literacy in educational settings is crucial for preparing students for active engagement in today's society, with content tailored to learners' levels and aligned with the learning objectives of digital literacy (European Commission, 2022, pp. 22-23).

The Commission's Digital Education Action Plan 2021-2027 (European Commission, 2020a) outlines Europe's strategy for education in the digital age, identifying the development of digital skills and competencies as a strategic priority. A sound understanding of the digital world is particularly significant in the context of the ongoing digital transformation and growing impact of emerging AI-driven tools, highlighting the need for education and training institutions to prepare individuals for the responsible use of technology, grounded in a clear understanding of its functioning.

To achieve this objective, in Strategic Priority 1 (European Commission, 2020a), digital competence is identified as a core skill for all educators and training staff, integrating it into every aspect of teachers' professional development, including initial teacher education. The plan recognizes teachers as key players in promoting an understanding of emerging technologies and their applications in education, developing ethical guidelines for AI, and emphasizing the essential need for training in digital skills, including digital teaching methods.

As advanced technologies and AI become deeply embedded in society and educational settings, they drive fundamental changes in pedagogical practices and redefine the role of the teacher. This shift demands a rethinking of teacher training paradigms, moving away from traditional content-focused models toward more dynamic, learner-centered, and technology-integrated approaches.

In this evolving context, the role of the teacher has transitioned from that of a knowledge transmitter to a facilitator of learning, a collaborative knowledge producer and a guide to citizenship in the era of AI (UNESCO, 2024c).

In this regard, the Six Pillars for the Digital Transformation of Education framework (UNESCO, 2024b) serves as a key reference point for implementing a digital shift aligned with global standards and international education objectives, particularly Sustainable Development Goal 4 (SDG4).

The process of digital transformation in education should be needs-driven and purpose-oriented, guided by principles that prioritize human-centered, ethical, sustainable, and future-oriented applications of technology in educational contexts. In particular, the Capacity and Culture Pillar focuses on the digital competencies, skills, attitudes, and mindsets of education stakeholders that are necessary for navigating

digital transformation in education and beyond. It encompasses the technical ability to use digital tools, manage transformation initiatives, and critically assess the social and environmental impacts of digital technologies. Additionally, it addresses stakeholders' perceptions and expectations of technology use in education, emphasizing growth mindsets and openness to innovation (UNESCO, 2024b, p. 15).

Competencies and mindsets stand out among the components of the Capacity and Culture Pillar. These have a crucial role in developing the digital and hybrid pedagogical competencies of teachers through pre- and in-service training and continuous professional development opportunities (UNESCO, 2024b, p. 17). The importance lies in the need to address resistance to using technologies in educational processes, which represents one of the key barriers hindering the positive social impact of digital transformation in education.

Despite a growing interest in integrating digital tools into teaching, learning, and administrative processes, nearly half of the countries lack digital skills standards, and only a small number have incorporated AI and data competencies into national curricula. Globally, there remains asymmetry in capacity and low digital literacy, hindering the meaningful use of these technologies in education (UNESCO, 2024a).

The OECD Teaching and Learning International Survey (TALIS) (OECD, 2019), the largest international study conducted every five years to examine learning environments and the working conditions of teachers and school leaders, provides valuable insights into teacher training. The survey revealed that during their education and training, teachers predominantly received instruction on subject content, pedagogy, classroom practice, student behavior, and classroom management, with these areas included in the training of 72% of the participating teachers. However, less emphasis was placed on the use of information and communication technology (ICT) for teaching (56%). Once teachers completed their initial preparation and began their professional practice, only 38% participated in formal or informal induction at their first school.

Despite this, teachers reported that the areas in which they require the most additional training are the development of advanced ICT skills, teaching in multicultural and multilingual contexts, and teaching students with special needs, highlighting the need for digital and inclusive training.

With specific reference to AI, recent studies (Isidori et al., 2024) have highlighted teachers' limited understanding of its tools and potential in education. Further research (Rott et al., 2022) has investigated the needs and requirements for additional AI qualifications among apprentices and teachers, building on a foundational theoretical framework of AI.

Teacher training in Italy has traditionally followed a standardized lecture-based model that emphasizes subject-specific expertise and pedagogical theory. However, in contemporary educational landscapes,

these traditional approaches are increasingly inadequate for equipping educators to address the complexities of modern classrooms. The influence of digital progress is driving a shift towards what has been termed the post-method era (Kumaravadivelu, 2001), a pedagogical approach that transcends rigid methodologies, advocating instead for flexible, context-responsive, and student-centered teaching practices.

In this framework, teachers are encouraged to adapt and integrate diverse tools and strategies based on the specific needs and goals of their students, a task that increasingly requires digital literacy and foundational understanding of AI.

The customization of learners' educational pathways based on their needs, along with assessment, bureaucratic tasks, and lesson planning, requires an exponential increase in teachers' time. The TALIS Survey confirms this trend: on average, across OECD countries, teachers spend 38.8 hours per week on all tasks related to their jobs in the surveyed schools, of which only 20.6 hours are allocated to teaching. In other words, nearly half (47%) of the teachers' working time is spent on activities other than classroom teaching, such as planning, preparation, and grading. Teachers spend 6.5 hours a week on planning and lesson preparation, the equivalent of 17% of their total working time, and 4.2 hours a week on marking and correcting, which is 11% of their total working time (OECD, 2019).

Among the most common priorities for policy intervention reported by teachers is to offer high-quality professional development for educators (55%) and reduce teachers' administration load (55%)” (OECD, 2019, p.82).

2. The AI revolution for teaching and learning

Since 2022, the Artificial Intelligence (AI) revolution has been profoundly reshaping our societies and the world at large, inevitably extending its transformative influence on the realm of education (Yee et al., 2024). This rapid advancement has opened up entirely new horizons, enabling possibilities that were previously unimaginable (Fei-Fei, 2024). AI is not only redefining how knowledge is delivered and acquired but also paving the way for personalized, adaptive learning experiences tailored to individual needs.

By integrating cutting-edge technologies, educators and learners alike are discovering innovative methods to enhance engagement, accessibility, and outcomes in education, fundamentally altering the traditional paradigms of teaching and learning (Rajaram, 2023).

AI plays a crucial role in shaping learning designs and pedagogical strategies to achieve a high level of educational efficacy. With AI integration, teaching approaches should empower students to take on roles as evaluators, critical thinkers, and knowledge creators.

This approach shifts the focus from mere content acquisition to an emphasis on the learning process itself. The priority moves toward fostering skills such as critical thinking, evaluative reasoning, constructive critique, and the ability to synthesize diverse perspectives. These skills enable students to engage more deeply with the material, promoting a holistic and meaningful understanding of the content.

AI in Education (AIED) technologies provide significant support for teachers by improving efficiency, allowing them to complete existing tasks more quickly and with less effort. By automating routine activities and streamlining workflows, AIED enables educators to focus more on high-value tasks, such as engaging with students and refining teaching strategies.

The literature highlights various ways in which AI can be applied in teaching and learning, categorized into student-focused, teacher-focused, and institution-focused AIED (Holmes & Tuomi, 2022). Each of these areas addresses different stakeholders and objectives, offering tailored solutions to enhance the educational experience.

Teacher-focused AIED concentrates on empowering educators with tools and functionalities designed to optimize their professional roles. The primary functions identified in the literature include:

- *Automated Grading and Assessment*: AI can handle repetitive grading tasks, especially for objective or semi-structured assignments, freeing teachers to dedicate more time to providing personalized feedback.
- *Plagiarism Detection*: advanced AI algorithms can detect instances of plagiarism, ensuring academic integrity while reducing the workload associated with manual checks.
- *Smart Curation of Learning Materials*: AI can assist teachers in finding and organizing educational resources tailored to their curriculum, saving time and ensuring the inclusion of diverse, high-quality content.
- *Classroom Monitoring*: intelligent systems can track student engagement and behavior during lessons, providing teachers with real-time insights to address inattentiveness or disruptions effectively.
- *AI Teaching Assistants*: virtual assistants powered by AI can support teachers by answering routine student queries, managing administrative tasks, and even facilitating discussions in digital learning environments.
- *Classroom Orchestration Tools*: AI-driven platforms help teachers manage classroom dynamics by organizing activities, monitoring group interactions, and providing actionable suggestions to maintain a productive learning atmosphere.

These applications exemplify the potential of teacher-focused AIED to revolutionize the educational landscape, enabling educators to work more efficiently

while fostering a richer and more personalized learning environment for their students.

Many AI-driven systems in education, particularly Intelligent Tutoring Systems (ITS), are primarily designed with students in mind. However, these systems often feature teacher-facing interfaces or dashboards, commonly built upon open learner models. These tools provide teachers with dynamic insights into both individual and group performance, highlighting areas of achievement as well as misunderstandings or misconceptions that require attention (Bodily & Verbert, 2017).

A particularly innovative application in this field leverages augmented reality (AR) technology. Teachers equipped with AR glasses can view dashboard-like information projected above students' heads while they engage with an ITS. This setup offers a real-time, contextual overlay of critical data, enabling more responsive and informed teaching interventions (Holstein et al., 2018).

Artificial Intelligence holds transformative potential for education, particularly in language teaching (Cinganotto & Montanucci, 2024). It offers tools to personalize learning, enhance accessibility, and streamline instructional processes. In teaching, AI can provide adaptive learning environments where systems respond to students' unique needs, allowing for personalized lesson plans, tailored feedback, and language practice at a comfortable pace. This individualized approach fosters learner autonomy and boosts engagement, which is particularly effective in language acquisition.

AI's integration into education is especially valuable in areas like automated assessment, virtual assistants, and content generation. For instance, machine learning algorithms can analyze students' performance to identify strengths and areas needing improvement, offering targeted support. Virtual teaching assistants can address routine inquiries and provide instant feedback, allowing teachers to focus on complex aspects of language instruction, like cultural context or higher-order thinking skills. Moreover, AI supports inclusivity in education. Natural language processing (NLP) tools help make learning resources accessible to non-native speakers, and speech recognition software can support pronunciation practice, vital in language teaching. Additionally, AI enables diverse content creation, making it easier to develop multilingual resources and tailored lessons that account for students' cultural backgrounds.

However, it is important to recognize the limitations of AI: it cannot create, conceptualize, or manage complex strategic planning, nor can it execute tasks requiring precise hand-eye coordination, address unfamiliar situations, or interact with empathy and compassion (Holmes et al., 2019).

These reflections outline the role of AI in educational settings, emphasizing its potential as an added value and an augmented intelligence that enhances teachers' work but can never replace it.

This point is further emphasized in the already mentioned UNESCO AI Competency Framework for Students and Teachers (UNESCO, 2024c), which provides a comprehensive guide to integrating AI literacy into education. The framework outlines the knowledge, skills, and attitudes required for both students and educators to effectively understand, and engage with AI technologies in educational contexts.

For students, the framework focuses on fostering critical awareness of AI, equipping them with the skills to navigate a world increasingly shaped by AI-driven systems. It highlights the importance of ethical considerations, data literacy, and the ability to critically assess the impact of AI on society and their own learning journeys.

For teachers, the framework identifies competencies that enable them to incorporate AI tools into their teaching practices effectively. It emphasizes the dual role of teachers as both users of AI-enhanced technologies and facilitators of AI literacy for students. Teachers are encouraged to understand the technical underpinnings of AI, apply it to personalize learning experiences, and address ethical concerns such as bias, transparency, and privacy in AI systems.

UNESCO frameworks underscore the need for a balanced approach that harnesses AI's potential to enhance teaching and learning while critically addressing its limitations and ethical challenges. This holistic perspective ensures that both teachers and students are not only consumers of AI technologies but also informed contributors to discussions about their responsible use. In fact, AI's integration in education also presents challenges: ethical considerations, data privacy, and the risk of over-relying on automated systems require careful planning and oversight. Technological advances must always be balanced with pedagogical goals: AI can help reach deeper learning goals emphasizing "versatility, relevance, student motivation, and transfer" (Holmes et al., 2019, p. 4), enabling learners to apply concepts in new contexts. This also calls for the expansion of a cross-curricular approach that embeds digital skills across various subjects.

In response to the needs and challenges arising from the AI revolution, teacher training has become increasingly essential to raise awareness about both the strengths and potential risks of AI in education.

3. The rationale of the study

This study, as presented in this paper, aimed to investigate the evolving paradigms of teacher training in relation to AI through a survey conducted among public school teachers in Italy. It focused on their training experiences, perceptions, preferences, and professional needs.

To answer the question of what specific training needs and competencies teachers need to effectively integrate

digital technologies and AI in a post-method educational framework, this study provides insights into the skills that teachers consider essential for navigating an AI-enhanced educational landscape. The findings reveal that, while teachers recognize the transformative potential of digital technologies in the classroom, they face significant challenges in adapting their instructional practices. By exploring teachers' perspectives and identifying their training needs, the study's findings, despite being based on a limited sample, could inform the development of an updated, needs-based teacher training framework. This framework would prioritize digital competencies and AI literacy as essential components for modern and future educational contexts.

4. Materials and Methods

The study employed a mixed methods design to explore the specific training needs and competencies that teachers require to effectively integrate digital technologies and Artificial Intelligence within a post-method educational framework. The target population comprised teachers working in Italian public schools across various levels of education and with diverse training backgrounds. Data were collected through an online survey administered via Google Forms, which included both multiple-choice and open-ended questions, to capture a comprehensive range of insights. The survey's quantitative component, consisting of structured multiple-choice questions and Likert-scale items (ranging from 1 to 5), was designed to assess teachers' current competencies and familiarity with digital tools and AI as well as their perceived training needs.

Qualitative data were gathered from open-ended questions, allowing participants to elaborate on the specific challenges and professional development requirements encountered when adopting technology-enhanced pedagogical approaches.

The data collected using Google Forms were analyzed using descriptive statistics, processed in Google Sheets to generate summary statistics and visual representations. Qualitative responses were thematically coded and analyzed manually to identify recurring themes related to training needs and instructional competencies.

This study sought to examine the professional training needs of teachers in the Italian public school system, focusing on their perceptions, practices, and aspirations. The study was guided by the following research questions:

- in which instructional areas do teachers feel the greatest need for professional development, and what program formats do teachers prefer?
- how familiar are teachers using digital tools and AI for teaching and to what extent do they integrate these tools into their practice?

- do teachers perceive their formal preparation to be sufficient to address the challenges of contemporary education?
- how interested are teachers in acquiring new skills related to the integration of digital technology and AI into educational practices?

These questions aim to provide a comprehensive understanding of teachers' professional development priorities and readiness to integrate emerging technologies, particularly AI, into contemporary educational practices. These findings will be instrumental in designing professional development paths tailored to address the real needs of teachers, starting from their existing practices, competencies, and challenges.

5. Profile of the respondents

The sample is composed of 139 teachers at Italian public schools from various educational levels, encompassing primary (25.2%), lower secondary (30.5%), and upper secondary schools (41.2%), with pre-primary educators being underrepresented. The participants covered a wide range of ages and teaching experience, with 50% having over 15 years of experience in education. The survey was distributed in schools where the authors were conducting online teacher training programs, allowing direct engagement with potential participants. Additionally, the questionnaire was shared through various professional and personal networks, ensuring a diverse and representative sample of teachers with different backgrounds and experiences.

As shown in Figure 1, regarding digital competencies for teaching, 34.5% of respondents rated their skills as advanced or expert, while 65.5% identified as having intermediate or beginner skills.

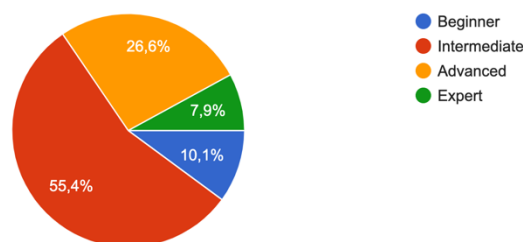


Figure 1 - Teachers' self-reported digital competence for teaching.

The question, 'Do you use multimodal approaches in your teaching (integrating different resources such as videos, audio, written texts, and images)?' yielded very interesting responses, as shown in Figure 2. A significant 60.4% of participants answered 'Always,' indicating a generally tech-savvy approach to teaching and a frequent integration of digital technologies into their lessons.

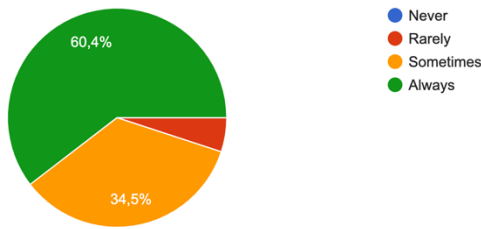


Figure 2 - Teachers' self-reported multimedia approaches used for teaching.

6. Results

The survey provides diverse insights into teachers' perspectives on professional training and digital competencies.

The findings highlight several critical areas where teachers feel they need further training to meet the demands of modern classrooms. The most identified instructional priorities include active methodologies (38.1%), educational technologies (23%), and inclusive teaching practices (20.9%) (Figure 3). These areas underscore a growing recognition of the need for pedagogical strategies that are not only innovative but also adaptable to diverse learner needs.

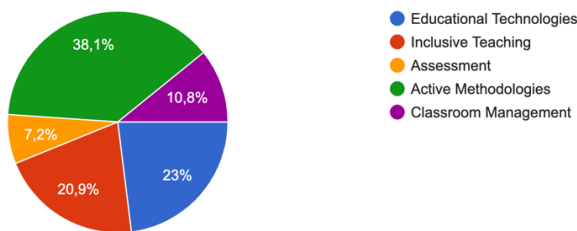


Figure 3 - Teachers' self-reported needs for training.

Over 70% of teachers rated the importance of training in inclusion and personalized learning as high or very high (4 or 5 on a 5-point scale), reflecting a strong demand for professional development opportunities that prepare them to address the diverse needs of their students. However, there appears to be a significant gap in existing teacher preparation programs, with approximately 50% of respondents rating their formal training as insufficient (1, 2, or 3 on a 5-point scale) to equip them for the complexities of today's educational environment.

Interest in digital personalization tools was notably high, with 72.5% of teachers rating their utility at four or five, particularly for customizing learning pathways. This indicates a growing reliance on technology to enhance differentiated instruction and student engagement.

Regarding the use of digital tools in everyday teaching practices, the survey revealed a high level of engagement with various technologies.

The most frequently reported tools include learning management systems (85.5%), presentation software (66.7%), document collaboration tools (55.1%), multimedia creation tools (54.3%), educational applications (51.4%), and interactive whiteboards (50%).

These results highlight the importance of digital literacy and the integration of technology in creating dynamic, interactive, and inclusive learning environments.

Overall, the findings emphasize the need for teacher training programs to focus more on equipping educators with the skills and knowledge to effectively implement active methodologies, leverage educational technologies, and create inclusive learning experiences.

As shown in Figure 4, 89.9% of participants reported rarely or minimally using AI-based tools, and 86.9% considered acquiring skills in applying AI to teaching extremely important.

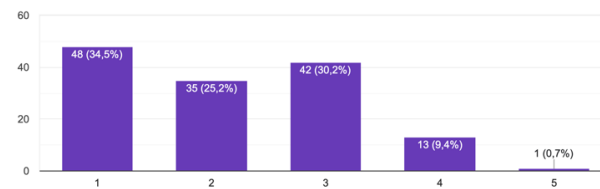


Figure 4 - Frequency of AI tool usage in teaching.

Moreover, a significant majority (84.5%) agreed that advancements in AI necessitate a rethinking of the content delivered in the classroom, with 89.1% supporting parallel rethinking of traditional approaches and methodologies, as reported in Figure 5.

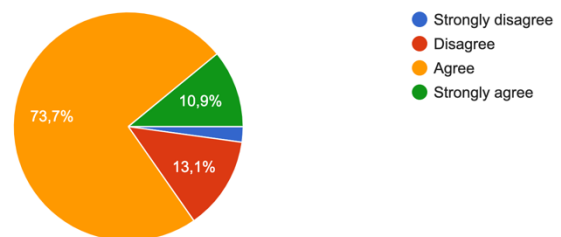


Figure 5 - Teachers' attitudes to rethinking traditional approaches and methodologies.

When considering preferred formats for professional development, 37.4% favored hybrid courses that combined in-person and online sessions, 25.9% preferred in-person workshops, and 23.7% opted for fully online courses (see Figure 6).

Most of the respondents (84.8%) had participated in training on the use of digital technologies in teaching, with 86.2% reporting that such courses were helpful to varying degrees in enhancing their skills.

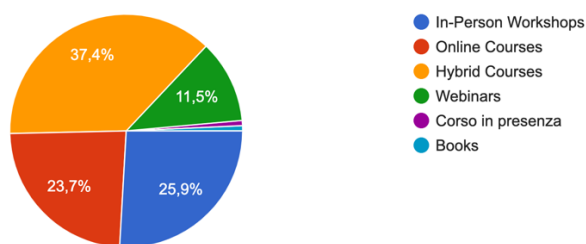


Figure 6 - Preferred formats for professional development courses.

Considering technological advancements, Figure 7 demonstrates that 91.4% of the sample expressed the need for further training on integrating digital technologies and AI into teaching, whereas 60.9% reported having never received specific training on the implementation of AI in education.

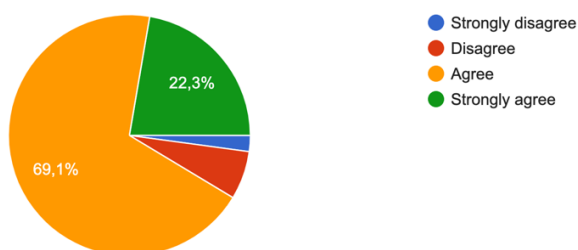


Figure 7 - Teachers' perceptions of the need for additional training on digital technologies and AI integration.

In response to the first open-ended question, 'If you could design your next professional development course, what topics would you prioritize, and how would you structure the course?', the most frequently mentioned topics were artificial intelligence, with a focus on subject-specific applications and active methodologies incorporating hands-on approaches and practical implementations directly applicable in teaching contexts. Additional areas of interest included classroom management and CLIL methodology, highlighting the perceived lack of practical focus on existing training offerings.

In the section dedicated to reflections on AI for teaching, there was unanimous agreement in considering AI as 'interesting, helpful, and useful' (the most frequently mentioned adjectives), especially for languages and scientific subjects, and valuable for integration into educational practices. Alongside recognizing its significant potential, participants also expressed concerns about its use in the classroom, emphasizing the limited knowledge of AI among teachers. Additionally, the respondents acknowledged the paradigm shift that AI adoption could bring to the teacher's role, underscoring the necessity of specific methodological training to support its effective implementation.

In the additional comments (provided in English), participants reiterated their interest in specific training on AI, while also highlighting the importance of training focused on relational dynamics, as clarified by this

statement "the psychological, emotional, relational aspect of teaching is what is missing in today's teacher training", which was noted as lacking within the teaching community, alongside the need for a balanced use of technologies. They also emphasized the challenges posed by a lack of time for lesson planning and the necessity of updating teaching practices through practical applications and subject-specific approaches.

The following comments highlight the teachers' attitude and reactions on the crucial role of AI literacy and training:

"We mustn't be scared at all; we have to use it and take the best from it!"

"We need to know about artificial intelligence because it is used in our society and because it can also be useful for teaching. At the same time, we need to understand its limits".

"I believe that AI is extremely important, both for the study and for the ability to use it".

"AI is a reality which must be seen as a new way of communication among students and teachers. Therefore, we must make the best of it, and we must encourage ourselves to find the newest and most exciting ways to use AI in our classrooms".

The importance of adopting a humanistic approach is emphasized in several teachers' comments. AI is seen as a valuable tool for enhancing teaching practices and improving students' learning outcomes by personalizing the learning experience to align with their needs and cognitive styles.

However, the teacher's role in mediating relationships and interactions with AI is consistently regarded as essential, as illustrated by the following comments:

"I do believe that AI might have a significant impact on both learning and teaching. It must, however, be duly and critically addressed to real teaching needs and not passively utilized by stunners and teachers".

"Artificial Intelligence in teaching has incredible potential [...]. It can help identify student strengths and challenges, allowing teachers to adapt lessons more effectively. However, AI should complement – not replace – the human aspects of teaching, as empathy, creativity, and adaptability remain essential qualities that technology cannot fully replicate".

"Artificial Intelligence can be a very useful tool for teaching and learning, but I don't think it's going to replace the role of the person-to-person teaching".

These findings highlight the need for AI training that fosters a human-centered approach, emphasizing

relational dynamics in which teachers act as mediators, ensuring a balanced and pedagogically meaningful integration of technology in education.

7. Discussion and Conclusions

The results collected very interesting insights to answer the research questions reported below:

- in which instructional areas do teachers feel the greatest need for professional development, and what program formats do teachers prefer?
- how familiar are teachers using digital tools and AI for teaching and to what extent do they integrate these tools into their practice?
- do teachers perceive their formal preparation to be sufficient to address the challenges of contemporary education?
- how interested are teachers in acquiring new skills related to the integration of digital technology and AI into educational practices?

The teachers in the sample perceived active methodologies, educational technologies, and inclusive teaching practices as their greatest training needs. These three areas are closely interconnected and show a context in which teachers seeking innovation in their instructional practices face challenges stemming from a lack of familiarity with emerging technologies and difficulties in their methodological integration.

There is a widespread perception of unpreparedness regarding active methodologies for inclusion that foster students' active participation as protagonists in their learning. Equally prevalent is the awareness that this represents a significant barrier preventing teachers from effectively addressing contemporary educational demands. This includes the pivotal role of the teacher as a guide in supporting students in acquiring digital and AI literacy.

Half of the respondents considered the formal programs they had attended insufficient for effectively managing the current complexities of teaching, which include, among other factors, the heterogeneity of students and different students' needs. Consequently, the importance of training in inclusion and personalized learning has emerged as central to teaching practice, with a strong interest in digital personalization tools.

Although most teachers reported possessing intermediate digital skills and regularly incorporating digital technologies into their lessons, the findings highlight the necessity of embedding technological competence within a comprehensive and robust methodological framework. This approach ensures that the integration of digital tools is not merely an add-on but is deeply connected to pedagogical goals, instructional design, and effective teaching strategies.

While digital proficiency enables teachers to utilize various technologies, its true impact lies in leveraging these tools to enhance learning outcomes, foster

engagement, and address diverse student needs. Embedding technology within a methodological framework also equips educators to critically assess and adapt digital resources, ensuring their alignment with curricular objectives and the overall learning experience. Furthermore, such a framework can help bridge the gap between technology use and evidence-based teaching practices, promoting a more meaningful and effective integration of digital innovations into education.

According to the data collected, the most widely used digital tools in classrooms are learning management systems (LMS), presentation software, and document collaboration tools. However, less than half of the respondents reported using tools designed to foster interaction and active learner engagement.

In response to an open-ended question, attention was drawn to the challenges posed by designing interactive activities and the time that generally demands detailed lesson planning. As one teacher noted,

"I would like to teach in a different way, but I don't have much time to create interactive lessons".

The participants emphasized that AI could assist teachers in streamlining the design and personalization of educational materials, empowering them to manage classroom complexities more effectively. By enabling the creation of resources tailored to diverse needs and providing structured guidance for planning, AI can help educators overcome these challenges while enhancing their teaching practices. In this context, AI tools and Large Language Models (LLMs) can be effectively utilized by educators to reduce workloads and enhance productivity in their professional activities. For instance, they can be used for the development of evaluation rubrics, the design of course syllabi, the creation of test questions, the preparation of activity-rich lesson plans and worksheets, the generation of visual data representations, drafting email responses, managing administrative tasks, and much more, thereby streamlining processes and supporting various aspects of teaching and academic management. It is evident that the conscious and proficient use of these emerging technologies can serve as a significant added value in educational practices, empowering teachers in ways that no other technology has ever achieved.

Regarding format, hybrid formats were the most preferred delivery method for professional development courses (37.7%), combining in-person and online sessions. This approach was favored over exclusively in-person (25.4%) or online courses (23.9%) as it was perceived to encourage participation while offering practical, immediately applicable workshop-style activities for classroom use. Teachers acknowledged that the paradigm shift AI could bring to teaching methodologies, underlining the need for targeted training in active methodologies for inclusion as well as CLIL methodology. Indeed, the findings also highlight the need to redefine the teacher's role in modernizing

education and integrating new technologies effectively. As noted in the Council's Conclusions on European teachers and trainers for the future (European Commission, 2020b), teachers play a pivotal role as drivers of change and should actively contribute to shaping education and training policies. Simultaneously, robust support is required through a holistic approach that encompasses initial education, induction, and continuous professional development. Notably, digital competence has been identified as a key area in which most teachers express a strong need for professional development (OECD, 2019).

In alignment with this, the survey highlights a nearly unanimous perspective among respondents on the need for training that focuses on integrating digital technologies and AI into teaching. Participants called for subject-specific applications within a methodological framework that fostered student engagement, interest, and inclusion. At the same time, almost all participants either did not use AI in education or had just begun exploring it. Nevertheless, they expressed openness to innovation, demonstrating their willingness to engage in continuous professional development on this topic.

The perception of AI's potential in education was overwhelmingly positive, as reiterated in the open-ended responses, reflecting a strong willingness to embrace widespread AI literacy.

However, participants also stressed the importance of adopting an ethical and critical approach, considering the limitations, biases, and risks that the use of AI in schools may entail. Lack of proficiency and familiarity with AI among teachers was recognized as a significant barrier to its implementation in teaching practice.

The open comments further underscored the need to develop digital and AI literacy among teachers before integrating AI-enhanced tools into educational activities. Such preparation is deemed essential for introducing these tools effectively, safely, and responsibly.

Among the identified professional development needs, participants frequently cited the necessity of improving classroom management. Specific training on relational dynamics and strategies to foster positive relationships within the school context was also highlighted.

A particularly pressing issue is the recognized need to rethink the content offered to learners, assessment methods, and approaches to study. This should align with what students will likely need to learn in the AI era, moving beyond traditional approaches and curricula. This perspective significantly shapes teacher training and prepares educators to address the critical challenge of equipping learners to navigate an evolving and increasingly complex society.

The following comment from one of the respondents, designing a potential training course in detail, is particularly noteworthy, as it succinctly captures the general needs and expectations regarding training opportunities. It offers valuable insights that could

inform and guide the design of future professional development initiatives. By reflecting the perspectives of educators, this input can help ensure that training programs are not only relevant but also aligned with the actual challenges and aspirations of teachers in their professional practice. This feedback underscores the importance of developing targeted, practical, and context-sensitive training opportunities that effectively address teachers' evolving needs:

"I would implement regular compulsory professional updating courses and not random interventions. I would prioritize topics that enable educators to effectively integrate technology into teaching methodologies, particularly in language education. My course would begin with foundational sessions on digital literacy, ensuring that all participants are comfortable with basic tools and platforms. Next, I would introduce modules that focus on specific technologies such as adaptive learning systems, natural language processing tools, and AI-based applications that can enhance language acquisition and cultural competence. These sessions would cover both the technical aspects of these tools, and the pedagogical frameworks needed to apply them. I would include a reflective session, encouraging educators to consider the ethical implications and potential challenges of using technology in teaching. The course would conclude with a collaborative session where participants share their newly created resources and strategies, creating a community of practice that can continue beyond the course".

As concluding remarks, teacher training and educational content must be fundamentally reconsidered, redesigned, and adapted to address the rapidly evolving demands brought about by the AI revolution. This transformation involves integrating AI literacy, digital competencies, and ethical considerations into teacher training programs to ensure educators are prepared to navigate and leverage the complexities of AI-driven educational environments.

Reimagined teacher training should go beyond the mere technical use of AI tools, focusing instead on equipping teachers with the pedagogical and critical thinking skills needed to integrate AI into their practice effectively. This includes fostering the ability to personalize learning experiences, critically evaluate AI systems, and address challenges such as bias, privacy concerns, and the ethical implications of AI in education.

Furthermore, educational content must be aligned with the realities of an AI-enhanced world, emphasizing interdisciplinary approaches, collaboration, and problem-solving skills. By embedding these principles into curricula and professional development, educational systems can ensure that both teachers and students are equipped to thrive in a rapidly changing world shaped by AI technologies. This holistic approach

will not only enhance the quality of education but also prepare future generations to be responsible citizens in a society increasingly influenced by AI.

Authors' contribution

The paper was developed collaboratively by the authors. However, Letizia Cinganotto wrote paragraphs 2,4,6,7 and Giorgia Montanucci wrote paragraphs 1,3,5.

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Evolving challenges in Ukrainian education: a comparative study of teacher perspectives

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Abstract

This study compares the educational challenges faced by teachers in Ukraine between 2022 and 2024, with a particular focus on the deterioration of student learning outcomes, lack of student motivation, and the ongoing influence of the war. In 2022, an open-ended survey was administered to 86 practising teachers, revealing key difficulties such as adapting teaching methods for distance learning, deteriorating student outcomes, large class sizes, motivational challenges, and managing students' social and emotional issues. These challenges were largely attributed to limited resources and the disruptive impact of the war rather than deficiencies in teachers' abilities.

To assess how these issues have evolved, the same survey was redistributed in 2024 to a comparable group of educators. The data were qualitatively analyzed to identify recurring and emerging themes, allowing for a direct comparison of the educational landscape across the two years. The study found that while some challenges persisted, the war's ongoing influence exacerbated issues like declining student performance and motivation, as well as the stress on both students and teachers.

The findings underscore the need for increased teacher involvement in national decision-making processes, particularly in the context of a protracted conflict, and highlight the ongoing struggle to balance educational quality with limited resources and external pressures. By comparing the experiences of teachers over these two years, this study provides valuable insights into the evolving needs of educators in Ukraine and offers recommendations for future policy and practice.

KEYWORDS: Ukrainian Education, Teacher Perspectives, War Impact, Educational Challenges.

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1. Introduction

Achieving sustainable development, a robust economy, and overall societal well-being are crucial for future prosperity, all powerfully interconnected with state policies in education and science. Effective policy coordination, strategic management decisions, and long-term investments are essential to attain these objectives. The Human Development Index (HDI) is a

critical dimension of a country's overall development, capturing average achievement across three key dimensions: a long and healthy life, access to knowledge, and a decent standard of living (UNDP, 2023). In Ukraine, the HDI has experienced fluctuations over recent years, mainly due to the impacts of ongoing conflict and socio-economic challenges. The UNDP Human Development Report 2023 highlighted that Ukraine's HDI stood at 0.77, setting the country within the high human development category (UNDP, 2023). The marked improvement from previous years reflects resilience in the face of the COVID-19 pandemic and war. However, as of March 2024, Ukraine's HDI value declined to 0.734, dropping the country's ranking to 100th out of 193 countries and territories. The drop represents a significant setback, bringing the HDI to its lowest since 2004 (UNDP, 2024).

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Despite being in the high human development category, socio-economic disparities have persisted, affecting various sectors, including education. The war and displacement of populations have disrupted access to education, healthcare, and stable livelihoods, exacerbating these inequalities. The full-scale invasion of Ukraine by Russia has had severe impacts on the country's development, including education. The disruption of educational services due to conflict, displacement, and frequent air alerts has led to significant learning losses, further widening the gap between Ukraine and other countries in key educational metrics. Prior to the intensification of the war, the PISA 2018 results revealed that Ukrainian students were already lagging behind their OECD counterparts in reading, mathematics, and science. This performance gap highlighted more profound, systemic challenges within Ukraine's educational framework, particularly concerning resource allocation and socio-economic disparities. In 2018, Ukrainian students scored 31 points lower in mathematics, 48 points lower in reading, and 35 points lower in science compared to the OECD average. This disparity equates to roughly one and a half years of schooling lost in mathematics and science and nearly two and a half years in reading (PISA 2018). Participation in PISA 2022 has further underscored these issues, with a significant decline in performance: math scores fell by 12 points, science by 19 points, and reading by 38 points, mainly due to the disruptions caused by the war. The educational impact on 15-year-olds in reading alone is equivalent to nearly two years of learning, demonstrating the war's profound effect on an already strained educational system (PISA, 2022). The ongoing war and its associated disruptions have likely exacerbated these educational challenges. The declining HDI in 2024 suggests that access to knowledge, a critical component of human development, has been significantly impaired. In conclusion, the decline in Ukraine's HDI from 0.77 in 2023 to 0.734 in 2024 reflects the cumulative impact of ongoing war, socio-economic challenges, and disruptions to essential services like education. While Ukraine's development has shown resilience, the continuing war has reversed some of these gains, underscoring the crucial need for robust international support and domestic policy interventions to stabilize and rebuild the country's human development trajectory.

The ongoing war in Ukraine has had severe and multifaceted impacts on the country's children, exacerbating risks such as poverty, disease, family separation, learning loss, mental health issues, violence, and exposure to unexploded ordnance. Over 22 months into the war, 2.92 million children, including 1.5 million girls, are in urgent need of assistance. The war has resulted in the deaths of 531 children and injuries to 911 others. One-third of Ukraine is now contaminated by explosive remnants of war, posing a

daily threat, particularly to boys and men (United Nations, 2023). The war has also led to significant displacement, with more than 3.7 million people internally displaced and 4.6 million returning to their places of origin. Many children, particularly in frontline areas, face unsafe living conditions, inadequate access to essential services, and intense shelling. Poverty levels have sharply increased, with the share of children living below the poverty line rising from 43% in 2021 to 65% in 2022. Vulnerable groups, including families with children with disabilities and single parents, are now frequently below the extreme poverty line (World Bank, 2023).

The war has taken a toll on children's mental health, with 56% of parents in eastern regions reporting that their children often feel anxious or tense. Social isolation and the upheaval of war have worsened the situation for displaced children, those living in institutions, and those with disabilities (UNICEF, 2023). The psychological impact on children is a stark reminder of the human cost of the war.

Educationally, the war has caused severe disruption. Nearly two million of the 3.837 million children enrolled in Ukrainian schools rely on online or blended learning due to the closure of 2,321 schools in frontline areas for safety reasons. As of December 2023, 3,714 educational facilities had been damaged and 392 destroyed. The 2022 PISA results indicate that 15-year-old students in Ukraine have experienced significant learning losses, equivalent to almost two years of skills loss in reading literacy (Ministry of Education and Science, 2023; OECD, 2023). This situation has compounded the effects of the COVID-19 pandemic, leaving many children with four years of disrupted education. The situation has worsened due to frequent air alerts and the constant threat of attacks, leading to significant distractions and interruptions in students' learning processes. These disruptions and distance education challenges during wartime have resulted in substantial learning losses. Estimates suggest that the cumulative effect of these interruptions could cause Ukrainian students' academic performance to fall below that of the poorest-performing countries in Europe.

In the context of the war, distance education remains a topic of concern in Ukraine, especially in light of the 2022 Russian invasion. The Ukrainian education sector is also grappling with budget constraints, low teacher salaries, and large class sizes, hindering the power to provide quality, personalized education. Despite some progress, such as introducing education subventions and reforms to align with European standards, the system still faces numerous obstacles, including outdated teacher compensation systems, incongruous education legislation, and the devastating effects of war. Motivating students amidst these challenges is complex and requires a multifaceted approach. The lack of individualized attention due to overcrowded

classrooms, declining teacher morale and the constant stress of war-related disruptions further diminishes student engagement and learning outcomes. The Ukrainian education system's struggle to adapt to modern needs and global shifts has resulted in numerous educational challenges that significantly impact the quality of education.

The study examines teachers' perspectives on these challenges, comparing the situation in 2022 with that in 2024. By exploring the deterioration of learning outcomes, lack of student motivation, and the influence of the war, including air alerts and other distractions, this research aims to provide insights into the evolving needs of educators in Ukraine and inform future educational policy and practice.

2. Literature review

The impact of class size differences on educational outcomes has been a subject of intense debate, widely covered in media and research. Much of the discussion revolves around how class size correlates with academic performance, with limited insights into the classroom dynamics that might drive any observed effects (Anderson, 2000; Finn & Achilles, 1999; Grissmer, 1999). Studies examining pupil-to-teacher ratios have indicated that smaller class sizes may lead teachers to shift from group teaching to more personalized, one-on-one instruction (Betts & Shkolnik, 1999). Anderson (2000) presented a comprehensive framework detailing potential factors that connect class size to student achievement, highlighting aspects such as enhanced understanding of individual students, increased instructional time, elevated student involvement, and a deeper dive into content material in smaller class settings.

However, Finn, Pannozzo, and Achilles (2003) determined that the impact of class size in elementary grades primarily pertains to student engagement rather than direct effects on teaching methods. Nevertheless, smaller classes can positively influence teachers' interpersonal approaches. Achievement motivation, recognized as a crucial factor in academic success, has been widely studied and confirmed by Robbins et al. (2004), Hattie (2009), Plante et al. (2013), and Wigfield et al. (2016). This motivation encompasses various components such as beliefs, task values, goals, and achievement motives, as supported by Wigfield and Cambria (2010) and Wigfield et al. (2016).

The closure of schools and the resulting social isolation during the COVID-19 pandemic had detrimental effects on students' psychological and emotional health, while families were thrust into the educator role amidst economic challenges (Dorn et al., 2021). Educators faced unprecedented challenges as they adapted to new technologies and navigated students' emotional and social needs (Decker & Beltran, 2021;

Zieher et al., 2021). The emphasis on social-emotional learning (SEL) became evident, focusing on competencies such as self-awareness, self-management, social awareness, relationship-building skills, and responsible decision-making (Reddig & Vanlone, 2022; Yang, 2021). Teachers' social-emotional competence and well-being were crucial to managing stress and burnout (Corcoran & O'Flaherty, 2022; Schonert-Reichl, 2021).

Research has also highlighted the impact of public perception on educators. Studies by Shine (2021) reveal a gap between teachers' perceptions and public sentiment, often portraying a negative image of the profession. Conversely, research by Cruickshank and MacDonald (2017) emphasizes the importance of recognition and gratitude in sustaining teacher motivation, while Allen et al. (2020) found that teachers are generally highly regarded but stressed the need for acknowledgment of their efforts.

The study aims to explore the challenges faced by Ukrainian educators amidst ongoing war and socio-economic disruptions. Specifically, the research question guiding this investigation is: "What do educators in Ukraine identify as the most significant factor influencing student outcomes amid ongoing war and socio-economic challenges?" This question is important for understanding how the dynamics of the education system have evolved from 2022 to 2024, particularly in response to the compounded effects of the war and other stressors on student performance and educational quality.

By examining this question, the study seeks to compare findings from previous years with the current situation, providing a comprehensive view of how factors impacting student outcomes have shifted over time and highlighting the evolving needs and challenges within the Ukrainian educational landscape.

3. Methods

The 2024 study involved a similar sample of 86 teachers actively teaching in Ukraine. The participants included 15 male and 71 female teachers. Their teaching experience was distributed as follows: 18% had 0-2 years, 22% had 3-6 years, 18% had 7-10 years, 6% had 11-15 years, and 50% had 16 or more years. This demographic provides a comprehensive view of the teaching profession amid current challenges.

The research question for this study was: "What do teachers in Ukraine identify as the most influential factor impacting student outcomes in 2024, given the ongoing war and socio-economic changes?". To explore this, an open-ended questionnaire was employed, asking participants: "In your opinion, what is the most significant factor currently influencing student outcomes in Ukraine?". This approach was

designed to encourage in-depth and thoughtful responses from educators, collect diverse perspectives without introducing bias, and uncover emerging factors that may not have been highlighted in earlier research.

Following Creswell's guidelines, the open-ended format allowed participants to express their views freely, ensuring that new insights could be captured. The data collection spanned from September 2023 to January 2024, with a response rate of 60%. The survey was administered through various methods, including distribution by school principals and contact teachers, to accommodate different school environments (Creswell, 2007). Data were analyzed using Braun and Clarke's thematic analysis method, which is suited for exploring participants' perspectives and identifying key themes.

The comparative aspect of this study involved examining changes in educators' perceptions of factors influencing student outcomes in Ukraine from 2022 to 2024. The analysis focused on three key areas: differences in perceived factors affecting student outcomes, trends in how socio-political and educational challenges have shifted, and emerging themes in teacher perspectives that reflect current realities. By comparing these aspects, the study aims to provide insights into how the evolving context of war and socio-economic conditions has shaped educators' views on the factors impacting student success.

First, the analysis sought to identify any differences in the factors that teachers perceived as most influential to student outcomes between 2022 and 2024. This involved evaluating changes in the significance and priority of various factors, such as economic stability, mental health support, access to educational resources, and safety concerns. Second, the study tracked trends in how socio-political and educational challenges have shifted over this period. This included examining how ongoing war, displacement, and economic challenges have affected the educational environment, influencing teacher perceptions. Lastly, the analysis aimed to uncover emerging themes that might not have been evident in earlier years. These themes were identified through a detailed review of qualitative responses, highlighting the evolving realities that teachers face.

4. Results

In the context of the ongoing war and socio-economic changes impacting Ukraine's educational system, the qualitative analysis of teachers' responses from the 2024 study revealed several distinct themes and categories (Table 1).

In comparing the challenges faced by Ukrainian teachers in 2022 and 2024, it is evident that while some issues have remained consistent, the nature and severity of these challenges have evolved in response to the

prolonged impacts of the war and COVID-19 pandemic.

Table 1 - Main categories and themes.

MAIN CATEGORIES AND THEMES
<p>1. TEMPORAL CHALLENGES</p> <p><i>Impact of War</i></p> <p>2022 Study: Future uncertainty</p> <p>2024 Study: Frequent disruptions due to war and air alerts.</p>
<p>2. INSTRUCTIONAL CHALLENGES</p> <p><i>Resource Limitations</i></p> <p>2022 Study: Limited resources and large class sizes were issues.</p> <p>2024 Study: Insufficient resources, outdated technology, and large class sizes.</p> <p><i>Curriculum and Content Delivery</i></p> <p>2022 Study: Difficulty in adjusting to online formats.</p> <p>2024 Study: Challenges in adjusting curriculum and maintaining standards.</p>
<p>3. BEHAVIORAL CHALLENGES</p> <p><i>Student Motivation and Engagement</i></p> <p>2022 Study: Low student motivation and connection to real-life.</p> <p>2024 Study: Increased disengagement and lack of real-life connection.</p> <p><i>Social and Emotional Well-being</i></p> <p>2022 Study: Stress and emotional issues among students.</p> <p>2024 Study: Elevated levels of anxiety and trauma among students.</p>
<p>4. SOCIETAL CHALLENGES</p> <p><i>Changing Perceptions of the Teaching Profession</i></p> <p>2022 Study: Declining status and unrealistic expectations.</p> <p>2024 Study: Further decline in status and increased expectations.</p>

Category 1: Temporal challenges

The comparative analysis of teachers' perceptions from 2022 to 2024 revealed significant shifts in the challenges faced by educators in Ukraine, highlighting the evolving socio-political and educational landscape. In 2022, 50% of teachers reported difficulties related to distance learning during the COVID-19 pandemic; however, by 2024, this theme was no longer prominent, as new challenges emerged. The war remained a major concern, with 90% of teachers in both years identifying it as a significant issue impacting education. While safety concerns due to the war were consistently reported by 90% of teachers in both 2022 and 2024, new issues such as inadequate infrastructure, which was not reported in 2022, emerged in 2024, with 40% of teachers highlighting it as a barrier to effective online learning. Additionally, 30% of teachers in 2024 mentioned reduced student engagement, while 35%

faced technical difficulties and challenges adapting traditional teaching methods to online environments. The ongoing war further worsened educational disruptions, with 75% of teachers in 2024 citing the destruction of infrastructure and displacement as critical issues. Furthermore, 85% of teachers reported experiencing trauma and psychological impacts on both students and educators due to the war, a theme not previously reported in 2022. Lastly, 45% of teachers in 2024 noted the need for curriculum adaptations to address the specific challenges and experiences of students affected by the war, indicating a shift toward more responsive and context-sensitive educational practices (Figure 1).

Category 2: Instructional challenges

The impact of limited resources and large class sizes increased dramatically, with a rise from 45% to 76%, highlighting growing challenges in managing classroom dynamics. Individualized attention saw an impressive increase from 35% to 85%, indicating a heightened focus on catering to the unique needs of students. Engagement and participation also improved, with scores rising from 45% to 75%, reflecting efforts to foster a more interactive learning environment. Interestingly, assessment and feedback remained constant at 63%, suggesting stability in evaluation practices despite changing conditions. The teacher workload saw an increase from 75% to 85%, underscoring the growing demands placed on educators. Lastly, the ability to address diverse needs improved significantly, rising from 45% to 78%, indicating a greater emphasis on inclusivity in the classroom. Overall, these findings underscore the evolving landscape of education and the increasing importance of individualized and engaged learning experiences (Figure 2).

Category 3: Behavioral challenges

The findings indicate notable shifts in behavioral challenges between 2022 and 2024. Student motivation experienced a decline, dropping from 50% to 35%, which raises concerns about the factors contributing to decreased interest and enthusiasm among learners. Similarly, engagement and participation also fell from 45% to 35%, suggesting that strategies aimed at fostering active involvement in learning have not been as effective in recent years. Conversely, social and emotional problems have escalated significantly, increasing from 55% to 73%. This rise highlights the growing challenges students face in their emotional well-being, which may further affect their overall academic performance. On a more positive note, behavioral management saw a substantial improvement, soaring from 40% to 78%. This suggests that there have been successful initiatives in managing classroom behavior, contributing to a more conducive learning environment. Overall, these findings point to

the need for renewed focus on student motivation and engagement while recognizing the importance of addressing social and emotional challenges (Figure 3).

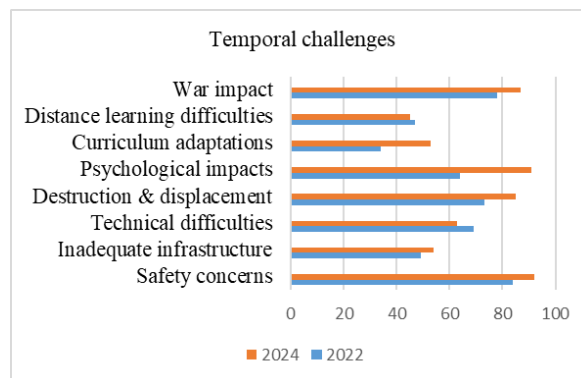


Figure 1 - Teachers' perceptions of temporal challenges in 2024 and 2022.

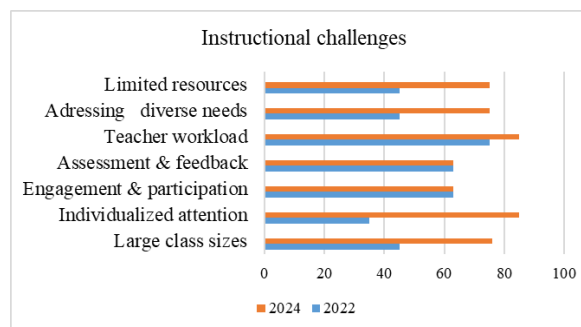


Figure 2 - Teachers' perceptions of societal challenges in 2024 and 2022.

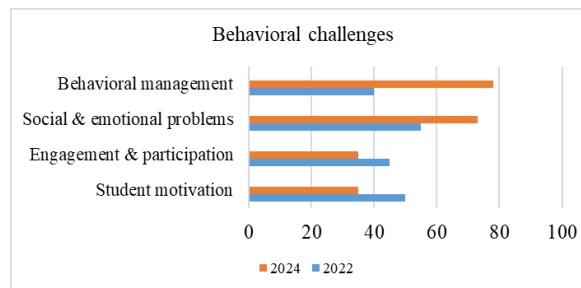


Figure 3 - Teachers' perceptions of behavioral challenges in 2024 and 2022.

Category 4: Societal challenges

Status decline among educators has increased from 47% to 62%, indicating a growing perception of diminished respect and recognition for the teaching profession. Unrealistic expectations have also risen dramatically, from 47% to 77%, suggesting that educators feel increasingly pressured to meet demands that may not align with available resources or realities in the classroom. Additionally, the increased workload and administrative burdens have become a pressing issue, with perceptions soaring from 50% to 87%. This highlights the escalating challenges educators face in

balancing teaching responsibilities with administrative tasks, potentially leading to burnout and decreased job satisfaction. Furthermore, societal criticism and negative perceptions of the teaching profession have also intensified, climbing from 60% to 75%. This reflects a concerning trend where educators may feel undervalued and scrutinized, impacting their morale and effectiveness in the classroom. Overall, these findings underscore the urgent need to address the pressures faced by educators and to foster a more supportive environment for teaching professionals (Figure 4).

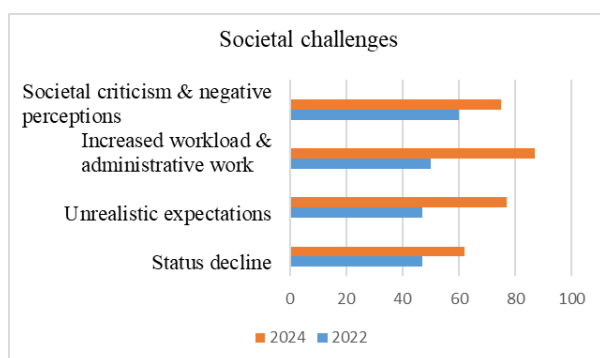


Figure 4 - Teachers' perceptions of societal challenges in 2024 and 2022.

4. Discussion

The implementation of distance learning in Ukrainian education has met various challenges, which have intensified in recent years due to the ongoing war. Limited access to technology and internet connectivity, particularly in areas affected by the war, leads to difficulties in conducting online classes. Inadequate training and resources for teachers also contribute to the challenge. Moreover, the ongoing war in Ukraine has created a host of obstacles for teachers and students, as the displacement of students and educators disrupts the continuity of education. The destruction of educational infrastructure, including schools and universities, has further negative impacts on the learning environment. Safety concerns and psychological trauma experienced by students and teachers also have negative effects on their educational experiences. These challenges were highlighted in the CEDOS review titled "War & Education: How a Year of Full-Scale Invasion Affected Ukrainian Schools" (CEDOS, 2023).

Ukraine's constrained financial situation has resulted in classrooms with a high student count, leading to challenges for teachers in offering instruction tailored to each student's unique needs. This observation aligns with Anderson's 2020 study, which explore the dynamics between class size, student performance, and in-class dynamics (Anderson, 2000). Equipping classrooms with the necessary resources and infrastructure can support teaching methodologies and

foster better student participation. This perspective aligns with findings from the OECD study titled "Improving Education Outcomes for Students Who Have Experienced Trauma and Adversity" (OECD, 2020).

Teachers have also identified a notable dip in student motivation, with insights suggesting that this decline is more attributable to students' decisions than any deficiency in motivational teaching techniques. A potential misalignment between the academic content and its real-world relevance diminish students' enthusiasm. Outdated educational methodologies and curricula could be the culprits behind this issue. This aligns with the research conducted by Chingos et al. (Chingos et al., 2012).

Ukrainian teachers are confronting the uphill task of addressing students' escalating social and emotional issues. Educators report increased levels of anxiety and trauma among their students, a rise from previous years. Poverty, unstable family environments, and mental health challenges can cast a shadow on the learning environment. These challenges mirror Choi's (2018) and Viac & Fraser (2020) findings. The research titled "Emotional Wellbeing of Children and Adolescents: Recent Trends and Relevant Factors" and "Teachers' Wellbeing – A Framework for Data Collection and Analysis" investigates trauma-associated cases, including stress, personal security concerns, bullying, physical discomfort, and the broader spectrum of emotional well-being.

Various societal challenges and unrealistic expectations have negatively impacted the status of teachers in Ukraine. In recent assessments, teachers reported a further decline in their professional status compared to previous years. These expectations, placed on educators by parents, policymakers, and society, create immense pressure and stress. The decline in the status of the teaching profession may also adversely affect the recruitment of qualified teachers. McCallum and Price (2010) argue that the well-being of both educators and learners is a shared responsibility among individuals, collectives, and communities. This highlights the complexity of addressing employee well-being, which must be approached holistically. They advocate for a collaborative effort between schools, sectors, relevant authorities, and professional associations to prioritize and address teacher well-being throughout the teacher training, induction, mentoring, and professional learning. (McCallum & Price, 2012).

The challenges in Ukrainian education identified in the study can be attributed to a range of factors, including limited resources, inadequate infrastructure, societal changes, the impact of war, and the overall economic situation in the country. Addressing these challenges requires investments in technology and infrastructure, teacher training and support, curriculum reform, and efforts to enhance the status and recognition of teachers in Ukrainian society. As the findings from the 2024

study demonstrate, a comprehensive and collaborative approach is essential for creating a sustainable and resilient educational system that can effectively support both teachers and students in the face of adversity.

5. Conclusions

The comparative analysis of the 2022 and 2024 studies highlights the evolving and multifaceted challenges faced by teachers in Ukraine. The transition from focusing on the impacts of the COVID-19 pandemic to the profound effects of the ongoing war underscores the dynamic nature of the educational landscape in conflict-affected regions. Temporal challenges have shifted to frequent disruptions caused by war and air alerts. These disruptions create an unpredictable learning environment, affecting both teacher effectiveness and student attendance. The constant threat of conflict not only disrupts instructional time but also places immense psychological strain on students and teachers alike. The need for a responsive and flexible educational framework has never been more critical, as teachers must adapt to an environment where safety concerns can lead to sudden changes in learning modalities.

Instructional challenges have intensified, with resource limitations and outdated technology hindering effective teaching and learning. The lack of access to modern educational tools further complicates the transition to effective online or hybrid learning models, emphasizing the urgent need for investment in educational infrastructure. Moreover, the difficulty in adjusting curriculum and content delivery to maintain standards amid these challenges can lead to educational inequities, particularly for marginalized or displaced students. In this context, professional development for teachers must focus not only on pedagogical strategies but also on utilizing available resources effectively to meet curriculum goals.

Behavioral challenges are evident in the declining student motivation and engagement, which has been exacerbated by the ongoing conflict. The increased disengagement and lack of real-life connection to their education can lead to a cycle of underachievement and frustration. This situation necessitates the implementation of innovative and engaging pedagogical approaches that resonate with students' lived experiences. Additionally, the social and emotional well-being of students has deteriorated, with heightened anxiety and trauma becoming significant barriers to effective learning. Schools must prioritize mental health support and social-emotional learning (SEL) programs to create a safe and nurturing environment that addresses the psychological needs of students.

The societal challenges identified indicate a troubling trend in the perception of the teaching profession. The

continued decline in status and rising expectations place additional pressure on teachers. This situation can lead to burnout, job dissatisfaction, an outflow from the profession. Acknowledging and addressing these perceptions is crucial for attracting and retaining competent teachers in the field. Community engagement and advocacy efforts are needed to elevate the status of teachers, highlighting their critical role in society and the challenges they face in delivering quality education under adverse conditions.

Recruitment and retention issues have been deteriorated by the war and financial constraints, leading to significant gaps in the teacher workforce. Effective recruitment strategies must be developed that not only attract new talent but also support existing teachers through mentorship programs and professional development opportunities. Policymakers and educational leaders must collaborate to create an attractive and supportive environment for teachers, ensuring that they feel valued and equipped to meet the demands of their roles.

Despite the formidable obstacles faced, teachers in Ukraine have exhibited remarkable resilience and commitment to delivering high-quality education. This resilience is particularly noteworthy in light of the ongoing challenges posed by the war and its consequences. To effectively overcome these difficulties, teachers engage in collaborative efforts, sharing best practices and seeking support from school administrators and educational leaders. This collaborative approach help foster a more supportive environment for both educators and students.

Addressing critical issues such as insufficient funding, large class sizes, lack of student motivation, and societal attitudes toward education is essential to enhancing Ukraine's education system. To achieve meaningful reform, it is advisable to conduct further investigations that delve deeper into these obstacles. By recognizing and actively addressing these challenges, Ukraine can make significant progress in its effort to achieve educational excellence, which ultimately contributes to effective integration into European and global society.

6. Limitations of the study and recommendations for future research

It is essential to acknowledge that the findings of this study do not represent the entirety of the national teaching workforce, as they are based on a limited sample of 86 teachers. Nonetheless, this qualitative and interpretive small-scale study provides valuable insights by contextualizing the experiences of teachers within their social and educational environments, considering both national and local factors that influence their work.

To explore these challenges in future research, it is advisable to conduct more in-depth investigations through individual interviews and focus group discussions with educators. These qualitative inquiries can examine the implications of current instructional, student-related, and societal challenges in greater depth, allowing for a more nuanced understanding of the issues at hand. Additionally, gathering teachers' suggestions for overcoming these challenges can yield practical solutions that may be implemented within the educational framework.

Conducting quantitative analysis to establish correlations between these four categories of challenges would be beneficial. Such analyses could illuminate the causal relationships among these challenges, particularly how lower-quality instruction impacts student motivation and behavior. This approach would provide a more comprehensive understanding of the interplay between these factors, offering insights into potential strategies for improvement.

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Time Perspectives and Career Anxiety among Vietnamese teacher education undergraduates

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Abstract

This study examined the relationship between time perspectives – present fatalistic, present hedonistic, and future – and career anxiety among 354 Vietnamese teacher education undergraduates (68.4% female). The findings show that present fatalistic and present hedonistic time perspectives are positively correlated with career anxiety and its dimensions, while a future time perspective (FTP) is negatively correlated with career anxiety. The study also highlights that lower socioeconomic status (SES) is linked to higher present fatalistic, lower present hedonistic, and variations in career ambiguity. The results suggest that promoting a future-oriented mindset may help reduce career anxiety. Additionally, the study emphasizes the significant role of employment pressure as a key source of career-related stress, underscoring the importance of integrating stress management and coping strategies into career development programs. Furthermore, notable differences in time perspectives and career ambiguity across SES groups highlight the need for targeted interventions. The study concludes with a discussion of its implications and limitations.

KEYWORDS: Career anxiety; Present fatalistic; Present hedonistic; Future time perspective; Teacher education; Socioeconomic status.

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1. Introduction

In Vietnam, the teaching job market is characterized by low turnover rates, contributing to a stable yet highly competitive employment landscape. Once teachers secure a position, they often remain in their roles for extended periods, creating job security but also limiting the availability of new openings for recent graduates (Tran & Moskovsky, 2024). This lack of mobility presents challenges for aspiring teachers, as fewer opportunities arise in the field (Vujicic et al., 2011).

Teacher education programs in Vietnam primarily focus on developing pedagogical skills, often neglecting the social and emotional competencies necessary for managing stress and building resilience (Dung &

Zsolnai, 2022). Combined with economic instability and the financial pressures of pursuing higher education, this lack of preparation exacerbates career anxiety among students entering the workforce.

Career anxiety refers to the distress individuals feel when navigating career development and job prospects (Pisarik et al., 2017). For college students, it is associated with negative outcomes, such as poor mental health, reduced well-being, and impaired decision-making (Dieringer et al., 2017; Mahmud et al., 2021; Müceldili et al., 2023; Qian et al., 2023). Research links career anxiety to a heightened risk of becoming NEET (Not in Education, Employment, or Training) and reduced self-efficacy, career exploration, and job satisfaction (Deer et al., 2018; Nauta, 2007; Park et al., 2017; Parola & Marcionetti, 2022; Sadler et al., 2014).

Social Cognitive Career Theory (SCCT) offers a framework for examining career anxiety among teacher education undergraduates. SCCT posits that self-efficacy beliefs, outcome expectations, and personal goals interact with environmental factors to shape career development (Lent et al., 1994). For teacher education students, low self-efficacy regarding teaching abilities or negative outcome expectations about employment

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prospects may heighten career anxiety. SCCT also accounts for contextual supports and barriers, such as socioeconomic conditions, which significantly impact career decisions and related anxiety (Brown & Lent, 2019; Lent et al., 2000).

Understanding the factors contributing to career anxiety is crucial for addressing the stressors students face during their transition to the workforce. By examining its dimensions – career ambiguity, lack of information, employment pressure, and external conflict (Choi et al., 2011) – interventions can be tailored to reduce career-related stress and foster greater resilience and confidence in students.

1.1 Time perspectives and Career anxiety among Teacher Education Undergraduates

Time Perspectives

Time perspectives refer to how individuals psychologically perceive and orient themselves toward time, encompassing past, present, and future orientations (Zimbardo & Boyd, 1999). These perspectives significantly influence attitudes and behaviors. For instance, individuals with a present hedonistic perspective prioritize immediate pleasures and may engage in risk-taking without considering future consequences (Stolarski et al., 2015; Zhang et al., 2013; Zimbardo & Boyd, 1999). In contrast, those with a present fatalistic orientation often feel powerless and resigned, believing their actions have little impact on their future (Stolarski et al., 2015; Zhang et al., 2013; Zimbardo & Boyd, 1999). Conversely, a future-oriented perspective reflects motivation to plan and achieve long-term goals, promoting behaviors aligned with future success (Cheng & Nguyen, 2022; Zimbardo & Boyd, 1999).

Time perspectives and Career anxiety among Teacher Education Undergraduates

Research suggests that time perspectives profoundly affect career-related attitudes and behaviors, including planning, decision-making, and resilience (Eren, 2017; Horstmanshof & Zimitat, 2007; King, 2016; Kvasková & Almenara, 2021; Taber, 2012; Zimbardo & Boyd, 2008). Among teacher education undergraduates, present fatalistic and present hedonistic perspectives are positively associated with career anxiety, as these orientations contribute to feelings of indecision, lack of control, and uncertainty about career paths (Rönnlund et al., 2019).

In contrast, a strong future time perspective (FTP) is negatively correlated with career anxiety. Future-oriented students often demonstrate higher levels of goal-setting, resilience, and self-efficacy, which help mitigate career-related stress (Boo et al., 2021). For instance, King (2016) found that future-oriented students tend to be more engaged and confident in

pursuing career goals, reducing their vulnerability to anxiety.

These findings highlight the importance of fostering a balanced time perspective to alleviate career anxiety. Encouraging students to adopt a more future-focused outlook may not only improve their mental well-being but also enhance their professional preparedness and resilience.

1.2 Socioeconomic Status and Time Perspectives among Teacher Education Undergraduates

Socioeconomic Status and Time Perspectives

Individuals' socioeconomic status (SES) significantly shapes their time perspectives. Those from lower SES backgrounds often adopt a present-oriented perspective, prioritizing immediate needs over long-term planning due to economic constraints and perceived lack of mobility (Adams, 2009; Bak & Yi, 2020; Guthrie et al., 2009). In contrast, higher SES individuals are more likely to adopt a future-oriented perspective, which is associated with greater planning, foresight, and goal-setting behaviors (Adams, 2009; Fieulaine & Apostolidis, 2015; Guthrie et al., 2009).

For teacher education undergraduates, SES may influence the adoption of specific time perspectives and their associated outcomes. Lower SES students, with a stronger focus on present concerns, may face heightened career anxiety due to limited resources and fewer opportunities. Conversely, higher SES students, with greater access to resources, may experience less anxiety and be better positioned to pursue long-term career goals.

SES and Career Anxiety Among Teacher Education Undergraduates

Low-SES students often face additional barriers to academic and career success, including financial instability, limited access to career resources, and higher levels of stress and anxiety (Jury et al., 2017; Liu et al., 2019; Ortiz-Hernández et al., 2007; Poon, 2020). These challenges contribute to greater career anxiety, which can hinder their professional aspirations and increase their risk of becoming NEET (Mac-Ginty et al., 2024; Titus, 2006; Vine et al., 2012). By contrast, high-SES students tend to have more career opportunities and access to resources, reducing their career anxiety and enabling them to pursue ambitious career paths (Dar & Getz, 2007).

Understanding these disparities among SES groups underscores the importance of providing targeted support for low-SES students, such as emotional regulation strategies, career counseling, and financial aid programs, to help them overcome these obstacles and build successful teaching careers.

In conclusion, this study aims to explore career anxiety among teacher education undergraduates, emphasizing its relationship with time perspectives and the influence

of socioeconomic disparities. Based on the findings, interventions designed to foster a balanced time perspective and provide targeted support for low-SES students could help reduce career anxiety, enhance resilience, and build professional confidence. These efforts are crucial for developing a capable and confident teaching workforce equipped to navigate personal and professional challenges effectively.

Research purposes

SCCT and existing research suggests the crucial role of present fatalistic, present hedonistic, FTP, and career anxiety among teacher education undergraduates. Additionally, the role of SES in shaping time perspectives and career anxiety varies among these students. Therefore, the primary research questions of this study are as follows:

RQ1: To what extent do time perspectives and career anxiety, including its various dimensions, of teacher education undergraduates? How do these factors link?

RQ2: How do time perspectives and career anxiety differ among teacher education undergraduates from various SES groups?

RQ3: How can educational policies and practices be adapted to address career anxiety equitably across different SES levels among teacher education undergraduates?

2. Procedures and methods

2.1 Participants

An anonymous questionnaire was distributed to 354 Vietnamese teacher education undergraduates, of whom 68.4% were female. Participants were randomly selected and voluntarily completed an online survey via Google Forms. They were informed about the voluntary nature of their participation and their right to withdraw at any time. The survey took approximately 8-10 minutes to complete.

2.2 Research Design

In addition to demographic information such as gender, age, and SES (categorized as low, medium, or high SES), two additional scales were included to explore the research questions. The questionnaire was translated from English to Vietnamese following a standard translation process.

Time Perspectives scale: The shortened version of the Short Zimbardo Time Perspective Inventory-15 (Zhang et al., 2013) was used, including three dimensions of time perspectives: present fatalism (e.g., “Often luck pays off better than hard work.”), present hedonism (e.g., “I make decisions on the spur of the moment.”), and FTP (e.g., “I complete projects on time by making steady progress.”). The items were rated on a five-point Likert scale ranging from strongly disagree to strongly

agree, with higher scores indicating a stronger orientation towards time. The Cronbach’s alpha for the three dimensions are 0.70; 0.73; and 0.89, respectively.

Career Anxiety scale: This scale was adapted and revised from the Korean Stress Inventory (Choi et al., 2011). It consists of four subscales: career ambiguity (e.g., “I am anxious because I do not know what my aptitude is.”), lacking information (e.g., “I am concerned that I do not have enough information on the job I want.”), employment pressure (e.g., “I am worried that I might not get the job I want”), and external conflict (e.g., “I am worried that the job I want will not provide a reliable income.”). Responses were measured on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with higher scores indicating greater anxiety in the respective areas. Cronbach’s alpha for the overall career anxiety scale and the four subscales are 0.96, 0.89, 0.91, 0.95, and 0.90, respectively.

2.3 Data analysis

Descriptive statistics and Pearson’s correlations were provided, with no issues of multicollinearity or outliers detected. A one-way ANOVA analysis using SPSS was conducted to examine potential differences in time perspectives among SES groups, career anxiety, and the career anxiety subscales.

3. Results

The results of the descriptive statistics and Pearson correlations between variables are presented in Table 1.

Table 1 - Descriptive Statistics and Pearson correlations.

	Mean	SD	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Age	20.6	0.7							
(1) Present fatalistic	3.6	1.0	-						
(2) Present hedonistic	3.4	0.9	.44**	-					
(3) Future time perspective	1.8	0.9	-.38**	-.57**	-				
(4) Career ambiguity	2.8	1.1	.19**	.28**	-.16**	-			
(5) Lacking information	2.9	1.1	.25**	.22**	-.14*	.75**	-		
(6) Employment pressure	3.4	1.2	.22**	.17**	-.19**	.66**	.78**	-	
(7) External conflict	2.7	1.2	.29**	.22**	-.18**	.71**	.75**	.68**	-
(8) Career anxiety	3.0	1.0	.27**	.25**	-.18**	.87**	.92**	.88**	.89**

Note: ** $p < .01$; * $p < .05$

The results showed that present fatalistic is positively and significantly linked to present hedonistic ($r = .44, p < .01$) but negatively linked to FTP ($r = -.38, p < .01$).

Present fatalistic were found positively and significantly linked to career anxiety ($r = .27, p < .01$) and its four dimensions ($r = .19, r = .25, r = .22, \text{ and } r = .29; ps < .01$). Similarly, present hedonistic were found positively and significantly linked to career anxiety ($r = .25, p < .01$) and its four dimensions ($r = .28, r = .22, r = .17, \text{ and } r = .22; ps < .01$). However, FTP was also negatively linked to career anxiety ($r = -.18, p < .01$) and its four dimensions ($r = -.16, p < .01; r = -.14, p < .05; r = -.19, p < .01; \text{ and } r = -.18; p < .01$).

Figure 1 presents a series of violin plots of examined variables.

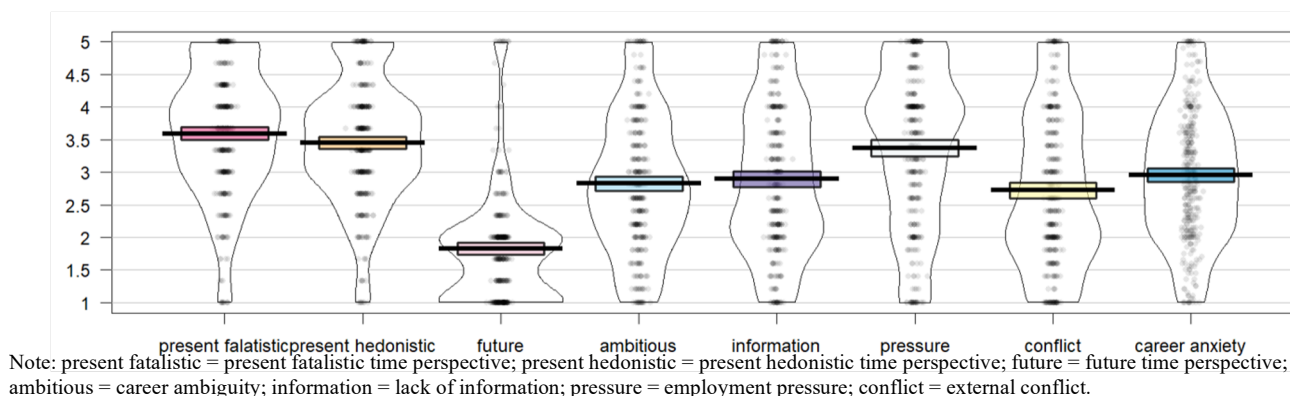


Figure 1 - Distribution of Examined Variables.

The present hedonistic time perspective variable displays a relatively symmetrical violin plot, suggesting a balanced distribution of values around the median. This indicates that individuals with a present hedonistic time perspective tend to place similar levels of importance on present enjoyment, with some variation in the responses.

Similarly, the present fatalistic time perspective also shows a balanced or slightly leaning tendency toward fatalistic thinking. The wide distribution reflects a range of views, suggesting that individuals may hold different levels of fatalistic attitudes toward the present, with some showing more concern than others.

In contrast, the FTP variable has a very narrow violin plot, reflecting low variability and a concentration of values around a specific point. This suggests that future-oriented thinking is less prominent or of less concern for most individuals.

Moreover, a paired samples t-test showed that the mean score of FTP is significantly lower than mean score of present fatalistic and present hedonistic ($ps < .001$). It indicates that, compared to present-oriented perspectives, future concerns are less widespread or less influential in this sample.

Regarding career anxiety variable and its dimensions, the figure reveals several dimensions of concern regarding one’s career, each with different characteristics. The career ambiguity dimension has a wide distribution with a slightly higher median, indicating variability in career motivation and goal-setting among individuals. Some individuals exhibit greater career ambition, while others show less concern or motivation.

The lack of information dimension of career anxiety has a central median with moderate variability. This suggests that most individuals feel relatively neutral or slightly positive about the information available to them, though some variation exists in how well-informed individuals feel about their career paths.

The employment pressure dimension of career anxiety shows a fairly symmetric distribution around a central

tendency. This implies moderate pressure regarding career concerns, with no extreme consensus. Most individuals report feeling a moderate amount of pressure without any overwhelming sense of urgency or stress.

Finally, the external conflict dimension of career anxiety displays a lower median with moderate variability. This suggests that while most individuals do not perceive high levels of conflict in their careers, there is some variation, with a few individuals experiencing more significant conflict or uncertainty.

Additionally, a paired samples t-test revealed that the mean scores for career anxiety was significantly higher than the mean scores for career ambiguity ($p < .001$), lack of information ($p < .011$), and external conflict ($p < .001$). However, the mean scores for employment pressure were significantly higher than those for career anxiety ($p < .001$).

In summary, career anxiety demonstrates a relatively higher median and broader distribution compared to its dimensions, with employment pressure standing out as a particularly prominent concern. This suggests that career-related anxiety is prevalent, with employment pressure being a notable source of stress.

A one-way between-participant Analysis of Variance (ANOVA) was conducted to examine the differences among SES group on examined variables. Because the Levene’s tests are not significant, the assumption of homogeneity of variances is met.

It revealed that there was a significant difference on present fatalistic ($F(2, 351) = 18.56, p < .001, \eta^2 = .10$), present hedonistic ($F(2, 351) = 12.08, p < .001, \eta^2 = .06$), and dimension career ambiguity ($F(2, 351) = 3.52, p = .031, \eta^2 = .02$) among the three SES groups.

Pairwise comparisons among the means were conducted using a Bonferroni to control for inflated type I error. Participants in the low SES group reported significantly higher present fatalistic ($M = 4.1; SD = 0.6$) than participants in the medium and high SES groups ($M = 3.5; SD = 1.0; M = 3.4; SD = 1.1$, respectively). However, participants in the low SES group reported significantly lower present hedonistic ($M = 3.0; SD =$

1.0) than participants in the medium and high SES groups ($M = 3.6$; $SD = 0.9$; $M = 3.6$; $SD = 0.9$, respectively). Similarly, participants in the low SES group reported significantly lower career ambiguity ($M = 2.6$; $SD = 0.9$) than participants in the medium SES group ($M = 2.9$; $SD = 1.1$). All other pairwise comparisons were not statistically significant.

In summary, SES groups differed significantly in present fatalistic, present hedonistic, and career ambiguity.

Table 2 - Descriptive Statistics across SES groups.

	Low SES		Medium SES		High SES		One-way ANOVA results
	Mean	SD	Mean	SD	Mean	SD	
(1) Present fatalistic	4.1	0.6	3.5	1.0	3.4	1.1	F (2, 351) = 18.56, p < .001, $\eta^2 = .10$
(2) Present hedonistic	3.0	1.0	3.6	0.9	3.6	0.9	F (2, 351) = 12.08, p < .001, $\eta^2 = .06$
(3) Future time perspective (FTP)	2.0	1.0	1.8	0.8	1.8	0.9	F (2, 351) = 1.93, p = .146
(4) Career ambiguity	2.6	0.9	2.9	1.1	2.9	1.0	F (2, 351) = 3.52, p = .031, $\eta^2 = .02$
(5) Lacking information	3.0	1.1	2.9	1.1	2.9	1.2	F (2, 351) = 0.21, p = .810
(6) Employment pressure	3.4	1.2	3.4	1.2	3.3	1.3	F (2, 351) = 0.32, p = .725
(7) External conflict	2.8	1.2	2.7	1.2	3.4	1.1	F (2, 351) = 0.21, p = .810
(8) Career anxiety	2.9	1.0	3.0	1.0	3.6	0.9	F (2, 351) = 0.07, p = .934

4. Discussion and Conclusions

The purpose of this study is to examine the relationship between time perspectives (present fatalistic, present hedonistic, and future) and career anxiety among teacher education undergraduates. The study reveals that present fatalistic and present hedonistic time perspectives were positively and significantly correlated with career anxiety and its dimensions, while future time perspective (FTP) showed a negative correlation, indicating that present-oriented thinking increases career anxiety, whereas future-oriented thinking reduces it. Low-SES students tend to exhibit higher levels of present fatalistic time perspectives and lower levels of present hedonistic time perspectives, with some differences in career anxiety dimensions, such as career ambiguity.

The study found that among Vietnamese teacher education undergraduates, present hedonistic and present fatalistic time perspectives are common, suggesting that many focus on immediate experiences but with differing emphasis. FTP is less prominent, indicating that most individuals are not highly concerned with long-term planning or future goals.

In terms of career anxiety, there is considerable variability across its dimensions. Career ambition shows a wide spread, suggesting differences in motivation and goal-setting. The results also suggest that career-related anxiety is prevalent, with employment pressure being a notable source of stress. This aligns with the context in Vietnam, where teacher employment opportunities are limited and primarily reliant on passing competitive

recruitment exams (Tran & Moskovsky, 2024; Vietnamese Government, 2012).

Consistent with previous research (e.g., Barnett et al., 2020; Hanna et al., 2023; King, 2016; Rönnlund et al., 2019; Zimbardo & Boyd, 2008; Zimbardo & Boyd, 1999), individuals with higher present fatalistic and present hedonistic time perspectives tend to exhibit lower FTP. These findings reflect an inverse relationship between focusing on the present – whether through a sense of resignation or a desire for immediate gratification – and adopting a future-oriented mindset.

Furthermore, both present fatalistic and present hedonistic perspectives are positively associated with career anxiety, indicating that individuals who either feel powerless over their circumstances or prioritize short-term pleasure are more likely to experience heightened concerns about their careers. In contrast, a strong FTP is negatively linked to career anxiety, suggesting that individuals with a clear focus on long-term goals and aspirations are less prone to career-related stress.

These findings align with Social Cognitive Career Theory (SCCT), which emphasizes the influence of self-efficacy, outcome expectations, and goals on career development (Lent et al., 1994). The negative relationship between FTP and career anxiety suggests that future-oriented students may possess stronger teaching self-efficacy and positive outcome expectations, facilitating goal-setting and persistence. Conversely, present-oriented perspectives correlate with lower career-related self-efficacy and negative outcome expectations, resulting in heightened anxiety.

The results revealed significant differences in present fatalistic, present hedonistic, and career ambiguity, highlight the distinct psychological and career-related attitudes across different SES groups.

Through the lens of SCCT, SES-based differences reflect varying levels of contextual supports and barriers that directly impact self-efficacy beliefs and outcome expectations (Brown & Lent, 2019; Lent et al., 2000). Lower SES students face financial instability, limited access to career resources, and elevated stress levels (Jury et al., 2017; Liu et al., 2019; Mac-Ginty et al., 2024; Ortiz-Hernández et al., 2007; Poon, 2020; Titus, 2006; Vine et al., 2012), which may undermine their career-related self-efficacy. This is evidenced by higher levels of present fatalistic thinking in this group, indicating a perception that their lives are heavily influenced by external circumstances beyond their control. This fatalistic outlook, stemming from persistent economic and social challenges, reduces their sense of agency and constrains their ability to envision positive future outcomes. The lower levels of present hedonistic orientation observed likely reflect restricted access to leisure opportunities, while lower career ambiguity suggests narrower perceived career options due to economic constraints. These contextual factors collectively shape cognitive-personal variables within SCCT, leading to the observed differences in time

perspectives and career anxiety dimensions across SES groups.

Conversely, individuals from higher SES backgrounds benefit from greater financial stability and access to career resources, which enable them to pursue ambitious goals and maintain a more optimistic outlook on life (Dar & Getz, 2007). The abundance of opportunities available to this group fosters a future-oriented perspective, allowing them to set long-term goals and invest in personal and professional growth. Greater access to leisure activities and experiences also contributes to higher levels of present hedonistic thinking, as they are better positioned to enjoy and prioritize immediate pleasures without significant economic worries. High SES individuals are less likely to experience the constraints that define the career paths of their low SES counterparts, which can result in greater career ambiguity. However, this ambiguity may be viewed positively, reflecting the flexibility and range of options available to them, rather than a lack of clarity or direction.

Implications and Limitations

This study emphasizes the importance of addressing present and future time perspectives and career anxiety, with a focus on the need for personalized interventions to promote better career outcomes for teacher education undergraduate students.

The study reveals that individuals with present fatalistic or present hedonistic time perspectives are more likely to experience heightened career anxiety. This highlights the potential benefit of interventions that encourage a future-oriented mindset. By shifting individuals' focus toward long-term career planning and goal-setting, career counselors and educators can help reduce anxiety and improve overall career trajectories. Programs designed to promote time management skills, as well as mindset shifts from short-term concerns to future planning, could alleviate career anxiety and enhance individuals' career outcomes.

Career anxiety, particularly related to employment pressure, emerges as a significant source of stress. The study highlights the importance of targeted interventions to address this specific type of anxiety. For Vietnamese teacher undergraduates, exploring diverse career pathways – such as working in private schools, pursuing studies abroad, or becoming researchers – can provide valuable alternatives to the limited opportunities available in public schools. Effective career guidance is essential in helping individuals navigate these challenges and reduce anxiety tied to employment expectations. By emphasizing practical coping strategies, educators or counselors can better support individuals in managing job-related stress and building resilience in their career journeys.

Career counselors and educators should focus on promoting future-oriented thinking and long-term career planning. Programs designed to develop time

management skills and shift mindsets from short-term concerns to future planning could significantly reduce anxiety and improve career outcomes. Additionally, practical coping strategies for managing job-related stress would help build resilience throughout students' career journeys.

Teacher education programs would do well to integrate interventions that help students shift from present-focused perspectives toward long-term career planning. Career counseling should emphasize goal-setting, time management, and diverse career opportunities beyond traditional teaching roles. Meanwhile, policymakers should consider alternative teacher employment models and enhanced financial aid programs to create a more equitable and resilient teacher workforce in Vietnam.

This study has several limitations that should be acknowledged. The sample size may not be fully representative of the broader population, and potential biases in self-reporting could affect the results. Moreover, the study did not conduct regression analysis to assess the strength and direction of the relationships between time perspectives, career anxiety, and other variables. Future research should aim to replicate these findings with larger, more diverse samples to validate the observed relationships. Longitudinal studies would offer a deeper understanding of how SES influences time perspectives and career anxiety over time, providing more comprehensive insights into the factors that shape career and life attitudes. Additionally, exploring other psychological variables and their interactions with SES could further enhance our understanding of the complex dynamics at play.

5. Conclusion

The study concludes that there are significant relationships among different time perspectives and between time perspectives and career anxiety among teacher education undergraduates. Specifically, focusing on immediate experiences (present fatalistic and present hedonistic perspectives) increases career anxiety, while long-term planning (future time perspective) reduces it. Additionally, low-SES students tend to have higher present fatalistic and lower present hedonistic perspectives, with notable differences in career anxiety dimensions, such as career ambiguity. These findings highlight the impact of socioeconomic status on time perspectives and career-related stress.

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Mindfulness levels among pre-service English language teachers: a comparative analysis of KIMS and MAAS scales

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Abstract

Mindfulness practices have gained increasing attention in educational settings, including language classrooms, for their potential to benefit both learners and teachers. While research highlights the positive impact of mindfulness on language learners, its role in the professional development of language teachers remains an area of interest. This study explores mindfulness levels among pre-service English language teachers and examines the comparability of two widely used mindfulness assessments: the Kentucky Inventory of Mindfulness Skills (KIMS) and the Mindful Attention Awareness Scale (MAAS). A total of 148 pre-service English language teachers from a Turkish state university participated in this quantitative study. Data were collected through online self-reported questionnaires, with both KIMS and MAAS demonstrating acceptable reliability for this sample. Descriptive and inferential statistical analyses revealed that participants exhibited moderate mindfulness levels across both scales. While overall mindfulness levels did not significantly vary based on demographic factors, notable differences emerged in specific subcomponents of KIMS and MAAS concerning gender and class level. Additionally, significant relationships were found between mindful attention awareness and the ‘describe’ and ‘act with awareness’ dimensions of KIMS. These findings suggest that pre-service English language teachers generally demonstrate moderate mindfulness levels, regardless of demographic characteristics. Moreover, the comparability of KIMS and MAAS results indicates that both instruments can be effectively used to assess mindfulness in this population.

KEYWORDS: Pre-Service Teachers, English Language Education, Mindfulness Assessment, Teacher Wellbeing.

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1. Introduction

As a way of activating the mind, body, and spirit, meditation dates back to ancient times and is associated with Hinduism and Buddhism (Cullen, 2011; Didonna,

2009; Hyland, 2014; Kabat-Zinn, 2003). Meditation aims to reach a particular state of mind, i.e., mindfulness, documented with diverse conceptualizations. Kabat-Zinn (2003) offers an operational working definition of mindfulness as a technique in Buddhist meditation when he describes it as “the awareness that emerges through paying attention on purpose, in the present moment, and nonjudgmentally to the unfolding of experience moment by moment” (p. 145). Zeilhofer (2023), highlighting the common themes of the existing definitions, shares the conceptualization of the term “as a state of mind in which one is observing one’s own actions in a way that is detached and non-reactionary and, most notably, with an emphasis on utilizing one’s

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awareness and attention” (pp. 97-98). Baer et al. (2006) tend to conceptualize mindfulness as a “multifaceted construct” (p. 42), including observe, describe, act with awareness, non-judge, and non-react. This five-dimension-conceptualization covers related abilities to notice experiences, express thoughts and feelings, fully engage in one’s experiences, stay away from judgments, and accept feelings and thoughts as they are.

Synthesizing the existing research, Roeser (2014) lists five types of mindfulness practices as “a process of skill and disposition development” (p. 394), including body scan, focused attention meditation, open monitoring meditation, loving-kindness meditation, and mindful movement. In body scan, attention is directed to the body and sensation of the individual sitting or lying down to relax the muscles, which avoids mindlessness and helps self-awareness and focused attention. Focused attention requires focusing on a single point such as a breath, a sound, or an image to observe nonjudgmentally and thus avoid mind-wandering. Open monitoring, on the other hand, generally occurs after focused attention and requires cultivating awareness and observing their awareness without focusing on one single point. In loving-kindness meditation, one repeats positive affirmations, directing them to both themselves and others, to have positive feelings such as kindness, empathy, harmony, and so forth. Lastly, in mindful movements, intentional physical activities such as yoga, tai-chi, and walking foster a deep connection with the body.

Rooted in Eastern psychology, mindfulness-based interventions aim to maintain “a fine balance of maintaining the integrity of the Buddhas’ teachings whilst applying it to the needs of the present day” (de Zoysa, 2016, p. 368). Mindfulness practices have gained significant popularity, particularly following the development of the mindfulness-based stress reduction program by Jon Kabat-Zinn at the University of Massachusetts Medical School in 1979 (de Zoysa, 2016; Hyland, 2014). Since then, mindfulness practices have found their way into various domains, spanning clinical and research programs, such as mindfulness-based stress reduction (Cullen, 2011; Didonna, 2009; Hyland, 2014; Kabat-Zinn, 2003), as well as education, where they are regarded as “a promising emerging approach to enhancing teaching, learning, and well-being in schools” (Roeser, 2014, p. 379). The current literature extensively highlights the potential benefits of mindfulness-based interventions across various educational domains. These interventions have been associated with improved knowledge recall (Bennett et al., 2018), reduced test anxiety (Tekin & Satan, 2024), and increased resilience among learners (Bennett et al., 2018; Tekin & Satan, 2024). Moreover, they facilitate learners in self-regulating their emotions and behaviors during the learning process (Bockmann & Yu, 2023), mitigating burnout levels for both learners and educators (de Carvalho et al., 2021; Gao, 2023; Yıldız-Akyol & Demir, 2019), enhancing attention, and

alleviating stress (Baena-Extremera et al., 2021; Morgan & Katz, 2021). Additionally, mindfulness practices have shown promise in improving overall well-being (Kuru Gönen, 2022), fostering creativity (Cheng, 2023), and boosting self-regulation, self-efficacy, and well-being among teachers (de Carvalho et al., 2021). These interventions also contribute to creating a nurturing classroom environment (de Carvalho et al., 2021) and aiding teachers in coping with job-related stress and burnout (Taylor et al., 2016; Taylor et al., 2021). Furthermore, mindfulness approaches have been linked to character development, moral values, and adaptive thinking and behavioral patterns (Ergas & Hadar, 2020). This is merely a glimpse into the wealth of benefits documented in the literature. Such interventions have been welcomed in foreign language education, particularly anxiety and burnout as two negative emotions need to be addressed to ensure positive learning outcomes (Gao, 2023). Unlike proponents of mindfulness, critics of mindfulness-based interventions, particularly in educational settings, identify various perceived barriers. These barriers include the heavy workload on teachers, time constraints, concerns about mindfulness being associated with Buddhism leading to potential religious conflicts, limited understanding among both teachers and students, insufficient physical space within educational settings, potential hindrance to student engagement due to embarrassment, the necessity of informing all stakeholders, the requirement for support from school administration, the unique nature of mindfulness, and the importance of teacher training (Wigelsworth & Quinn, 2020).

Despite numerous studies examining the effects of mindfulness and meditation-based interventions in various contexts such as general learning, and medical and health settings (Baer et al., 2006), the incorporation of such interventions in foreign language classrooms remains relatively rare and innovative (Gao, 2023; Kuru Gönen, 2022; Zeilhofer, 2023). Among these limited applications, Zeilhofer (2023) investigated the role of meditative practices, specifically guided meditation and the count-to-ten method, within a German learning environment in Japan. The study revealed that implementing such interventions led to heightened language awareness and improved academic performance among the participants. Besides, the participants found the intervention quite pleasing. Similarly, in a descriptive and correlational study with Chinese English learners, Gao (2023) found that learners with a low level of mindfulness tended to suffer from burnout, thereby feeling less proficient in English. The study, therefore, justifies the employment of mindfulness-based interventions “as a tool to break the vicious circle of students’ negative emotions and their perception of their language competence” (Gao, 2023, p. 12). In another quasi-experimental study, Moghadam et al. (2020) investigated the role of mindfulness-based instruction on reading and writing

as well as burnout for Iranian English learners. Their treatment aimed at helping learners retain consciousness and develop a tolerant attitude toward how they think, feel, and behave, which all were expected to teach them how to regulate their emotional states and become academically successful. They found that the treatment depleted the burnout levels of the participants and enhanced their reading and writing skills. Among the other positive outcomes, they listed high interest and engagement in language learning, enhanced ability to express feelings, motivation towards learning outside classroom borders, positive attitudes towards in-class language activities, positive classroom atmosphere, willingness to speak, positive traits including self-confidence, self-satisfaction, self-concept, and courage, and positive vision of their future career. Zeilhofer and Sasao (2022) conducted another related study where they found that a high level of mindfulness helps productive and receptive vocabulary learning. Besides, studies exploring participants' mindfulness levels have not reached a consensus, in that there are several documenting a low level of mindfulness (see, for instance, Ulivia et al., 2022). Yet, the existing literature presents studies with an opposite picture, i.e., participants with a moderate or above moderate level of mindfulness (Tural & Küçükkaragöz, 2021).

In addition to the positive outcomes of mindfulness practices for students, it has been recently documented that such practices could enhance teachers' well-being and motivation (Pan & Liu, 2022), increase their immunity and work engagement (Li, 2022), encourage pre-service teachers to reflect on their practices, contribute to the construction of self-care, and supportive interaction, which are all assumed to contribute to personal growth and decrease teacher burnout (Dirghangi, 2019), as well as contribute to language teachers' professional development (Roeser et al., 2012). In a correlational study, Hermana et al. (2021) found that mindfulness and social-emotional competence could enhance the academic achievement of pre-service English teachers, for they encourage positive mood and motivation to further knowledge. Mindfulness-based interventions are thus suggested as a way to endure the training of professionally qualified language teachers. In another study, Hue and Lau (2015) found that their mindfulness program enhanced the psychosocial condition of pre-service English teachers in Hong Kong, letting them suggest that such interventions are feasible to improve pre-service teachers' well-being and decrease their anxiety. However, pre- and in-service teachers' perceptions of mindfulness-based interventions are under-researched (Wigelsworth & Quinn, 2020), and empirical investigations into the role of mindfulness within teacher education are notably scarce in the extant literature (Yuan et al., 2023). Moreover, English teachers' understanding of the concept is still partial, thereby creating the need to raise awareness levels

among all stakeholders in education, including administrators, teachers, students, and parents (Khalid et al., 2023; Wigelsworth & Quinn, 2020).

As evidenced by research, meditation and mindfulness-based interventions have recently received much attention in Türkiye. The related previous research in this area can be broadly categorized into five categories. One category consists of studies investigating the effects of mindfulness-based programs or interventions. The studies collectively showed that mindfulness interventions benefit EFL teachers' resilience, well-being, and interactions (Çiçek & Gürbüz, 2023), improve teachers' well-being and immunity (Karanfil, 2023), enhance EFL students' academic resilience and attitudes toward mindfulness (Erdemir et al., 2024), increase students' willingness to communicate, emotion regulation, concentration, mindfulness awareness, and decrease speaking anxiety (Yangın-Ersanlı & Ünal, 2022), improve English teachers' motivation (Olgun-Pamuk, 2021), boost EFL students' speaking performance (Öz, 2017), and reduce anxiety while enhancing vocabulary test proficiency among English-majoring freshmen (Önem, 2015).

In addition to quasi-experimental studies, there are a few descriptive studies investigating the mindfulness levels among language students. These studies revealed varying levels of mindfulness. To illustrate, Demirci (2022) found preparatory program students with moderate mindfulness and learner autonomy, Koçali (2020) observed moderate mindfulness levels alongside anxiety, Tural and Küçükkaragöz (2021) described preparatory program students with above-moderate mindfulness levels unrelated to achievement or gender, and Altan (2021) identified high mindfulness levels among EFL pre-service teachers using the MAAS scale.

Alongside the examination of mindfulness interventions and descriptive studies, another focal point of research focuses on scale validity studies, evaluating the effectiveness of recent scales in measuring mindfulness-related constructs. For instance, Deniz et al. (2023) examined the concurrent validity of the Fears and Resistances to Mindfulness Scale (FRMS), developed by Gilbert et al. (2023), revealing a negative correlation between fear, resistance, depression, anxiety, stress, and life satisfaction, while Arslan et al. (2020) validated the Adolescent and Adult Mindfulness Scale (AAMS) by Droutman et al. (2018) for Turkish undergraduate university students.

In addition to the aforementioned categories, there are systematic review studies that have explored the impact of mindfulness on foreign language education, emphasizing its positive effects (see, for example, Koçali & Asik, 2022; Pektaş, 2023), and several other studies focusing on mindfulness applications, suggesting mindfulness-informed language teaching tasks and activities for EFL educators (e.g., Kuru Gönen, 2022).

Diverse challenges of the modern and interconnected world including isolation resulting from technological advancements, poor nutrition, various discriminatory acts, environmental problems, economic issues and problems, conflicts, wars, and illnesses all worsen this picture for not only teachers but also students. Besides, the interactive and imaginary nature of English teaching in the evolving globalized world makes teachers feel unsure about their teaching content and actual and practical situations students need to be prepared for, which all cause discomfort and burnout in teachers (Kramersch, 2014).

Therefore, to create a conducive learning environment, it is essential for teachers to be mindful of mindfulness practices, given their potential to yield various positive outcomes as listed above. Additionally, as Schelhorn et al. (2023) state, teachers' emotional competence, mental health, and self-regulation skills directly affect teacher-student relationships, thereby creating the need for emotional competence training. The preliminary step of such training should be incorporating mindfulness and mindfulness-based pedagogies into teacher preparation, benefiting both their awareness and their own well-being. As Dirghangi puts it, "pre-service English teachers enter their teaching careers already at risk of burnout," given the nature and demands of their roles during student teaching. Therefore, recognizing the significance of mindfulness practices in mitigating stress and enhancing well-being among pre-service teachers, it is crucial to address the specific challenges they face. These challenges include the imminent threat of burnout, as "with little experience and in a short time, pre-service English teachers in their student teaching must build trusting relationships, identify areas of need in developing student literacy, familiarize themselves with curricular materials, and perform alongside decades-old school testing pressures" (Dirghangi, 2019, p. 72).

Furthermore, through the examination of pre-service teachers' mindfulness levels and emotional awareness, a deeper understanding of their needs and challenges can be gained. This insight could guide administrators and teacher educators in expanding teacher education curricula and programs to incorporate strategies and practices aimed at enhancing pre-service teachers' awareness and understanding of these issues. Such efforts do not only benefit pre-service teachers but also positively impact their future students (Altan, 2021; Chen et al., 2024).

Moreover, existing studies have reported contradictory findings regarding the correlation between mindfulness levels and gender (e.g., Alispahic & Hasanbegovic-Anic, 2017; Sipahutar et al., 2023), highlighting the need for further research to clarify this relationship. Accordingly, in response to recent calls to investigate mindfulness and related issues in the foreign language classroom, the current study aims to explore the

mindfulness levels of pre-service teachers across all levels.

Accordingly, in response to the recent calls to investigate mindfulness and related issues in the foreign language classroom, the current study aims to explore the mindfulness levels of pre-service teachers from all levels. To that end, two oft-cited scales, i.e., the Kentucky Inventory of Mindfulness Scale (KIMS) developed by Baer et al. (2004; 2006) and the Mindful Attention Awareness Scale (MAAS) developed by Brown and Ryan (2003), were used to see whether there is a significant correlation between these scales. To achieve these aims, the following research questions and sub-questions were devised:

1. What are the mindfulness levels of pre-service English language teachers in different class levels, ages, and genders?
 - 1.1. How do the overall mindfulness levels vary among different class levels, ages, and genders?
 - 1.2. Are there specific facets of mindfulness that differ significantly across class levels, ages, and genders?
2. Do the two different mindfulness scales (KIMS and MAAS) yield comparable results among pre-service English language teachers?
 - 2.1. How do the individual subscales of KIMS correlate with the scores obtained from MAAS?
 - 2.2. Can the scores from the KIMS subscales predict the scores obtained from MAAS?

These research questions aim to investigate both the levels of mindfulness among pre-service English language teachers and the comparability of results obtained from different mindfulness scales. By addressing these questions, the study seeks to contribute to understanding mindfulness among this particular group and assessing the soundness of the selected measurement tools.

2. Material and Methods

To answer the research questions of the current study, a quantitative research approach was opted for several reasons (Dörnyei, 2007). Describing the mindfulness levels of the participants required gathering data centering around numbers with scales covering the predetermined categories of the measured concept. The researchers' interest in describing the mindfulness level of the whole group with all five levels rather than unique cases and their aim at following a standardized procedure with the two predetermined scales to gather reliable, replicable, and generalizable data to different settings required the adoption of a quantitative approach.

The setting of the current study was the English Language Teaching Department of a Turkish state

university, located in the northeast of the country. The sample of the study included 148 pre-service teachers studying in different levels of the teacher training program to get their BA degree in teaching English: preparatory program students (N=25), freshmen (N=27), sophomores (N=21), juniors (N=28), seniors (N=22), and recent graduates (N=25). The sample included 72% female and 28% male pre-service teachers. The majority, comprising 90%, were aged 24 years and younger, while the remaining 10% were 25 years old and above.

To collect the data, the researchers asked the participants to fill in two self-report scales converted into Google Docs questionnaires, using their institutional e-mails at their convenience. The researchers opted for two well-documented scales in the field. The first one is a five-facet-mindfulness questionnaire (FFMQ) developed by Baer et al. (2004, 2006), which is accepted as the most prominent mindfulness scale (Zeilhofer, 2023). The 5-item Likert scale in the form of a self-report questionnaire covers 39 items grouped under four facets of mindfulness: (1) observing, (2) describing, (3) acting with awareness, and (4) accepting without judgment. The second scale used to describe the participants' mindfulness level is the Mindful Attention Awareness Scale (MAAS) developed by Brown and Ryan (2003). This self-report questionnaire covers 15 items and a 6-point Likert scale to find out individuals' attention and awareness of their current daily life experiences. The two scales were chosen, for they are documented as the most popular mindfulness scales and reported as reliable and valid measurement tools with a high internal consistency to allow meaningful, consistent, and appropriate interpretations of the scores (see, for instance, Christopher et al., 2012, for the former and Hue & Lau, 2015, for the later). Still, the researchers attempted to ensure quantitative quality standards by choosing those two scales documented as a reliable and valid measurement tool as well as calculating Cronbach's alpha coefficients. The reliability analysis conducted on the subscales of the KIMS, encompassing Observe ($\alpha=.833$), Describe ($\alpha=.829$), Act with awareness ($\alpha=.763$), Accept without judgment ($\alpha=.848$), along with the MAAS ($\alpha=.909$), demonstrated strong internal consistency within the current study sample. All Cronbach's alpha coefficients exceeded the threshold of .70, indicating a high level of reliability, as widely accepted in the field (Tabachnick & Fidell, 2007).

Prior to data analysis, thorough checks were performed to ensure data integrity. This included scrutinizing for missing values, and outliers, and assessing normality. Notably, no missing values or outliers were detected, and assessments for normality, including skewness and kurtosis, indicated a normal distribution of the data. These preparatory steps were essential for organizing the data effectively and determining appropriate statistical tests for analysis. Statistical Package for the Social Sciences (SPSS) 29 was used to analyze the data,

using both descriptive and inferential statistics. Descriptive statistics were calculated to find out the overall mindfulness levels of the participants in both scales. Inferential statistics, on the other hand, were calculated to compare the means across the year of study, gender, and age variables. One-way ANOVA was used to compare the means based on the year of study variable including six categories (from prep to graduate), thus leading to select the Bonferroni post-hoc test, which is one of the conservative ways to control Type-1 error in addressing multiple comparisons (Sauder & DeMars, 2019). Besides, a t-test was used to do the analyses based on gender and age variables. The researchers also performed the Pearson Product-Moment Correlation Analysis to determine the relationship between scores obtained from the MAAS and KIMS with all five subscales. Lastly, a multiple linear regression analysis was performed to determine the predictive power of KIMS subskills to predict MAAS.

3. Results

Descriptive statistics regarding the scores obtained from KIMS subscales and the MAAS to determine the mindfulness levels of pre-service teachers were examined, and the findings are presented in Table 1.

Table 1 - Descriptive statistics for KIMS subscales and MAAS scale.

Scale/Subscales	n	\bar{X}	SD	Min	Max
KIMS/Observe	148	3.36	.652	1.67	4.92
KIMS/Describe	148	3.32	.654	1.63	5.00
KIMS/Act with awareness	148	2.91	.637	1.00	4.30
KIMS/Accept without judgment	148	2.93	.745	1.11	4.78
MAAS	148	3.66	.975	1.40	5.67

Upon examination of the mean scores obtained by pre-service teachers from the KIMS subscales and MAAS, it was evident that they all exhibited moderate levels of mindfulness across all measures.

The differences between the pre-service teachers' mindfulness skills and mindful attention awareness according to their educational class levels were examined. Descriptive statistics pertaining to this investigation are presented in Table 2, while the results of the One-Way ANOVA analysis regarding the differentiation status are provided in Table 3.

When examining Table 2, it is observed that graduate students exhibit the highest average score for the observe ($\bar{X}=3.72$) and describe ($\bar{X}=3.65$) skills.

Table 2 - Descriptive statistics regarding the class (year of study) variable.

Scale/Subscales	Year of Study	n	\bar{X}	SD
KIMS/ Observe	Prep	25	3.11	.582
	Freshman	27	3.32	.623
	Sophomore	21	3.44	.597
	Junior	28	3.27	.717
	Senior	22	3.31	.524
	Graduate	25	3.72	.720
KIMS/ Describe	Prep	25	3.29	.536
	Freshman	27	3.21	.556
	Sophomore	21	3.40	.680
	Junior	28	3.04	.610
	Senior	22	3.39	.662
	Graduate	25	3.65	.769
KIMS/ Act with awareness	Prep	25	3.04	.705
	Freshman	27	2.71	.617
	Sophomore	21	3.07	.669
	Junior	28	2.88	.538
	Senior	22	3.00	.575
	Graduate	25	2.82	.702
KIMS/ Accept without judgment	Prep	25	3.01	.717
	Freshman	27	2.86	.674
	Sophomore	21	3.00	.840
	Junior	28	2.86	.761
	Senior	22	3.06	.797
	Graduate	25	2.85	.753
MAAS	Prep	25	3.52	.953
	Freshman	27	3.45	1.016
	Sophomore	21	3.97	1.224
	Junior	28	3.67	.764
	Senior	22	3.38	.758
	Graduate	25	4.03	1.015

In contrast, sophomore students demonstrate the highest average score for the act with awareness skill ($\bar{X}=3.07$), and senior students for accept without judgment ($\bar{X}=3.06$). Additionally, the highest average score for the MAAS is observed among graduate

students ($\bar{X}=4.03$). In other words, graduates are the group with the highest average mindful attention awareness.

Table 3 - ANOVA results for KIMS subscales and MAAS scores by class (year of study) variable.

Scale/ Subscales	Year of Study	Sum of Squares	df	Mean Square	F	p	Sig.
KIMS/ Observe	Between groups	5.134	5	1.027	2.537	.031*	Prep- Graduate
	Within groups	57.473	142	.405			
	Total	62.606	147				
KIMS/ Describe	Between groups	5.447	5	1.089	2.686	.024*	Junior- Graduate
	Within groups	57.596	142	.406			
	Total	63.043	147				
KIMS/ Act with awareness	Between groups	2.433	5	.487	1.205	.310	-
	Within groups	57.338	142	.404			
	Total	59.770	147				
KIMS/ Accept without judgment	Between groups	1.000	5	.200	.351	.881	-
	Within groups	80.799	142	.569			
	Total	81.798	147				
MAAS	Between groups	8.700	5	1.740	1.883	.101	-
	Within groups	131.180	142	.924			
	Total	139.879	147				

As shown in Table 3, the one-way analysis of variance (ANOVA) conducted to determine whether there was a significant difference in pre-service teachers' scores on KIMS subscales and the MAAS according to the class variable revealed that there was no significant difference in pre-service teachers' scores on the MAAS scale based on class level ($F(5, 142) = 1.883; p > .05$). In other words, the mindful attention awareness of pre-service teachers remained consistent across different class levels. However, significant differences across class levels were identified between the participants scores for KIMS/Observe and KIMS/Describe skills [KIMS/Observe ($F(5, 142) = 2.537; p < .05$)], [KIMS/Describe ($F(5, 142) = 2.686; p < .05$)].

Subsequent Bonferroni test outcomes, aimed at identifying specific group discrepancies, are presented in Table 4 and Table 5.

Table 4 - Bonferroni test results for KIMS/observe scores by class (year of study) variable.

(I) Year of Study	(J) Year of Study	Mean Difference (I-J)	Std. Error	p
Prep	Freshman	-.20765	.17658	1.000
	Sophomore	-.32317	.18832	1.000
	Junior	-.15750	.17506	1.000
	Senior	-.20106	.18598	1.000
	Graduate	-.60333*	.17994	.015
Freshman	Prep	.20765	.17658	1.000
	Sophomore	-.11552	.18510	1.000
	Junior	.05015	.17160	1.000
	Senior	.00659	.18272	1.000
	Graduate	-.39568	.17658	.399
Sophomore	Prep	.32317	.18832	1.000
	Freshman	.11552	.18510	1.000
	Junior	.16567	.18365	1.000
	Senior	.12211	.19409	1.000
	Graduate	-.28016	.18832	1.000
Junior	Prep	.15750	.17506	1.000
	Freshman	-.05015	.17160	1.000
	Sophomore	-.16567	.18365	1.000
	Senior	-.04356	.18125	1.000
	Graduate	-.44583	.17506	.179
Senior	Prep	.20106	.18598	1.000
	Freshman	-.00659	.18272	1.000
	Sophomore	-.12211	.19409	1.000
	Junior	.04356	.18125	1.000
	Graduate	-.40227	.18598	.483
Graduate	Prep	.60333*	.17994	.015
	Freshman	.39568	.17658	.399
	Sophomore	.28016	.18832	1.000
	Junior	.44583	.17506	.179
	Senior	.40227	.18598	.483

Table 5 - Bonferroni test results for KIMS/describe scores by class (year of study) variable.

(I) Year of Study	(J) Year of Study	Mean Difference (I-J)	Std. Error	p
Prep	Freshman	.07667	.17677	1.000
	Sophomore	-.11976	.18852	1.000
	Junior	.24482	.17524	1.000
	Senior	-.10136	.18617	1.000
	Graduate	-.36000	.18013	.714
Freshman	Prep	-.07667	.17677	1.000
	Sophomore	-.19643	.18530	1.000
	Junior	.16815	.17178	1.000
	Senior	-.17803	.18292	1.000
Sophomore	Graduate	-.43667	.17677	.220
	Prep	.11976	.18852	1.000
	Freshman	.19643	.18530	1.000
	Junior	.36458	.18385	.739
	Senior	.01840	.19430	1.000
Junior	Graduate	-.24024	.18852	1.000
	Prep	-.24482	.17524	1.000
	Freshman	-.16815	.17178	1.000
	Sophomore	-.36458	.18385	.739
	Senior	-.34619	.18145	.876
Senior	Graduate	-.60482*	.17524	.011
	Prep	.10136	.18617	1.000
	Freshman	.17803	.18292	1.000
	Sophomore	-.01840	.19430	1.000
	Junior	.34619	.18145	.876
Graduate	Graduate	-.25864	.18617	1.000
	Prep	.36000	.18013	.714
	Freshman	.43667	.17677	.220
	Sophomore	.24024	.18852	1.000
	Junior	.60482*	.17524	.011
	Senior	.25864	.18617	1.000

Upon review of Table 4, it becomes apparent that there exists a statistically significant difference favoring graduate students in their *observe* skill scores compared to prep students. This suggests that graduate students have higher observe skills.

When reviewing Table 5, it is evident that there is a statistically significant advantage for graduate students over junior students in their *describe* skill scores. This implies that graduate students tend to exhibit higher levels of the describe skill.

The findings regarding the gender-based differences in pre-service teachers' mindfulness skills and mindful attention awareness are presented in Table 6. Upon reviewing the table, it is evident that there is no statistically significant difference between male and female students' MAAS scores, as determined by an independent samples t-test ($t(146)=.927$; $p>.05$). Consequently, there was no substantial fluctuation in the mindful attention awareness of pre-service teachers concerning gender. However, concerning the Act with awareness skill, a significant difference emerges between male ($\bar{X}=3.14$) and female ($\bar{X}=2.82$) students' mean scores ($t(146)=2.783$; $p<.05$). Similarly, a significant difference is observed between male ($\bar{X}=3.15$) and female ($\bar{X}=2.85$) students' mean scores in the Accept without judgment skill ($t(146)=2.229$; $p<.05$).

Upon reviewing Table 7, it is observed that there is no statistically significant difference in the mean scores of KIMS subscales and MAAS between students aged 24 and below compared to those aged 25 and above. Put differently, the mindfulness skills and mindful attention awareness of pre-service teachers did not show variation according to age.

The findings of the correlation analysis conducted to determine the relationship between mindfulness skills in the KIMS and mindful attention awareness for the second research question are presented in Table 8.

As seen in Table 8, significant correlations were found between the MAAS and KIMS subscales of describe and act with awareness. In other words, significant relationships have been observed between mindful attention awareness and the skills of describing and acting with awareness. Accordingly, a moderate, positive, and significant correlation was identified between pre-service teachers' MAAS scores and KIMS/Describe scores ($r=.316$, $p<.001$). Similarly, a moderate, positive, and significant correlation was determined between students' MAAS scores and KIMS/Act with awareness scores ($r=.388$, $p<.001$).

The findings of the multiple linear regression analysis conducted to determine the prediction of pre-service teachers' mindful attention awareness as determined by the MAAS by mindfulness skills in the KIMS are presented in Table 9.

Table 6 - Independent samples t-test results for KIMS subscales and MAAS scores by gender variable.

Scale/ Subscales	Gender	n	\bar{X}	SD	df	t	p
KIMS/ Observe	Male	42	3.22	.606	146	-1.681	.095
	Female	106	3.42	.665			
KIMS/ Describe	Male	42	3.26	.684	146	-.650	.517
	Female	106	3.34	.645			
KIMS/ Act with awareness	Male	42	3.14	.548	146	2.783	.006
	Female	106	2.82	.651			
KIMS/ Accept without judgment	Male	42	3.15	.858	146	2.229	.027
	Female	106	2.85	.682			
MAAS	Male	42	3.78	.957	146	.927	.356
	Female	106	3.62	.983			

Table 7 - Independent samples t-test results for KIMS subscales and MAAS scores by age variable.

Scale/ Subscales	Age	n	\bar{X}	SD	df	t	p
KIMS/ Observe	24 and below	133	3.34	.653	146	-1.305	.194
	25 and above	15	3.57	.634			
KIMS/ Describe	24 and below	133	3.29	.647	146	-1.668	.097
	25 and above	15	3.58	.690			
KIMS/ Act with awareness	24 and below	133	2.89	.658	146	-1.610	.120
	25 and above	15	3.08	.393			
KIMS/ Accept without judgment	24 and below	133	2.95	.724	146	.773	.441
	25 and above	15	2.79	.933			
MAAS	24 and below	133	3.65	.976	146	-.381	.704
	25 and above	15	3.76	1.000			

Table 8 - Pearson Product-Moment Correlation analysis results for the relationship between MAAS and KIMS subscale scores.

		MAAS	KIMS/ Observe	KIMS/ Describe	KIMS/ Act with awareness	KIMS/ Accept without judgment
MAAS	r	1	.018	.316**	.388**	.128
	p		.832	.000	.000	.122
	n		148	148	148	148

Note: **p<.001, *p<.05

Table 9 - Multiple linear regression analysis for predicting MAAS from KIMS.

	B	Standard Error	β	t	p
Constant	1.21	.70		1.75	.082
KIMS/ Observe	-.08	.15	-.053	-.53	.595
KIMS/ Describe	.40	.14	.27	2.88	.005
KIMS/ Act with awareness	.48	.13	.31	3.77	.000
KIMS/ Accept without judgment	.00	.12	.00	.04	.972

Note: $R=.453$ $R^2=.205$ $Adj. R^2=.183$ $F(4, 143)=9.23$, $p<.001$

A multiple linear regression was conducted to determine the predictability of independent KIMS skills on mindful attention awareness, with a Durbin-Watson test result of 1.71, indicating that there was positive autocorrelation (Flatt & Jacobs, 2019). Using the enter method (i.e., forced entry) of regression, the analysis revealed that the model established to explain MAAS was significant ($F(4, 143)=9.23$, $p<.001$), explaining 18% of the variance in total by the KIMS skills. According to the standardized regression coefficients (β), the relative importance of KIMS skills on mindful attention awareness was observed in the following order: Act with awareness, describe, observe, and accept without judgment. As per the established model, the describe skill was the best predictor for mindful attention awareness ($\beta = .27$, $SE = .14$, $t = 2.88$, $p < .001$). Likewise, the skill of act with awareness also showed a significant association with mindful attention awareness ($\beta = .31$, $SE = .13$, $t = 3.77$, $p < .001$). However, no other variables demonstrated a significant explanatory relationship with mindful attention awareness.

4. Discussion and Conclusions

The aims of the present study were twofold. First, it sought to assess the mindfulness levels of pre-service English language teachers, considering various factors such as class levels, ages, and genders. Second, it intended to compare the results obtained from two different mindfulness scales, namely the KIMS and MAAS. The findings revealed moderate levels of mindfulness across all measures among the pre-service teachers, indicating a consistent level of mindfulness awareness within this cohort and confirming Altan (2021). These results suggest that regardless of their demographic characteristics, mindfulness exists among pre-service teachers as a trait. Therefore, it could be concluded that Turkish pre-service English language teachers could focus on the moment and overcome their current problems (Altan, 2021).

The quantitative findings showed that the overall mindfulness levels did not significantly differ across class levels, ages, or genders. However, notable differences in specific aspects of mindfulness concerning class levels, ages, and genders were identified. This highlights the significance of considering demographic factors in assessing their levels of mindfulness. Consequently, there arises a need to devise mindfulness-based interventions in pre-service teacher training programs that account for such demographic differences.

Firstly, the examination of variances in mindfulness skills and mindful attention awareness based on educational class levels yielded interesting insights. The findings highlighted the absence of significant differences in overall mindful attention awareness across different class levels. This suggests that academic standing (i.e., grade level) does not significantly alter the overall level of mindfulness attention awareness among pre-service teachers of English. However, the participants' mindfulness skills in all four areas in KIMS, including the skills to observe, describe, act with awareness, and accept without judgment, were found to be meaningfully different across various levels, highlighting the role of educational succession.

The highest average score for the skills of observing and describing belonged to the graduate participants, showing heightened abilities in perceiving and articulating experiences. On the other hand, the sophomores exhibited superior scores in the act with awareness skill, suggesting active involvement in present-moment experiences rather than dwelling on the past. Furthermore, graduates demonstrated the highest average score for mindful attention awareness, illustrating an enhanced overall awareness. In general, these education-level dependent findings highlight the potential impact of educational progression on the cultivation of specific mindfulness skills among pre-

service teachers, recognizing mindfulness as a skill that can be improved over time (Altan, 2021).

Another purpose of the present research was to see whether both scales indicated any gender-based variations in mindful attention awareness and mindfulness skills. The analysis of MAAS did not prompt any significant differences between male and female participants. However, the statistical analysis of KIMS highlighted important gender disparities in two sub-skills, namely act with awareness and accept without judgment, with male participants' mean scores surpassing those of their female counterparts. The present study corroborates those of the previous ones (e.g., Alispahic & Hasanbegovic-Anic, 2017) that found gender-related differences, yet, it has conflicting result with other earlier studies disproving the hypothesis that there is a correlation between gender and mindfulness (see, for instance, Sipahutar et al., 2023).

On the other hand, the finding of the present study portraying older participants as highly mindful (e.g., Alispahic & Hasanbegovic-Anic, 2017) conflicts with earlier studies. The consistent level of mindfulness across different age groups allows researchers to conclude that age-related development may not affect mindfulness levels, contrary to previous suggestions.

Finally, the present study aimed to evaluate the effectiveness and compatibility of two mindfulness scales, the KIMS and MAAS, in assisting researchers to measure mindfulness levels among pre-service English language teachers. The absence of significant differences in overall mindfulness scores obtained from both the KIMS and MAAS indicates that these scales yield comparable results. This supports the conclusion that researchers can use either scale interchangeably to assess the extent to which pre-service language teachers are mindful of the present moment, accept both their own and others' actions nonjudgmentally, and regulate their emotions.

Additionally, the significant correlations between the two subscales of the KIMS (namely, describing and acting with awareness) and the overall scores of the MAAS highlight a strong relationship between the specified subscales of the former and the overall mindful attention awareness of the latter. This finding supports earlier studies that disclosed the potential utility of the KIMS in predicting overall mindful attention awareness, thereby evidencing its internal consistency, reliability, and construct validity (e.g., Baer et al., 2004).

Overall, the findings of the present study indicated that pre-service teachers consistently demonstrated moderate mindfulness levels across all measures, reflecting a uniform mindfulness awareness within this group. Besides, it was found that the two scales could efficiently evaluate the mindful awareness levels of pre-service English language teachers and be used interchangeably.

Mindfulness has been largely documented to play a key role in shaping teacher outcomes and functioning (Chen et al., 2024), thereby influencing the learning environment and student outcomes. A higher level of mindfulness is often associated with increased self-cognition and self-acceptance, which, in turn, can predict teachers' subjective well-being (Dirghangi, 2019). It is also acknowledged that a high level of mindfulness can predict teachers' engagement in critical thinking, cognitive maturity, and proficiency in problem-solving and decision-making (Chen et al., 2024). Therefore, it is essential to expand the scope of initial teacher education programs by implementing mindfulness-based interventions and practices. This could help pre-service teachers by enhancing their mindfulness awareness, alleviating their stress, and promoting their overall well-being, as suggested by Altan (2021). This preparation also equips them with the familiarity, skills and competence needed to effectively support their future students' emotional development, and mental health and resilience. However, such training should be provided by individuals with a pertinent attitude and mindset, along with the necessary academic and personal expertise in this area. This ensures that pre-service teachers receive guidance from knowledgeable and empathetic instructors who can effectively impart mindfulness techniques and strategies.

The insights provided into the mindful awareness levels of pre-service English language teachers strongly support integrating mindfulness-based interventions into pre-service teacher training programs. Such initiatives could enhance both teachers' well-being and their effectiveness within the school environment.

While the current findings could provide valuable support for implementing training programs aimed at enhancing the moderate mindfulness levels of pre-service teachers, further research is warranted to explore the longitudinal effects of mindfulness training on the development of mindfulness skills and mindful attention awareness among pre-service teachers. Such inquiry may provide valuable insights into the sustained benefits and potential long-term impacts of incorporating mindfulness practices into teacher education programs.

To conclude, the present study indicates that pre-service English language teachers are moderately mindful regardless of their demographic characteristics. Additionally, the compatible results offered by the MAAS and KIMS in identifying the mindfulness levels of individuals entering the teaching profession allow researchers to conclude that both instruments can be used interchangeably to determine the mindfulness levels of pre-service teachers. Portraying pre-service teachers' existing mindfulness levels should be regarded as the initial step toward devising and integrating mindfulness-based interventions into pre-service teacher training

programs, benefiting not only pre-service teachers but also their future students (Altan, 2021; Chen et al., 2024). As observed by Altan (2021), the potential of this conscious awareness to enhance the lives of teachers, their students, families, colleagues, and the broader society has become more important than ever, especially in light of recent epidemics, disasters, and social challenges over the past few years.

Educational institutions can contribute to the holistic development of pre-service teachers by prioritizing mindfulness in teacher education, equipping them with the personal and interpersonal skills needed to thrive in the complex and demanding field of education. Integrating mindfulness into teacher education offers a range of benefits for pre-service teachers. By cultivating mindfulness practices, such as stress reduction techniques, emotional regulation skills, and increased focus, pre-service teachers can better manage the demands of their profession. Moreover, mindfulness fosters empathy, compassion, and improved communication, enabling teachers to connect with students and create a supportive learning environment. Additionally, mindfulness contributes to better classroom management by promoting self-awareness and self-regulation. Ultimately, incorporating mindfulness into teacher education programs enhances pre-service teachers' professional development, equipping them with valuable tools for ongoing growth and adaptation in their upcoming careers. Consequently, pre-service teachers who receive mindfulness training may experience improved learning outcomes and develop valuable life skills such as emotional regulation and effective communication. These students are more likely to create positive classroom environments and provide emotional support to their future students. Furthermore, through the examination of pre-service teachers' mindfulness levels and emotional awareness, a deeper understanding of their needs and challenges can be gained. This insight could guide administrators and teacher educators in expanding teacher education curricula and programs to incorporate strategies and practices aimed at enhancing pre-service teachers' awareness and understanding of these issues. Such efforts could not only benefit pre-service teachers but also positively impact their future students. Moreover, existing studies have reported contradictory findings regarding the correlation between mindfulness levels and gender (e.g., Alispahic & Hasanbegovic-Anic, 2017; Sipahutar et al., 2023), highlighting the need for further research to clarify this relationship. Accordingly, in response to recent calls to investigate mindfulness and related issues in the foreign language classroom, the current study aims to explore the mindfulness levels of pre-service teachers across all levels.

In addition to the benefits for pre-service teachers and their future students, integrating mindfulness into teacher education can also positively impact teacher educators. Teacher educators who incorporate

mindfulness practices into their own teaching can model its benefits, fostering a supportive and collaborative learning environment. By reducing burnout and enhancing well-being, mindful teacher educators are better equipped to guide and mentor pre-service teachers effectively. Thus, integrating mindfulness into teacher education can create an all-inclusive approach to teacher development, leading to a virtuous circle and benefiting the entire educational community.

The study has several limitations that could guide future research. One limitation is the sample size, which may impact the generalizability of the findings. Future research should aim to include a larger and more diverse sample to enhance the representativeness of the results. Despite this limitation, the findings provide preliminary insights into mindfulness levels among pre-service teachers, suggesting the need for further investigation in this area. Additionally, the current sample offers a valuable picture that can guide future studies in refining methodological approaches and expanding the scope of research.

While overall mindfulness levels did not differ significantly by gender, specific facets showed marked disparities. With a sample comprising 72% female and 28% male pre-service teachers, future studies could replicate with a more gender-balanced sample. In addition, although the study relied on commonly used self-reported instruments with satisfactory internal consistency, the risk of social desirability bias remains, indicating the importance of replication with additional inventories and methods to observe participants physically, as suggested by Chen et al. (2024).

Datasets and reproducibility

Dataset is available upon reasonable request from the corresponding author.

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Video-based learning activities in teacher education: effects on self-efficacy and perception of feedback for learning

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Abstract

Transferring pedagogical knowledge from university courses to school is a complex challenge for many teachers. For this reason, teacher education experts began to recommend integrating practice during university learning activities. Classroom videos could be one of the resources in supporting this critical process. The research involved 84 future teachers randomly assigned to two experimental conditions. In both conditions, the subjects watched two clips in which two teachers interacted with students following a triarchic feedback model: task-oriented feedback, motivational-oriented feedback, and student-oriented feedback. In the first treatment, the participants observed the clips in the context of the knowledge construction (KC) approach. By contrast, in the second treatment, the participants viewed the clips in the context of a direct instruction (DI) strategy. The study had two objectives: understanding the participants' perception of video-taped teachers' feedback; and testing the effects of treatments on the participants' self-efficacy to provide feedback. For the first research goal, the findings partially confirm the three-facet model of feedback. The analysis produces a two-factor solution based on the following components: learning-oriented feedback, and motivational-oriented feedback. Concerning the second research goal, the results show that KC approach seems to produce a higher level of self-efficacy in providing feedback to students. This treatment has a direct impact on the self-efficacy score, with evidence that no teacher and contextual factors directly influence the score or moderate the effects of the approach on the dependent variable. This finding is consistent with studies that address how university courses may positively promote teacher self-efficacy.

KEYWORDS: Video-Based Learning Activities, Feedback For Learning, Self-Efficacy, Knowledge Construction, Direct Instruction.

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1. Introduction

Academic courses for teacher education struggle to build a close connection between pedagogical knowledge acquired in university courses and real teaching in the

classroom (Seidel, Blomberg & Recnkl, 2013). The transfer of new pedagogical ideas from university activities to the workplace can be a complex challenge for many teachers. For this reason, teacher education experts began to recommend integrating practice during university learning activities (Darling-Hammond & Bransford, 2005). However, the application of pedagogical knowledge does not necessarily imply a direct exposition to a real classroom setting (Seidel, Blomberg & Recnkl, 2013). Teachers can have an experience of vicarious learning (Bandura, 1986) to facilitate the comprehension and transfer of pedagogical knowledge into the classroom. Classroom videos could be one of the resources in supporting this important professional learning process (Santagata & Yeh, 2014).

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Video-taped teaching actions became popular in academic courses and in professional development activities. Their use has been gradually affirmed, until becoming one of the most used instruments in improving the quality of teaching (Calandra & Rich, 2015; Gaudin & Chaliès, 2016). This fact suggests an accurate consideration and research programs with the aim of understanding if and how videos can help teachers increase their professional knowledge (Bakkenes, Vermunt & Wubbels, 2010; Lieberman & Pointer Mace, 2008). For example, pre-service teachers struggle to understand the complexity of teaching events, so to perceive themselves as unable to apply the pedagogical theories studied in academic courses (Seidel & Stürmer, 2014). Educating teachers on the ability to analyze video can promote high-quality professional knowledge. Consequently, one of the priorities of university courses for teachers should be building an integrated system of pedagogical and practical knowledge along with the self-confidence to apply it in the classroom.

Video-taped teaching actions can contain several educational and didactic events. Some of them play a critical role in student learning, and some do not. The identification of a noteworthy event consists of the teacher's ability to pay attention to aspects that are crucial in the learning process of students (Seidel & Stürmer, 2014). In this case, videos work as the first stimulus of knowledge activation (Kersting, 2008). However, on which pedagogical key elements should we focus? The meta-analyses by Seidel and Shavelson (2007) and by Hattie (2009, 2012, 2023) on the effects of a range of educational, cognitive, and motivational factors, offer a first knowledge base. For example, Seidel and Shavelson (2007) indicate the following factors that can have a significant impact on learning:

- goal setting and orientation of learning towards goals;
- activation of student thinking through challenging tasks;
- supporting students through constructive feedback;
- supportive learning climate by taking students' needs seriously.

In line with this, Hattie's meta-analyses (2009; 2012; 2023) shed light on dimensions such as:

- learning intentions;
- feedback targeted to students and teachers;
- teaching methods and strategies to support students' surface and deep learning;
- whole school and outside contextual factors;
- curriculum, technologies and classroom variables;
- classroom variables and students' individual differences;
- teacher attributes and teacher education.

Most factors within each dimension can be an object of video observation, consequently they can be elements of pedagogical knowledge to include future teacher education.

In the present study, we focused on how to provide better feedback to students. Firstly, we collected two videos showing two teachers providing feedback in two different instructional contexts. Second, we developed two video-based learning activities to promote the teachers' understanding of different facets of feedback. Finally, we tested the effects of the video-based learning activities on participants. The study had two objectives:

- understanding the participants' perception of video-taped teachers' feedback;
- testing the effects of two learning activities on participants' self-efficacy to provide feedback.

2. Assessment and feedback for learning

In the last 30 years, the concept of assessment has changed, and the discussion has focused on the distinction between *formative assessment*, *assessment for learning*, and *summative* or *assessment of learning* (ARG, 1999; 2002). The first term characterizes an assessment aiming to improve teaching and learning processes. On the contrary, with *summative assessment* teachers formally judge students after an instructional period (at the end of a unit, a term, a whole year, or a cycle of studies), commonly using final performance tests. Concerning *assessment for learning*, Klenowski (2009) refined the definition by highlighting the following elements:

- teachers and pupils are the critical actors in the assessment process;
- assessment is a daily process that engages teachers and students to seek information and reflect on it;
- dialogs, demonstrations and observations support and enhance learning.

Earl and colleagues (2003, 2013; Dann, 2014; Earl & Katz, 2008) have extended the concept of *assessment for learning* by emphasizing the active involvement of pupils. Based on this premise, the authors proposed an evolution and a third perspective: *assessment as learning*. Students are the actual assessors of their learning and this connection between assessment and learning can promote the development of metacognition and self-regulated learning (Clark, 2012).

We argue that feedback aimed at students is a practice to implement the *assessment for* and *as learning*, and we consider it as a key component directly connected to teacher assessment competence (Hattie, 2023; Mitchell & Sutherland, 2020). We proposed to assume a three facets model of feedback.

1. Task-oriented feedback. Teachers formulate responses, gives corrective indications, offers insights on "how" and "why" a result was achieved (Hattie, 2012). The main goal of this type of feedback is to regulate the students' learning processes.
2. Motivational feedback. Another kind of feedback consists of praise, positive reinforcements, social

recognition (Heitink et al. 2016). The main goal of this second kind is to motivate students to learn.

3. Student-oriented feedback. Feedback may be more effective and valuable for students if it is “just in time,” “just for me,” or “just for where I am” in the learning process (Hattie, 2012, p. 122). The primary purpose of this last feedback is to personalize the ways of reaching achievements.

Hattie and Temperley (2007) compare the impact of *task-oriented feedback* and *motivational feedback* on student learning. In all comparisons, the *task-oriented feedback* has a better effect on student learning if compared with praises and positive reinforcements. In studies that evaluate the effect of task-oriented feedback, the mean value of ES is 0.67. Conversely, the mean value for praises and reinforcements is 0.48. However, according to Hattie’s meta-analysis (2009, 2012) both values fall in the zone of desired effects. We are not telling teachers to stop praising students. We suggest mixing the three types of feedback, by mostly focusing on task-oriented ones. Briefly, the effect on learning is greater when the goal of feedback is to provide instructions to improve the performance of a task; in contrast, it is observed lower-level effects are observed when teachers communicate praises or positive reinforcement.

3. Teacher self-efficacy

According to Bandura’s theory (1977), self-efficacy (SE) refers to how people judge “their capabilities to organize and execute courses of actions required to attain designed types of performances” (ivi, p. 391). Later, Bandura (1994), pointed out that “self-efficacy beliefs determine how people feel, think, motivate themselves, and behave” (ivi, p. 71) providing additional emotional and motivational dimensions to the SE construct. Overall, a strong belief in self-efficacy is typically positively associated with high performance and general well-being (Ngui & Lay, 2020; Pajares, 1997). Therefore, people with a high SE show engagement in their tasks by maintaining a persistent effort and motivation to increase knowledge and skills. Furthermore, SE is associated with positive strategies to cope with new challenges and learning opportunities across a range of tasks and behaviors (Schunk, 1995). By contrast, low SE is associated with maladaptive coping strategies, for example, avoidant behaviors, doubt about one’s skills, low effortful control, and low-level goals (Bandura, 1994). As a result, people with low SE are more likely to achieve minimal or poor performances (Kelley et al., 2020).

Regarding teacher self-efficacy (TSE), scholars define it as a feeling of confidence and a sense of effectiveness in subject-specific teaching strategies and/or classroom management (Kelley et al., 2020; Hajovsky et al., 2020; Perera & John, 2020; Skaalvik & Skaalvik, 2019). It is expected that the higher TSE, the better teachers are

motivated to use knowledge in their practices. Moreover, when future teachers have a high SE, they are more motivated to transfer new pedagogical knowledge into their practice (Kelley et al., 2020; Gegenfurtner, 2011).

4. Video-based learning activities

The simple vision of a video is not enough to generate an accurate comprehension of the teaching and learning processes. The effectiveness of video depends on the learning strategies that are put into action (Seidel & Stürmer, 2014). Tucholka and Gold (2025) examine the application of videos in teacher education. They discuss the “order of conceptual input” and whether it is preferable to present theoretical concepts initially or to evaluate the videos first. They suggest that theoretical information prior to video analysis enhances the capacity to assess the events video-taped in the clips. Major and Watson (2018) highlight the efficacy of video of classroom practices, indicating that colleagues’ observations and discussions can enhance the effectiveness of videos in improving teaching methods. They further point out that passive video viewing does not ensure learning; it is essential to integrate effective pedagogical strategies and offer high-quality professional support.

Referring to pedagogical strategies, Seidel and colleagues (2013) proposed two overall approaches, both oriented to the use of videos in teacher education.

1. *Direct instruction* (DI). The first strategy presents a pedagogical principle, followed by an example shown through videos. The underlying scheme is “from rule to application”. Participants receive fundamentals of pedagogical knowledges, then, they are asked to watch a video and to take notes, to think about what was noted, recalling the pedagogical knowledge earlier received (Seidel, Blomberg & Renkl, 2013). The focuses of observation are expert teachers, videotaped during the performance of successful activities: exemplary lessons, with a total or near-total absence of critical incidents and with positive reactions from the students. In this case, the stimulated reasoning would sound like this: “It is good to do so, if you want to achieve suitable educational outcomes”. It is mostly practiced in pre-service teacher education, to teach pedagogical knowledge, or the use of educational principles and effective teaching strategies.
2. *Knowledge construction* (KC). In this second strategy, teacher educators show an example of practice in one or more videos, teachers observe the video and write down notes about teaching facts to prepare the next pedagogical reflections and reasonings. Before the vision of the video, instructors do not provide any knowledge about principles, teaching strategies and research evidence (Seidel, Blomberg & Renkl, 2013). The

strategy implements the pattern “from application to rule”. The schema is thought to help teachers to tackle specific issues that could arise during classes and students’ activities. For this reason, the KC strategy is mostly practiced in professional development activities, in which there is the need to learn something that will be later applied in the classrooms (Kleinknecht & Schneider, 2013; Tacconi & Mejia Gomez, 2012) and working collaboratively with colleagues to share reflections and reasonings about authentic classroom situations (Greeno, 1989; Resnick, 1991).

Regardless of the nature of teacher education (university courses versus professional development initiatives), teacher educators can combine KC and DI approaches and propose hybrid solutions to both categories of teachers. It can propose learning activities in university courses based on the KC strategy; by contrast, it can carry out activities in professional development based on the DI strategy.

5. Method

The present study involved a group of Italian teachers enrolled in one-year academic courses to attain a national qualification in special education. We focused our attention on supporting them in understanding “how to provide better feedback to students”. One sub-group worked on the videos with the KC approach, the other worked with the DI approach (Blomberg et al., 2014). The purpose of the study was to compare the effects of the two video-based learning strategies on teacher self-efficacy and perception of feedback for learning. Specifically, the aim was to answer three research questions (RQs):

RQ1. How do the teachers perceive the video-taped teacher’s feedback? Is the participant’s perception coherent with the theoretical feedback model (task-oriented, motivation-oriented, student-oriented)?

RQ2. How does self-efficacy for providing feedback change in relationship to experimental treatments (KC versus DI)?

RQ3. Is the relationship between treatments and self-efficacy moderated by relevant teacher (gender, age, total years of teaching) and contextual (grade level, high-density school locations, total number of students per school) factors considered critical elements for future professional commitment and development (European Commission/EACEA/Eurydice, 2015)?

5.1 Participants

The study involved 84 Italian teachers (84.5% female), attending a one-year academic course for accomplishing a national qualification in special education. They had a mean age of 38.44 (SD = 6.98), 61.9% worked in middle school, 34.5% in high school, and 2.3% in primary school. Their average teaching experience in years was

6.55 years (SD = 4.07). Finally, 53.8% of the overall teacher sample worked in a school located in a town with less than 15,000 citizens (the respective counterparts worked in places with more than 15,000 citizens), and the average number of students per school was 344 (SD = 324).

5.2 Procedure and measures

The teachers were randomly assigned to two experimental conditions: 43 in DI treatment, and 41 in KC treatment. One group worked with the KC approach; the other one worked with DI approach (Blomberg et al., 2014). The teachers watched two CLIPS in which two teachers, previously trained in the implementation of the three facets model of feedback, were providing feedback to students (Figure 1). Concerning CLIP-I, participants observed a teacher during an interaction with the whole class of students involved in a writing assignment. One student with special educational needs was integrated into the classroom. Regarding CLIP-II, the subjects viewed a teacher during an interaction with a small group of students involved in a series of math assignments. All students were involved in a special education program.



CLIP 1 - A teacher during an interaction with whole class involved in a writing assignment - 2 min.



CLIP II - A teacher during an interaction with a small group of students involved in a series of math assignments - 7 min.

Figure 1 - Two teachers committed to provide feedback in two different classroom settings.

In each experimental condition we designed five tasks. The first condition is based on the KC approach:

teachers were sharing their notes with colleagues. The emphasis was on social cognition and collaboration. In the KC learning activity, the group started watching videos, afterward it began to understand the theory and details of the feedback through a guided discovery learning process (production and sharing notes). The second condition is based on tasks of understanding and applying pedagogical knowledge about the feedback. In DI learning activity, the instructor started presenting the theory and the details of the feedback through a brief lecture, afterward the subjects tried to understand the theory and details of the feedback through lecture, individual and small group exercises, analysis of examples. At the end of this path, the subjects observed the videos. Table 1 shows the two treatments.

Table 1 - Experimental treatments: KC approach versus DI approach.

Treatment 1 KC learning activity		Treatment 2 DI learning activity	
Starting at 2:00 P.M.			
Each group together for a general presentation			
Timing	KC tasks	DI tasks	Timing
15'	First vision of CLIP I/II and production of individual notes.	Brief lesson on "how to provide better feedback to students".	30'
60'	Sharing notes in small groups.	Comprehension test: 10 questions answered in small group.	25'
60'	Sharing notes in whole class.	An instructional design task in three phases: individual, pair, small group.	45'
Break 3:30 P.M.		Break 3:45 P.M.	
15'	Second vision of CLIP I/II.	Examples: presentation of two teaching cases.	60'
45'	Data collection.	Vision of CLIP I/II and data collection.	60'
Ending at 6:00 P.M.			

At the end of each learning activity, we collected data through a questionnaire organized in 3 sections:

1. nine items with 4-point Likert scale ("disagree" vs "agree") proposed twice - for CLIP I and CLIP II - addressed to capture the perception of video-taped teacher's feedback;
2. one item with 6-point Likert scale ("much unconfident" vs "much confident") addressed to capture the subjects' self-efficacy to provide feedback after participation in the treatments ("How confident I feel that I have the ability to communicate feedback to students") (Caprara, 2001);
3. teacher and contextual variables (gender, age, total years of teaching, grade level taught, location where the teacher teaches, total number of students

in school) (European Commission/EACEA/Eurydice, 2015).

Two different researchers lead each condition. No significant differences were detected in teacher and contextual variables between the two groups.

6. Results

6.1 Perception of video-taped teacher's feedback

With the purpose to capture the participants' perception of video-taped teacher's feedback, two factor analyses were carried out for CLIP I (Teacher interacts with the whole classroom during a writing assignment) and CLIP II (Teacher interacts with a small group during a series of math assignments). The 9 items - designed to capture the participant's perception of video-taped feedback were subjected to principal component analysis (PCA).

A broad spectrum of guidelines exists for the subject-to-item ratio, often advocating for a minimum of 3 to 20 subjects per item. Nonetheless, actual evidence corroborating these particular ratios is scarce (Mundfrom et al., 2005; Rouquette & Falissard, 2011). Nunnally (1978) recommends a ratio of 10 to 1, meaning ten subjects for each item to be factor analyzed. Others propose that five cases per item are sufficient in most instances (Tabachnick & Fidell, 2007), and if there are a few distinct factors, a smaller sample size is adequate (Tabachnick & Fidell, 2013). Although recommendations differ, an increased ratio and bigger sample size typically result in improved outcomes. The interplay between sample size and item quantity is substantial, but our particular experimental settings have implied setting a subject-to-item ratio of 9 to 1.

The procedure revealed a two factors solution with 8 items. Table 2 shows the hierarchical order of processed items. The two factors explain 52% of the total variance, with Component 1 contributing 35,46% and Component 2 contributing 16,70%. There is a weak correlation between the two components ($r = .24$). We named the first factor learning oriented feedback (LoF), while we called the second motivational-oriented feedback (MoF).

The second factor analysis confirmed the outcome of previous one but with a different hierarchical order in factor loadings (Table 3). The two factors explain 54% of total variance, with LoF contributing 33,43% and MoF contributing 20,80%. There is no correlation between the two factors ($r = .089$).

6.2 Effects of treatments on self-efficacy scores

Since some subjects reported missing data on the outcome variable, the final sample comprised 37 subjects in the KC condition and 41 subjects in the DI condition. Preliminary analyses showed that missing values occurred completely at random, and they were completely unrelated to teacher and context variables.

An independent-sample t-test was conducted to compare self-efficacy scores (*level of confidence in the ability to provide feedback to students*) for DI treatment and KC treatment. There is a significant difference, in self-efficacy for KC (M = 0.91, SD = 2.03) and DI (M = -0.80, SD = 3.17), with $t = -2.88(71)$, and a $p < 0.05$ (Table 4).

The magnitude of the difference in the means (= -1.70, CI: -2.89 to -0.52) is moderate (Cohen's $d = 0.626$). In Figure 2, the value with the minus sign before identifies a low level of perceived self-efficacy to provide feedback, whereas the values with positive sign before identifies a high level of self-efficacy.

Table 2 - Perception of video-taped feedback: Factor loadings (CLIP I).

Item	LoF	MoF
T encourages reflection on "how" to work	0.808	
T encourages reflection on "how" to improve	0.744	
S receive a "just in time" feedback	0.722	
S receive a "where to next" feedback	0.666	
S receive a "just for me" feedback	0.652	
T praises the student's work		0.758
T says, "Well done", "Good", "Perfect", "Right"		0.753
T focuses student's attention on positive answers		0.60
T = Teacher S = Students LoF = Learning oriented feedback MoF = Motivational oriented feedback		

Table 3 - Perception of video-taped feedback: Factor loadings (CLIP II).

Item	LoF	MoF
T encourage reflection on "how" to work	0.803	
S receives a "where to next" feedback	0.767	
T encourages reflection on "how" to improve	0.718	
S receive a "just for me" feedback	0.57	
S receive a "just in time" feedback	0.522	
T says, "Well done", "Good", "Perfect", "Right"		0.865
T praises the student's work		0.784
T focuses student's attention on positive answers		0.618
T = Teacher S = Students LoF = Learning oriented feedback MoF = Motivational oriented feedback		

Table 4 - Independent-sample t-test: SE * Treatments.

	Treatment	N	M	SD	t	df	Sig.*
SE	DI	42	-0.80	3.17	-2.88	71	0.005
	KC	37	0.91	2.03			
* 2 tailed SE = Self-efficacy score DI = Direct Instruction KC = Knowledge Construction							

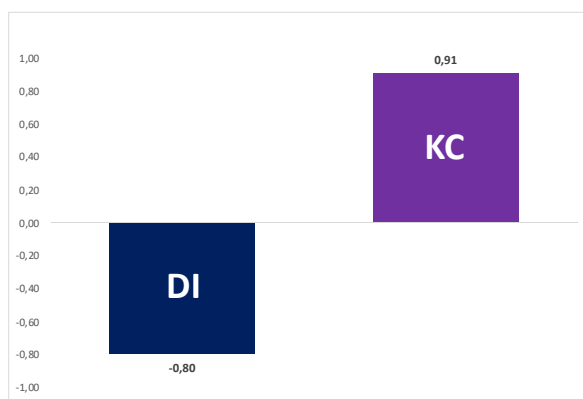


Figure 2 - Impact of treatments on self-efficacy score. DI = Direct Instruction KC = Knowledge Construction

6.3 Testing direct and moderated effects on self-efficacy scores

To strengthen the results associated with RQ2, we tested if the relationship between treatments and self-efficacy was affected by factors such as gender, age, total years of teaching and context, grade level, high-density school locations, and total number of students per school. Figure 3 presents the relationship model between experimental treatments (KC versus DI), teacher and context variables, and self-efficacy score.

In other words, we considered, on one side, the probability that teachers and contextual factors could explain KC's positive influence on self-efficacy and, on the other hand, the possibility of these variables' direct influence on self-efficacy score.

A full factorial MANCOVA model was initially carried out to test the conceptual model against the data. The dependent variable was the score on the single item reflecting TSE in providing feedback, the fixed factors were the treatment grouping variable, gender, grade level (primary, middle, high school), and school location (school located in places with less or more than 15,000 citizens). All principal, two-way and three-way interaction effects considered in the model were statistically non-significant ($p > .10$).

Building on this prior evidence, we formulated a set of alternative informative hypotheses (Hoijtink, 2011) regarding the difference in the self-efficacy score between KC and DI conditions. Differently from the null hypothesis significance testing (NHST approach, see Nickerson, 2000), results from competitive informative hypothesis testing may directly support the hypothesis most compatible with the observed data compared to its competitors. Below, we describe the four alternative informative hypotheses formulated for the present study.

$$H_0: \mu_{\text{TreatmentDI}} = \mu_{\text{TreatmentKC}} \quad (1)$$

$$H_1: \text{TreatmentDI} = \text{TreatmentKC} \quad (2)$$

$$H_2: \text{TreatmentDI} > \text{TreatmentKC} \quad (3)$$

$$H_3: \text{TreatmentKC} > \text{TreatmentDI} \quad (4)$$

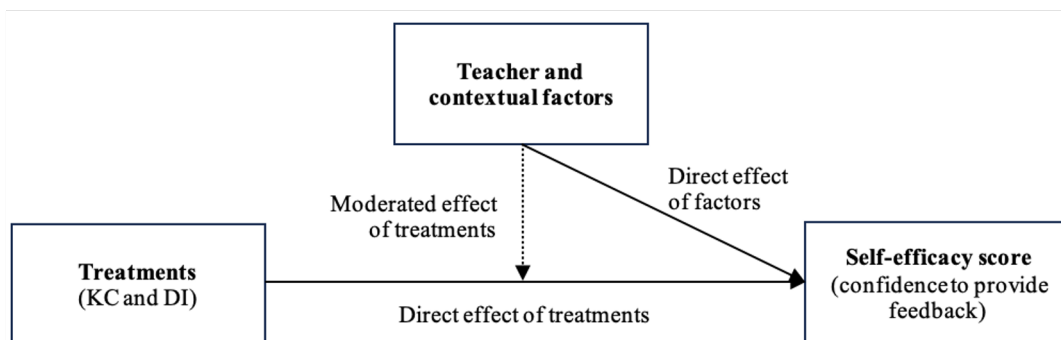


Figure 3 - Model of relation between treatments, teacher and contextual factors and self-efficacy score.

H_u (also known as the unconstrained hypothesis) does not impose constraints on the means of self-efficacy score between the two groups. It is not a specific hypothesis of interest here: rather, it represents the most general hypothesis in which all other competitive hypotheses are nested. H_1 represents the null hypothesis tested within the NHST approach: no mean differences between DI and KC are expected on the dependent variable. H_2 and H_3 posit, respectively, that self-efficacy score is higher in the DI (or KC) condition compared to the other.

We tested and compared these hypotheses within the analytic framework of Bayesian ANCOVA, controlling for the effects of, for example, teacher experience (expressed in years). Although preliminary results highlighted a non-significant effect of this covariate on the dependent variable, its inclusion in this model is theoretically sound, since it may represent a proxy of one of the most important sources of TSE which is critical to control for (see *mastery experience*, Pfitzner-Eden, 2016). Furthermore, Bayesian approaches facilitate the integration of previous information, which can substantially affect the necessary sample size. Informative antecedents may result in reduced sample sizes, whereas non-informative priors could necessitate larger samples to attain equivalent precision (Santis, 2007; Zheng et al., 2020; Sahu & Smith, 2006).

Bayesian ANCOVA with informative hypothesis testing was performed using the *bain module* of the JASP v. 0.16.3. software (JASP Team, 2022). Table 5 displays results from this analysis. The unconstrained Bayes Factor (BF.u) provides the quantity of support of a given hypothesis over H_u . As can be noted, H_3 received two times more support from the data than H_u . With respect to its alternative hypothesis (H_2), H_3 fits the data four hundred times better than the observed data. Finally, the posterior model probabilities (based on equal model probabilities) suggest that H_3 received 62.9% support from the data among the other considered hypotheses (including H_u), and 91.8% support from the data when H_u is excluded. Thus, we can conclude that, on average, in the KC treatment teachers reported higher scores (adjusted $M=4.84$, $SD=.80$) than what observed for the DI condition (adjusted $M=4.17$, $SD=1.25$), after controlling for teacher and contextual variables.

Table 5 - Results for the tested informative hypotheses.

Hypothesis	BF.u	BF.c	PMPa	PMPb
H1	.172	.172	.079	.054
H2	.005	.002	.002	.002
H3	1.995	400.235	.918	.629
H_u	-	-	-	.315

Note - BF.u and BF.c denote the Bayes factors of the hypothesis in the row versus the unconstrained hypothesis and complement, respectively. Posterior model probabilities (a: excluding the unconstrained hypothesis, b: including the unconstrained hypothesis) are based on equal prior model probabilities.

6. Discussion and conclusions

One of the fundamental premises of the study is that videos' effectiveness depends on the learning strategies (Seidel et al., 2013). Their efficacy is contingent upon the learning methodologies employed: it is not the video itself that is effective, but rather its integration inside a learning approach (Kang & van Es, 2019). Furthermore, studies suggest that a video alone is insufficient for effective learning; it must be incorporated into a well-organized training program. The impacts of videos are contingent upon the implementation of instructional strategies, including pre/post-video observation activities, expert facilitation, discussion with colleagues (Seago et al., 2018).

Regarding the first research objective, the factor analysis produced a two factors solution based on two components: LoF and MoF. This solution doesn't confirm the three facets theoretical model of feedback proposed during the two treatments. Furthermore, the factor structure shows a difference in the hierarchical order of items for CLIP I and II. This order, probably, depends on the content of the video observed. In the CLIP II, subjects perceived the teacher much more oriented to students, whereas the CLIP I seems to convey a better balance between feedback given to the classroom and feedback oriented to specific student.

The distinction between LoF and MoF is coherent with studies that depict feedback as a multifaceted process in which the teacher may have different goals: (a) helps students understand and improve their learning by

providing practical guidance (regulative function); (b) supports students' motivation to maintain cognitive engagement (motivational function). This view integrates the two main goals of feedback: regulation of learning to promote the activation of cognitive and metacognitive skills and motivation to learn in terms of emotional and affective support.

Gentile (2019) compared five couples of studies in which researchers calculated the ES of feedback and praises on student learning (Hattie & Temperley, 2007). In all comparisons, the LoF has a better effect on student learning than praise and positive reinforcement. In studies that evaluate the effect of LoF, the mean value of ES is 0.67. Conversely, the mean value for praises and reinforcement is 0.48. However, according to Hattie's meta-analysis (2009, 2012), both values fall in the zone of desired effects. The meta-analysis proposed by Wisniewski et al. (2020) emphasizes that high-information feedback is the most effective and proves that MoF is the least effective type of feedback. In brief, we are not suggesting that teachers should avoid praising students. We suggest mixing the two types of feedback, mainly focusing on LoF.

Concerning the second research objective, the findings suggest that participants feel more confident in providing feedback after participating in learning activities based on KC. Furthermore, the treatment has a direct impact on the self-efficacy score, with evidence that no teacher and contextual factors directly influence the score or moderate the effects of treatment on the dependent variable. These findings are coherent with studies addressing how pre-service teachers' education may positively promote TSE (Clark & Newberry, 2019; El-Abd & Chaaban, 2021; Yada et al., 2020). Effectively, starting from a general optimism in an earlier career, teachers tend to become less confident with their teaching capacities due to negative experiences with students and colleagues. This is a relevant point considering that Bandura (1997) argued that efficacy beliefs tend to be resistant once established on the basis of experience (Matoti et al., 2011). In this regard, teacher education may play a relevant role in promoting new teaching strategies and recognizing their effectiveness in enhancing students' learning achievement.

We interpret the present findings as pilot knowledge, propaedeutic for further replications. One limitation of this pilot is the absence of a third group, which could improve the evidence of the causality in our substantive conclusions. With the aim of providing more soundness to this perspective, the purpose is to design a new trial with three randomly assigned groups. The groups will observe the clips within a KC and DI learning activity, while the control group will observe the video without following specific learning tasks (e.g., individual notes, collaborative work, design tasks, etc.). The goal is to verify if the groups differentiate their responses depending on learning activities and if there are direct or interaction effects on the dependent variable score after

controlling for teacher and contextual variables. Furthermore, the new study should also improve the measurement of self-efficacy, which in the present research was limited to a single item. By adopting Bandura's instructions (Bandura, 2006), we can continue to assess the TSE following a task-specific domain approach and ask them to rate how confident they feel in providing feedback as a specific assessment practice.

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Teachers competencies in evaluating digital sources and tackling disinformation: implications for media literacy education

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Abstract

This study examines teachers' competencies in evaluating digital content and tackling disinformation through analysis of pre-test data from 243 Italian primary and secondary school teachers participating in a media literacy training program. Drawing on the DigComp 2.2 framework, we assessed seven key digital literacy competencies, including source evaluation, social media verification, and visual literacy. Our findings reveal significant gaps between teachers' digital engagement patterns and their critical evaluation skills, particularly in visual content assessment. Using cluster analysis, we identified four distinct teacher profiles: Skeptical and Vulnerable Teachers, Traditional Trust-Based and Uncritical Teachers, Digitally Engaged and Trusting Teachers, and Balanced Critical Evaluators. The results show that teachers are moderately good at finding assertive signs of reliability, but they have trouble with more difficult "inferred context" tasks, especially when it comes to judging visual content. The study shows that different types of professional development are needed and suggests specific ways to help teachers improve their media literacy skills in a world where digital information is getting more complicated.

KEYWORDS: Information Literacy, Teachers, Digital Skills, Digital Content, Disinformation.

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1. Introduction

Disinformation, defined as the deliberate dissemination of incorrect or misleading information, represents a growing threat to democratic processes, public health, and social trust (Pérez-Escobar et al., 2023; Bennet et al., 2018). The rapid digitalization of information sharing has intensified this challenge, with the COVID-19 pandemic highlighting how surges of misinformation can amplify societal discord and jeopardize public safety (Springer et al., 2022). Within this context, educational institutions face mounting

pressure to develop students' capacity to navigate an increasingly complex information landscape (Nygren et al., 2024). A report by IDMO (2023) indicates that both educators and students perceive themselves as frequently encountering disinformation.

Recent research demonstrates that students often struggle to differentiate between credible and biased information sources (Breakstone et al., 2021; Martini et al., 2024), making them particularly vulnerable to manipulation in digital environments (Jones-Jang et al., 2021). This vulnerability has prompted academic, civil, and governmental entities to advocate for the integration of media literacy education into core curricula. Organizations such as the UNESCO (2018) and the European Union (2022a; 2022b) have identified media literacy – the ability to critically analyze, evaluate, and comprehend information sources – as a fundamental defense against disinformation (Bruno et al., 2023). The European Commission's DigComp 2.2 and DigCompEdu frameworks specifically emphasize digital and information literacy as essential competencies for contemporary education (European Commission, 2022a; 2022b).

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Evidence supporting the effectiveness of media literacy interventions against disinformation continues to emerge (Kozyreva et al., 2024; Roozenbeek et al., 2023; Bateman et al., 2024; Dame Adjin-Tetty, 2022). A comprehensive meta-analysis of 49 studies revealed that media literacy interventions significantly enhance resilience to misinformation ($d = 0.60$), reduce belief in false information ($d = 0.27$), and decrease the likelihood of sharing misinformation ($d = 1.04$) (Huang et al., 2024). Similarly, educational programs aligned with European Commission guidelines have demonstrated success in increasing perceived social media literacy and reducing conspiracy beliefs among young adults (Gross & Balaban, 2024).

However, the successful implementation of media literacy education depends critically on teacher preparedness. Current research indicates a substantial gap between institutional expectations and educators' readiness to deliver media literacy interventions effectively (Erdem et al., 2018; Tsankova et al. 2023; Dongxue & Nagappan, 2024; Zaçellari et al., 2024). While many teachers demonstrate proficiency in using digital resources for classroom instruction (McNelly, 2021), they often lack the specific competencies needed to teach critical evaluation skills (Ranieri et al., 2017; Ranieri, 2021). This disparity is reflected in broader European trends, with an Ipsos Mori (2021) survey revealing that only 9% of Europeans across 11 nations have received training in distinguishing between accurate and inaccurate online information, despite 58% expressing interest in such training.

The persistent gap between the recognized importance of media literacy education and its effective implementation underscores the need for systematic research into teacher preparedness.

This study addresses this need by examining the media literacy competencies of Italian primary and secondary school teachers through analysis of pre-test data from a professional development course designed and delivered within the media literacy programme Open the Box (www.openthebox.io). By identifying specific deficiencies in educators' media literacy abilities and their capacity to transmit these skills, this research aims to inform the systematic integration of media literacy into educational curricula. Our findings contribute to the growing body of research on comprehensive media literacy education (Livingstone, 2012; Greenhow & Lewin, 2016) while providing practical insights for educational policy and teacher training programs in the European context.

The study is guided by the following research questions:

Q1- To what extent are educators equipped to identify and evaluate disinformation in its different appearances, including manipulated images, sponsored content, and dubious news sources?

Q2- What behavioral patterns in teachers' skills and approaches to digital sources can be identified in order to propose customized training programs for enhancing information literacy?

A survey was administered to Italian teachers attending a series of courses on information literacy organized by the media literacy program Open the Box. The results are analyzed using descriptive statistics tools and a multivariate analysis technique, namely cluster analysis useful to create groups among statistical units according to their features.

After the description of Methods for data collection and analysis in Section 2, the authors provided the results (Section 3) and a discussion about the findings in Section 4.

2. Methods

This study seeks to evaluate the foundational competencies of primary and secondary school teachers in topics related to disinformation resistance.

2.1 Sample and Variables

The data provided here originate from a pre-training evaluation aimed at assessing teachers' foundational abilities in identifying and appraising different forms of digital information. Table 1 lists the variables used in the analysis.

A total of 279 educators engaged in the pre-test, conducted across four separate teacher training programs held in Italy during the 2023-2024 school year. After deleting missing data, the final sample was made by 243 teachers. The sample taken has an average age of 51 years, in line with the average age (52 years) of Italian teachers (Svimez, 2024).

The pre-test questionnaire comprised four sections: (1) demographic data, (2) media consumption and trust patterns, (3) self-assessment of issues pertinent to digital literacy (including definitions of fake news, disinformation, and misinformation), and (4) the capacity to assess the reliability of digital content. In this last part, educators were introduced to seven distinct forms of digital content derived from real-world case studies (see Annex).

Participants were instructed to evaluate the trustworthiness of each item via a multiple-choice question (e.g., "Which of these two sites is more reliable?"; "Has this image been altered?") and to provide a concise written rationale for their selection.

Responses were assessed through both quantitative and qualitative methods. Quantitative responses were assigned a score of 1 (correct) or 0 (incorrect), whereas qualitative arguments were evaluated on a 1-5 scale, with 1 denoting insufficient and 5 signifying extremely good.

Table 1 - Variables list.

<i>Group</i>	<i>Variables</i>	<i>Description</i>	<i>Range/Options</i>
Social media	Facebook Whatsapp Telegram YouTube Instagram Twitter / X Pinterest TikTok	Binary variables attesting to the use of each social media	Yes/No
	social_n	Sum of social media used among the previous listed	Min: 0 Max: 8
	social_hours	Number of hours during which teachers used social media the day before the survey	Min: 0 Max: 7
Information sources	TV_info radio_info web_info social_info friends_info online_news_info family_info	Binary variables attesting to the use of each information source	Yes/No
	info_sum	Sum of information sources used among the previous listed	Min: 0 Max: 7
Confidence in information sources	TV_trust radio_trust newspaper_trust social_trust web_app_trust family_trust friend_trust	Ordinal variables describing the confidence levels of teachers in each source	Min: 0 (lower) Max: 5 (higher)
	sum_trust	Sum of the trust levels referred in the previous list	Min: 0 Max: 40
Assessment	Reliable	Assessment to question related to checking the ability to differentiate reliable from misleading sources	Min: 0 Max: 4
	Trustworthy	Assessment to question related to checking the ability to evaluate trustworthy versus deceptive news content	Min: 0 Max: 4
	Sponsored	Assessment to question related to checking the ability to recognize sponsored content	Min: 0 Max: 4
	Verified	Assessment to question related to checking the ability to identify verified profiles on social media	Min: 0 Max: 4
	Satirical	Assessment to question related to checking the ability to distinguish satirical material from factual content	Min: 0 Max: 4
	Decontextualized	Assessment to question related to checking the ability to detect decontextualized images	Min: 0 Max: 4
	Manipulated	Assessment to question related to checking the ability to identify manipulated photographs	Min: 0 Max: 4
	Assessment	Sum of the scores in all questions	Min: 0 Max: 28

The final score allocated 25% to quantitative responses, due to the potential for random accurate answers, and 75% to qualitative responses, as they offer greater insight into the teachers' critical thinking abilities.

This analysis centers on seven critical competencies vital for digital literacy, as highlighted in the DigComp 2.2 framework (European Commission, 2022a). These include:

- (1) differentiating reliable from misleading sources,
- (2) assessing trustworthy versus deceptive news content,
- (3) recognizing sponsored content,
- (4) identifying verified profiles on social media,
- (5) distinguishing satirical material,
- (6) detecting decontextualized images, and
- (7) identifying manipulated photographs.

These competencies represent essential skills for educators in assessing the authenticity and reliability of various digital resource kinds within a progressively intricate information environment.

2.2 Analysis Methods

We used descriptive statistics tools to reply to Q1 and verify teachers' levels of information literacy.

To reply to Q2, we conducted a cluster analysis to differentiate the skills and habits of teachers in our sample. Cluster analysis is a multivariate analysis technique that, starting from the distance between statistical units, generates groups in which the units are most similar to each other and distant from those in the other clusters (Hair et al., 2014; Bartholomew et al., 2008).

We studied solutions with three and four clusters using different types of distance and agglomeration methods. Finally, we performed hierarchical clustering, calculating the Euclidean distance and using the Ward agglomeration method (Ward.D) that is the solution that give the possibility of better identifying multiple teachers' profiles. The variables used in the Cluster Analysis were the quantitative ones, namely social_n, social_hours, info_sum, sum_trust, and assessment. We chose a 4-cluster solution that better fits our data.

Analysis was conducted using R/R Studio and packages: stats, psych, corrplot.

3. Results

3.1 Competencies of teachers in evaluating digital content (Q1)

The findings from the pre-test reveal key insights into the foundational competencies of teachers in evaluating digital content. These results highlight the significant challenges educators face in navigating and assessing the reliability of information in the digital landscape, as

well as their reliance on traditional media hierarchies and surface-level evaluation strategies.

Social Media Usage and Information Sources

Around half of the teachers interviewed declared to account for 3-5 social media; 77% of teachers stated to have spent 1-2 hours using social media the day before the survey (see Figure 1). Table 2 shows that teachers overwhelmingly favor traditional communication tools, with WhatsApp being the most used platform (97%), followed by Facebook (70%) and Instagram (64%). Usage of platforms popular among younger demographics, such as TikTok (14%) and Twitter/X (14%), remains minimal. This pattern suggests a potential disconnect between educators and the digital spaces their students frequently engage with, emphasizing the need for training to bridge this gap.

When it comes to sources of information, half of teachers declared consuming more than 4 sources (Figure 2). In Table 3 we found that traditional media dominate, with 75% of teachers relying on TV for news, followed by online newspapers (63%) and social media (59%). Family (57%) and friends (44%) are also significant sources, reflecting a strong dependence on close networks for information. This reliance highlights a lack of confidence in navigating broader digital ecosystems.

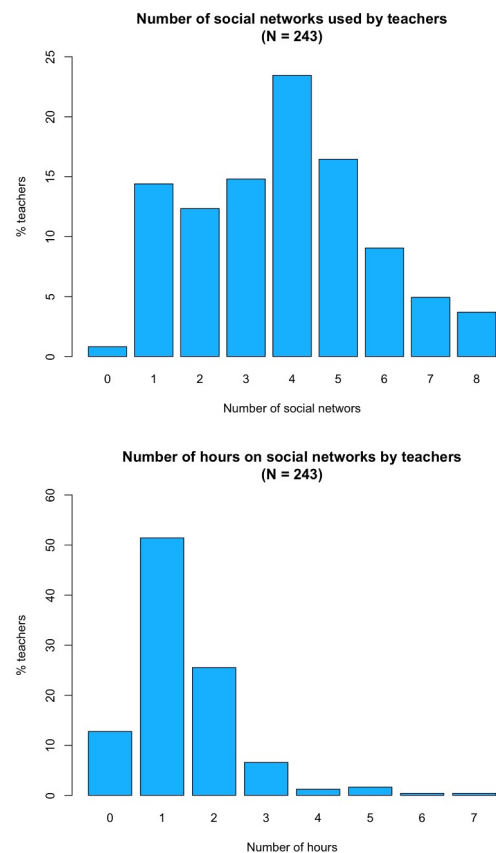


Figure 1 - Number and time spent on social media by teachers.

Table 2 - Social media use by teachers (N = 243).

Social Media	Percentage
WhatsApp	97%
Facebook	70%
Instagram	64%
YouTube	43%
Telegram	42%
Pinterest	34%
TikTok	14%
Twitter / X	14%

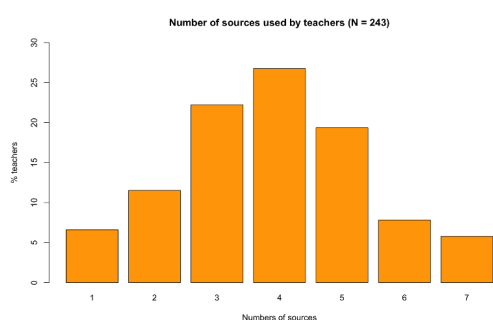


Figure 2 - Number of information sources by teachers.

Table 3 - Information source used by teachers (N = 243).

Information Sources	Percentage
TV	75%
Online Newspapers	63%
Social	59%
Family	57%
Radio	45%
Friends	44%
Web	43%

Trust Levels in Information Sources

Teachers exhibit a polarized trust dynamic, with high levels of trust in traditional media like TV and newspapers, while expressing skepticism towards digital platforms. Figure 3 indicates that the upper limit for the variables social_trust and web_app_trust is lower than for all other variables. The percentage of teachers expressing high trust levels (scoring 3, 4, or 5) was 77% for family, 72% for newspapers, 70% for friends, 65% for radio and 58% for TV compared to only 40% for web applications and 19% for social media.

This bias appears rooted in outdated hierarchies of trust rather than an evidence-based evaluation of reliability.

Teachers’ reluctance to engage critically with digital sources underscores their limited understanding of “post-mediality” (Eugeni, 2015; Moriggi, 2023), where traditional and digital media increasingly overlap and influence one another. This highlights the importance of fostering critical evaluation skills to address such biases.

Assessment of Digital Literacy Skills: challenges with Visual Sources

Teachers were assessed on their ability to evaluate seven key competencies identified in the DigComp 2.2 framework, including differentiating reliable from misleading sources, evaluating news content, and detecting manipulated images. Results in Figure 4 indicate moderate proficiency in identifying reliable websites and recognizing verified profiles on social media (e.g., blue checkmarks). With the minor exception of sponsored content, less than 25 percent of teachers scored 60 percent on the questions, i.e., sufficiency. Teachers struggled significantly with more “inferred context” tasks, such as distinguishing trustworthy content or manipulated photographs, “leveraging information available on the open web to infer where a piece of content came from, how old the content may be, what claims are being made about it and by whom, etc.” (Hebbar et al., 2024).

Moderately better performance only occurs in the case of evaluating “assertive provenance” signals, such as recognising a social media profile from the blue checkmark. In opposition to “inferred context” activities, Hebbar et al. (2024) define assertive provenance as “techniques used at the creation or editing stage to provide a clear signal regarding the means of creation of a piece of content”.

Visual literacy emerged as a critical area of weakness. Teachers had the most difficulty evaluating visual content, such as detecting manipulated images or identifying the original content of a photograph. This aligns with the text-centric nature of traditional schooling, which prioritizes textual analysis over visual and multimedia literacy (Rivoltella, 2020; Farné, 2021). The lack of an integrated aesthetic literacy framework, as discussed in Manovich’s concept of post-medial aesthetics (2001), further emphasizes the need for systematic training that incorporates visual and multimedia evaluation skills.

Checking correlations (Figure 5), higher values were revealed among variables in the same groups. Correlations among variables belonging to different groups were generally low, between -0.24 and 0.31. They suggested weak connections among the number, time spent, and trust in social media, mistrust in family and friends, and higher scores on information literacy assessment. In particular, trust in newspapers corresponds to higher values in the assessment scores, contrary to trust in the family.

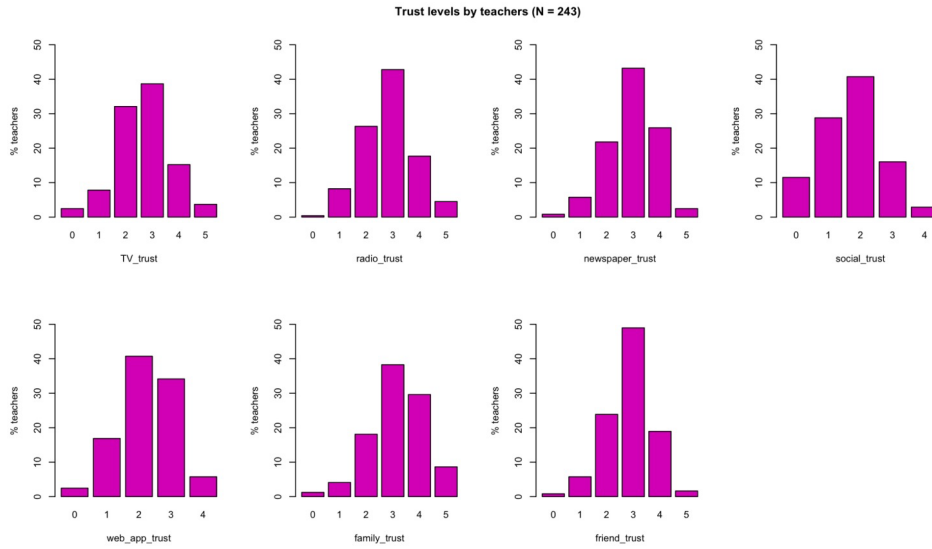


Figure 3 - Trust levels in sources by teachers.

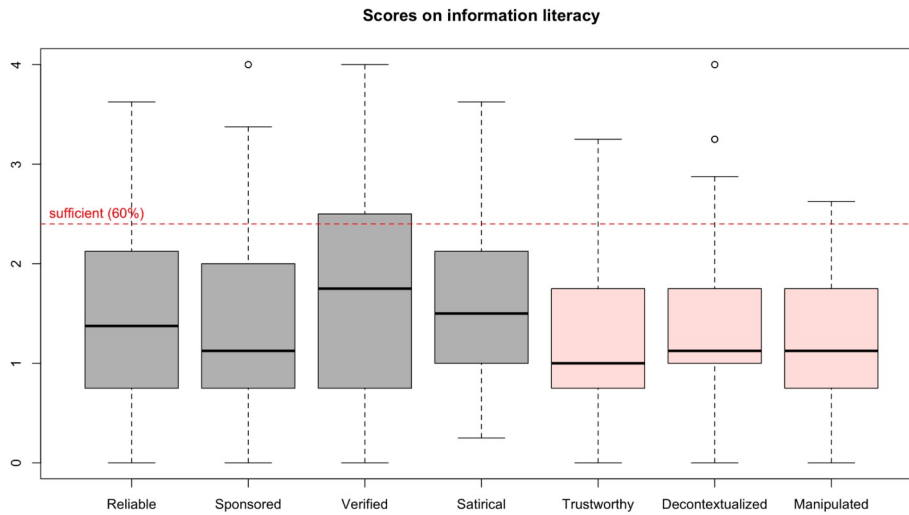


Figure 4 - Boxplots of the score on questions on information literacy.

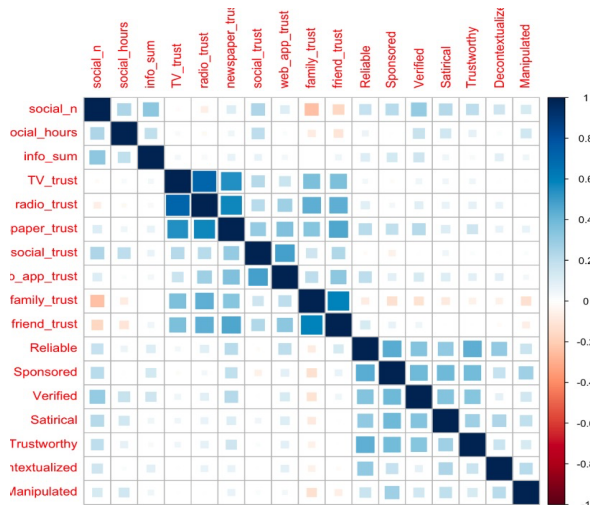


Figure 5 - Correlation matrix.

3.2 Behavioral patterns in teachers’ skills and approaches to digital sources (Q2)

Our analysis revealed four clusters of different sizes as shown in the dendrogram in Figure 6.

The first cluster, the less numerous (N = 30, 12%), includes teachers who make fairly frequent use of social media and consult a good number of social and information-seeking tools. Compared to the others, they have the lowest levels of trust in information sources and perform poorly in the information literacy assessment questions. We define this cluster as *Skeptical and Vulnerable Teachers*.

The second cluster, on the contrary, is the most numerous (in fact, it gathers 40 percent of the teachers in the sample, N = 98). It is composed of teachers who, compared to the other clusters, use less social media and resources for a limited amount of time (usually one hour), have a strong reliance on familiar sources (particularly family, friends and radio), and have lower assessment results than the other clusters. We define this cluster *Traditional Trust-Based and Uncritical Teachers*.

Cluster 3 (N = 57, 24%) and Cluster 4 (N= 58, 24%) have similar sizes. Teachers in Cluster 3 have higher levels of use and trust than all other clusters except in the assessment, where instead, teachers in Cluster 4 have the best scores on the information literacy assessment while declaring moderate levels of use and trust in sources. We define cluster 3 *Digitally Engaged and Trusting Teachers* and cluster 4 *Balanced Critical Evaluators*.

Figure 7 shows the boxplots on variables used for clustering for each group.

The radar chart on the left in Figure 8 confirms the just-described different use of social media by teachers: high for cluster 3, moderate for cluster 1 and 4, low for cluster 2. Basically, the trends do not differ substantially from the order of preferences in the entire sample. Instead, the sources predominantly preferred by teachers vary in the four clusters (right side of Figure 8).

In cluster 1, the majority of teachers choose TV (73%), family (67%), and friends (63%), followed by web applications (60%), online newspapers (57%), and in last place radio (47%) and social media (47%).

In cluster 2, 82 percent chose TV. Family, online newspapers, social media, and radio have percentages between 40 and 52. Around a third of teachers in the cluster refer to web applications and friends to gain information.

As said, the number of sources in Cluster 3 is generally high. Among the most used are social media (91%), TV (86%), and online newspapers (79%), followed by family and friends, and finally web applications and radio, which, however, stand above 50 percent.

In the fourth cluster, 74 percent of teachers use online newspapers, followed by social media (59%) and TV (55%) which falls to third position. Friends are, after all, with 34% of preferences.

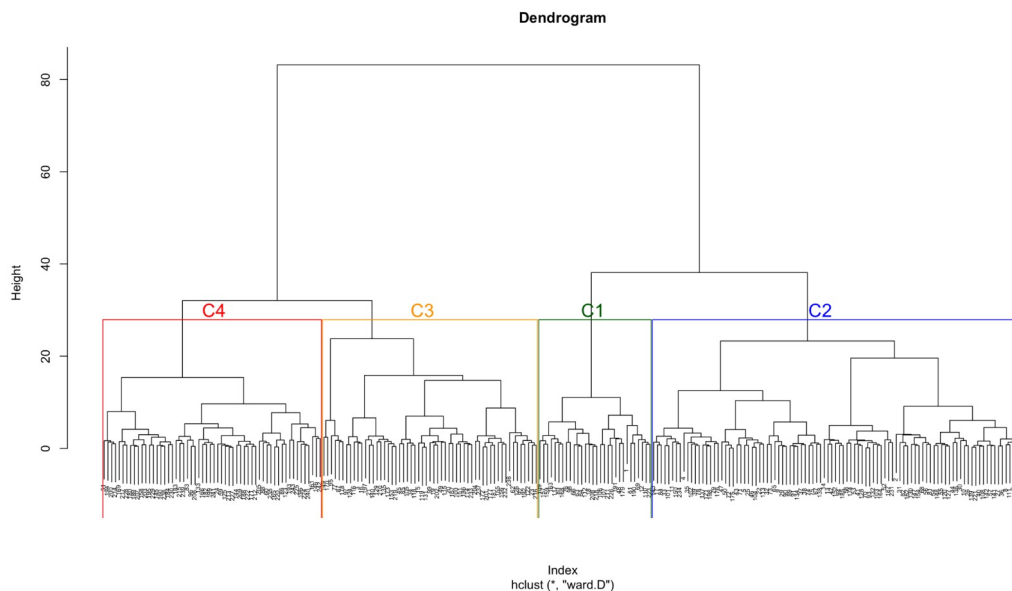


Figure 6 - Dendrogram.

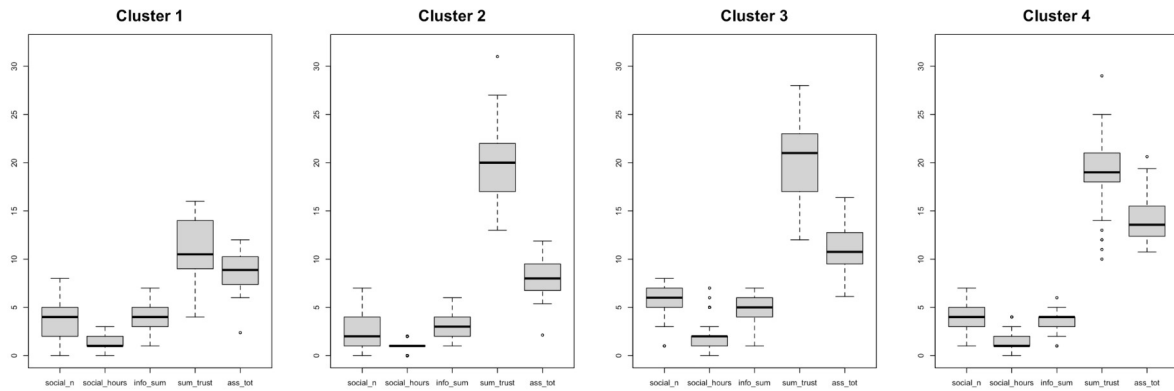


Figure 7 - Variables distribution in clusters (social_n, social_hours, info_sum, sum_trust, and assessment).

Social media usage in teachers' clusters Sources usage in teachers' clusters

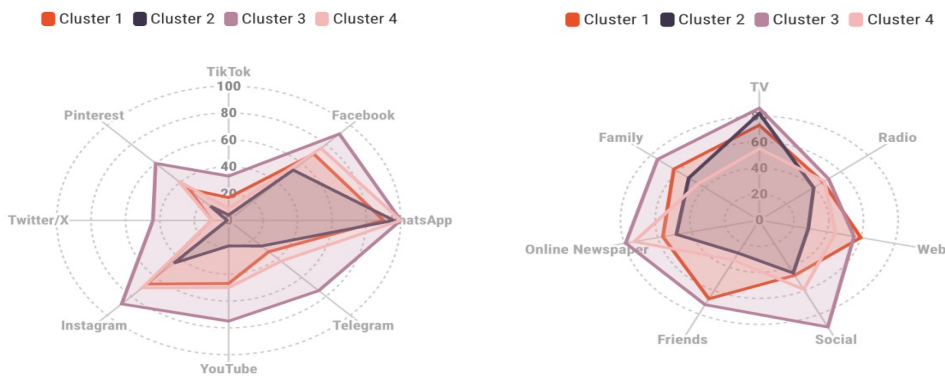


Figure 8 - Use of Social media (left) and Sources (right) in teachers' clusters (radar charts were made with Flourish).

4. Discussion

This study provides critical insights into teachers' competencies in evaluating digital content and their readiness to implement media literacy interventions, contributing to the growing body of research on educational responses to disinformation (Dame Adjin-Tettey et al., 2022; Bak-Coleman et al., 2021; Nygren et al., 2024). Our analysis reveals several key patterns that have important implications for teacher training and educational policy within the European context.

An initial result of this contribution – obtained through descriptive statistics – has allowed us to measure the level of digital competence of primary and secondary school teachers. Despite frequently being invited by educational institutions to address the topic of disinformation in the classroom, only 1 in 4 teachers (25%) manage to achieve a sufficient level of media and information literacy competencies. 3 out of 4 teachers (75%) register moderately low or insufficient competencies, which certainly makes them unprepared to deal with the issues of verifying digital sources and addressing disinformation in the classroom.

These insights underline the need to promote training campaigns that can reach as many teachers as possible to improve their media and information literacy skills and equip them with the content and methodologies to be able to carry out classroom activities independently with their students.

Secondly, in order to better understand the digital behavior and attitudes of the teachers in our sample, we carried out a cluster analysis that allowed us to distinguish four distinct teachers' profiles, each representing different combinations of digital engagement, trust patterns, and media literacy competencies:

1. *Skeptical and Vulnerable Teachers* (12% of sample): these teachers show moderate social media usage (3-4 platforms) and consume multiple information sources, particularly TV (73%) and interpersonal networks (family 67%, friends 63%). Despite their skepticism toward information sources, they paradoxically demonstrate poor performance in information literacy assessments, particularly struggling with visual content verification. This combination suggests that their skepticism may arise from uncertainty rather than critical evaluation skills.

2. *Traditional Trust-Based and Uncritical Teachers* (40% of sample): the largest cluster comprises teachers with limited digital engagement (1-2 platforms, typically one hour daily) but high trust in traditional sources, especially TV (82%) and mainstream media. Their below-average performance in media literacy assessments, particularly in identifying sponsored content and manipulated images, coupled with strong reliance on family networks, suggests a traditional approach to information consumption that may leave them exposed to digital misinformation.

3. *Digitally Engaged and Trusting Teachers* (24% of sample): these teachers demonstrate the highest digital platform engagement (5-6 platforms) and diverse information source usage (social media 91%, TV 86%, online newspapers 79%). While they show high trust levels across sources, their media literacy assessment scores remain moderate, indicating a gap between digital participation and critical evaluation skills. Their broad and trusting engagement suggests a need for focused training in analytical skills.

4. *Balanced Critical Evaluators* (24% of sample): this group shows the most promising profile, combining moderate digital engagement with measured trust levels and the highest scores in information literacy assessments. They prioritize online newspapers (74%) over traditional TV (55%) and show particular strength in identifying manipulated content and evaluating source reliability. Their balanced approach to digital media consumption aligns with stronger critical evaluation skills.

These profiles emphasize the heterogeneity of teachers' digital competencies and the necessity for diversified professional development approaches. Varying configurations of digital interaction, trust dynamics, and media literacy skills require the design of educational interventions other than one-size-fits-all, as is often done at the institutional level. An initial assessment of teachers' skills, knowledge, and attitudes would make it possible to tailor the needs of different groups of teachers.

Third, when we look more closely at the profiles of the different types of teachers, it's clear that most of them have a strong preference for traditional media information sources (especially clusters 1 and 2). This attitude manifests in high confidence in mainstream sources like television and newspapers, while maintaining persistent skepticism toward digital platforms. The reliance on family and friends as information sources, observed mostly in clusters 1 and 2, reflects what McLuhan (1970) conceptualized as "tribal media" behavior. This behavior points to a larger issue with finding your way around complicated digital spaces, which makes teachers turn to comfortable social networks to check information. Such behavior may limit educators' ability to model effective digital literacy practices for their students,

who increasingly engage with diverse online information ecosystems (Common Sense Media, 2022).

Moreover, another piece of evidence concerns teachers' struggle across all clusters with "inferred context" evaluation tasks, especially regarding visual content. The participants showed moderate ability at finding "assertive provenance", like verified social media profiles, but they had a lot of trouble using argumentation and "inferred context" to assess untrusted websites or visual content that had been taken out of its original context. This failure is confirmed in the broader research conducted by McGowan-Kirsch et al. (2023) on the importance of image-based misinformation literacy.

Many media literacy interventions focus on an approach that is sometimes excessively prescriptive and solution-based, paying attention only to the more technical and operational aspects of content evaluation. The results of this study, on the other hand, underline – confirming Manovich's (2021) intuition – the need for a post-media aesthetic education, that is to say, training courses that enable teachers (and consequently students) to read and write the 'new alphabets' of the contemporary world (Rivoltella, 2020; Gee, 2007).

While comprehensive research on students' susceptibility to misinformation is well established, empirical studies specifically investigating teachers' competencies in evaluating digital sources and resisting disinformation remain relatively limited. Findings from the Czech Republic and Slovakia (Kopecký et al., 2023) confirm the presence of critical gaps among educators, with a significant proportion of teachers either misidentifying disinformation or recommending unreliable sources. These results align with our study's identification of widespread difficulties in "inferred context" tasks and visual verification. More broadly, international assessments such as ICILS (IEA, 2018) and TALIS (OECD, 2018) highlight persistent training needs among teachers in ICT and digital content evaluation, corroborating our observation that technical familiarity does not equate to critical digital literacy. The cluster profiles we identified further echo qualitative findings from pan-European studies (TeaMLit, 2023), which emphasize the heterogeneity of teachers' digital confidence and resilience to misinformation, reinforcing the need for differentiated and targeted professional development programs.

The results of this study should be considered within certain limitations. The study's focus on Italian teachers may limit its generalizability to other educational contexts, though the alignment with broader European trends suggests similar patterns may exist across the region. Additionally, the pre-test nature of our data provides a snapshot of initial competencies but does not capture the potential impact of subsequent training interventions. Future research could benefit from longitudinal studies examining how teachers' digital literacy competencies evolve through

professional development programs and their impact on classroom practices, particularly in light of the rapidly evolving nature of digital disinformation.

5. Conclusions

This study provides insights into the current state of teachers' digital literacy competencies and their readiness to address disinformation in educational contexts. Our findings reveal a complex landscape where technical familiarity with digital platforms does not necessarily translate into critical evaluation skills. The identification of four distinct teacher profiles highlights the need for nuanced, targeted approaches to professional development in media literacy education.

The persistent gap between surface-level evaluation skills and deeper analytical capabilities, particularly in visual content assessment, suggests that current approaches to teacher training may need significant revision. Our results indicate that while teachers can often identify basic reliability indicators (based on "assertive provenance" signals), many struggle with the "inferred context" techniques needed to evaluate complex digital content effectively. This challenge is particularly acute in the evaluation of visual materials, where less than 25% of teachers achieved sufficient proficiency scores.

These findings have immediate implications for educational policy and teacher training programs. They highlight the urgent need for enhanced training in information and visual literacy, particularly given the increasing prevalence of image-based misinformation in digital environments.

Authors contributions

According to CRediT system: *Nicola Bruno*: Conceptualization, Methodology, Investigation, Project Administration, Supervision, Writing - Original Draft, Writing - Review & Editing; *Annamaria De Santis*: Methodology, Formal analysis, Data Curation, Visualization; *Stefano Moriggi*: Conceptualization, Methodology, Investigation, Writing - Review & Editing.

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Annex

01 Reliable Sources

Immagina di essere alla ricerca di informazioni sul Covid-19. Ti imbatti in queste due fonti:

Il Primato Nazionale: <https://archive.vn/MSa6f>

Torino Medica: <https://archive.vn/uQcP6>

Quale consideri più affidabile?

Per quale motivo?



02 Sponsored contents

Dopo aver letto questo articolo su La Repubblica, come valuti i contenuti?

- Attendibile
- Non attendibile
- Non so

Per quale motivo?

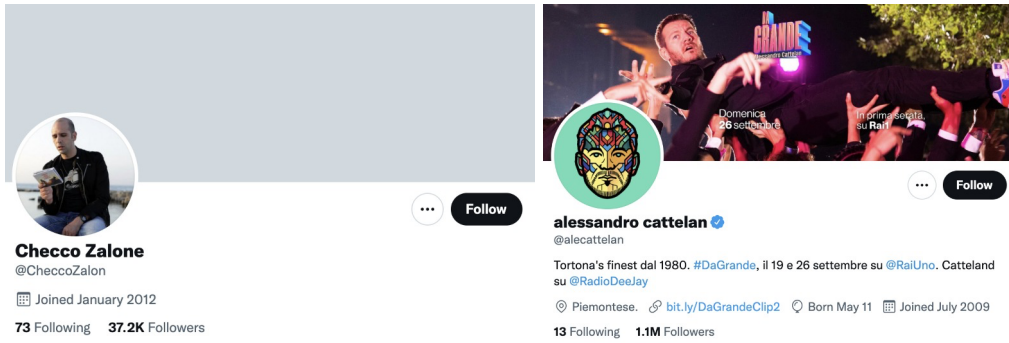


03 Verified profiles

Quale di questi due profili è più attendibile?

- Checco Zalone
- Alessandro Cattelan

Per quale motivo?



04 Satirical content

Come valuti questa notizia del Comune di Bugliano?

- Attendibile
- Non attendibile

Per quale motivo?



05 Clickbaiting news

Quale titolo di queste due notizie ti sembra poco attendibile?

- TPI <https://perma.cc/CM6X-LVME>
- Viral Magazine <https://perma.cc/59BM-G3VA>

Per quale motivo?



06 Decontextualized images

Mentre navighi online, ti imbatti in questa foto con il titolo "In Siria, dormendo tra i propri genitori". Come la consideri?

- Attendibile
- Non attendibile

Per quale motivo?



07 Manipulated photos

Come valuti questa foto condivisa su Twitter?

- Attendibile
- Non attendibile

Per quale motivo?



eCRONY: hypothesis and experimentation of a new educational tool in motor skills teaching

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Abstract

The eCRONY project hypothesises the development and ongoing experimentation of a digital educational tool aimed at enhancing motor sciences teaching. Traditionally, motor skills education relies on demonstration and imitation, often limited to describing visible movements. This approach does not delve into biomechanical causes or proprioceptive sensations as primary learning tools, aspects typically left to practical internships. However, the growing adoption of digital technologies and distance learning highlights the need for an approach that integrates these elements to better support online students with limited guided practice.

eCRONY, structured in four progressive levels (proprioceptive exploration, biomechanical analysis, comparison of causes and effects, and simulation in the absence of terrestrial forces), aims to serve as a valuable educational supplement. The educational pathway promotes a deep understanding of movements, exploring causal forces and enhancing both sensory learning and autonomous feedback abilities. The proposed experimentation aims to assess the effectiveness of this innovative approach compared to traditional methods, hypothesising improvements in proprioceptive awareness, biomechanical understanding, and critical self-assessment abilities among students. If confirmed, the expected outcomes could position eCRONY as a valuable tool for a more scientific and accessible approach to motor skills teaching.

KEYWORDS: Didactics, Training, Motor Sciences, Proprioception, Biomechanics.

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1. Introduction

The teaching of more practical subjects, such as motor sciences, has traditionally followed an approach based on demonstration, imitation, and repetition, where students observe a movement and replicate it under the guidance of an instructor. Rooted in social learning theories (Bandura, 1977), this method has traditionally

focused on visible movement correction. The adoption of digital technologies has broadened this perspective, providing tools that enhance movement analysis while limiting in-person correction (Porter et al., 2010; Dewi et al., 2020). Additionally, these tools have broadened knowledge regarding the visible effects of motor gestures, focusing on the forces acting in overt movement without delving into the internal forces that cause them (Andrews et al., 2016). Despite observing movement execution, students often lack access to the underlying biomechanical and proprioceptive mechanisms (Willis et al., 2021), an issue exacerbated in online learning environments. Currently, no tools directly support this learning, making it dependent on individual proprioceptive practice (Bernardi et al., 2015; Heald et al., 2018; Leite et al., 2019). Proprioception enables the identification, through sensation, of the muscles responsible for motor action. Supporting this concept, numerous studies today confirm the importance

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of a proprioceptive approach in developing movement understanding (Urgesi et al., 2006; Borner et al., 2023; Kurita et al., 2014). In this context, biomechanical studies also help shift students' attention towards the causes of movements (Proske & Gandevia, 2012; Toma & Lacquaniti, 2016). Schmidt and Lee (2019) demonstrated that effective motor learning requires access to information about causal forces. This is because the distribution of muscle contraction forces is not immediately visible; nonetheless, these forces ultimately determine the outcome of an action, thereby holding primary significance for those aiming to teach motor education (Dimitriou, 2016). The understanding of such internal force dynamics is still often limited to medical fields through the use of advanced tools like electromyography, whose data are generally not translated or made accessible within the motor education setting. This limits the integration of such information into university motor learning practices, delegating this step, as analysed, to the abilities of the individual or their instructor and keeping the teaching, particularly in online contexts, focused on effects and imitation (Aoyama & Kohno, 2020; Cho et al., 2022). These limitations highlight the need for a more integrated approach that addresses both proprioceptive awareness and biomechanical analysis, leading to the research question of this study. As Enoka (2015) pointed out, improving the quality of motor teaching might require going beyond imitative didactics and integrating teaching tools that enable students to understand the biomechanics of forces in action. Biomechanics provides students with the tools necessary to develop a deeper understanding of causal motor processes (Cos et al., 2013; Lieberman & Breazeal, 2007; Bogert et al., 2013; Stergiou, 2020). Further studies on optimising motor didactics highlight that biomechanics, when understood, enables the development of a more critical and generalisable approach in teaching (Wulf & Lewthwaite, 2016). With the changes brought about by new tools in this field, a targeted transmission of biomechanical concepts in support of causal learning could be of particular interest (Hebert et al., 1996). In this context, a new didactic methodology, Sincrony, is emerging as an innovative bridge between proprioceptive development and biomechanical analysis, offering an integrated approach that values both bodily perception and scientific exploration of movement. On the one hand, it focuses on the biomechanical study of muscle activation sequences that enable the gesture, as well as their interaction with physical forces such as gravity, mass, or acceleration (De Bernardi, 2008; Fogliata et al., 2022; Latash, 2008). On the other, it emphasises the importance of using proprioception as a fundamental tool for practical motor learning (Tezel et al., 2024). Supporting teaching, particularly online teaching, with a tool that integrates proprioceptive response to movement as a primary source of feedback could provide an interesting perspective to make this type of learning more effective

(Johnson et al., 2023). This would represent a shift from a traditional 'know, demonstrate, imitate' approach to a more integrated model based on 'know, perceive through sensation, analyse (causes), demonstrate (effects), imitate' (Zhan et al., 2023). Such an approach, if used in implementing new learning tools, could naturally enable students to observe the full technical execution with an internal focus that is both physical (proprioceptive) and cognitive (causal biomechanics) (Schmidt & Wrisberg, 2008). It could also adapt well to distance learning, thanks to the use of specially created educational videos to help students better understand gestures and the forces at play (Lindberg et al., 2013; Souissi et al., 2021; Mirdamadi & Block, 2020; Batcho et al., 2016; Lin et al., 2022). These aspects were highlighted in the work of Hodges and Franks (2002), who found a direct correlation between increased focus in practical hours and the ability to analyse movement parameters, making them generalisable for teaching purposes. In broader terms, therefore, a didactic integration would be fully aligned with universities' objectives to train critical thinkers capable of analysing and solving complex problems not only as individuals but through repeatable paradigms (Syaputra & Warni, 2023). In light of what has been discussed, teaching motor skills, particularly in online settings, may require introducing new tools for causal learning based on proprioceptive stimulation and expanded biomechanical knowledge. As Knudson (2007) noted, an approach focused solely on the visible effects of movement (trajectories, angles, speed, and acceleration) is insufficient to develop a comprehensive understanding of motor dynamics since this understanding is itself influenced by the ability to relate to the sensation and/or experience of actual movement (Guilhem et al., 2014; Marchal-Crespo et al., 2014; Seidler et al., 2013). A tool that acts as an educational support in this sense could enhance teaching quality, offering greater learning opportunities even to students who do not primarily rely on visual channels (Syaputra & Warni, 2023). These models aim to gradually reduce errors through continuous correction linked to feedback on external feedback (Albert & Shadmehr, 2016; Drews et al., 2021; Tang et al., 2022). However, it is essential to recognise that each individual builds knowledge through a subjective process, often influenced by prior experiences or context; an approach based solely on external feedback may not be sufficient (Piaget, 1972; Vygotsky, 1978). Constructivist theory, in particular, has shown that learning is an active and personalised process, where each student interprets reality based on their own prior knowledge and individual perceptions. This implies that, in motor teaching, the same gesture may be interpreted differently by different individuals, leading to variations in understanding and correction (Bransford et al., 2000). The more educational strategies are varied and objective, the more effective the educational intervention may be in reducing such biases (Chiviacowsky, 2020). Another important factor in this

context is selective attention: what a student focuses on determines what they perceive and, consequently, how they learn. Psychology has studied the concept of selective attention in detail, demonstrating how it can influence visual perception and the way we interpret the stimuli around us. Research on selective attention, such as studies on “change blindness,” shows that focused attention can narrow our field of vision, often causing us to miss significant changes in our environment. This suggests that if we rely solely on the visual channel as our approach, it may limit our ability to perceive and learn new elements, even at low speeds. In fields requiring the integration of complex information at high speeds and with multi-structural elements, such as learning motor skills, relying exclusively on selective attention based on a focused visual channel could reduce the breadth of perceived information, hindering comprehensive and dynamic learning (Simons & Chabris, 1999; Simons & Rensink, 2005). When applied to movement, this implies that two students observing the same movement may notice different aspects depending on their visual attentional focus, and, consequently, the feedback they receive may be interpreted differently (Martay et al., 2021). Furthermore, Heisenberg’s uncertainty principle, typically applied to physics, could be extended to motor learning, suggesting that the observation of a movement is influenced by subjective variables, such as the observer’s angle, knowledge, and cognitive biases. This makes it clear that movement correction based solely on external observation is not always sufficient (Lin et al., 2022). This research aims to investigate whether and how an integrated teaching approach, combining the development of proprioception with the analysis of biomechanical forces, can significantly enhance motor skills students’ understanding of movement. The objective is to determine whether this innovative methodology can offset the limitations of online learning, where guided practice and direct correction are reduced. Specifically, the study will explore whether the combination of proprioception and biomechanics can facilitate a deeper and more critical understanding of the causes of movement, compared to traditional teaching methods, which are primarily based on demonstration and imitation. The eCRONY project addresses the growing need to make motor skills education more accessible and flexible, particularly in online learning contexts or where in-person guidance is limited. By integrating proprioceptive feedback and biomechanical analysis, eCRONY supports a new mode of instruction that enables students to develop motor competencies autonomously, in a scientifically informed and replicable way, aligning with modern trends in educational mobility and online training.

2. Materials and Methods

This study follows a Design-Based Research (DBR) approach, in which the development of eCRONY must undergo a process of verification and empirical validation before reaching the pilot phase. Currently, the literature review phase has been completed. Through an analysis of academic programs from the top 20 Sport Science universities ranked in the Shanghai Ranking’s Global Ranking of Sport Science Schools and Departments 2024 (Shanghai Ranking Consultancy, 2024), the absence of similar didactic tools in current curricula has been confirmed. No existing tool combines proprioception, dynamics and kinematics like eCRONY. Additionally, with the support of theoretical physics experts, the scientific foundations of the biomechanical models to be used in the eCRONY system have been validated. The development of educational materials has reached an advanced stage, and eCRONY is now entering its pilot phase. At present, the first instructional videos are being finalized, marking the completion of the material development phase. In the next phase of the research, a pilot study will be conducted on a selected group of students to assess the effectiveness of eCRONY in motor learning, with a particular focus on the development of proprioception and biomechanical understanding. In light of the above, the development of eCRONY would be underway, an innovative educational tool designed to enable students to access content based on guided proprioceptive sensation stimulation, while simultaneously offering an in-depth understanding of movement biomechanics (Vandevoorde et al., 2022). eCRONY would be based on progressively complex levels, utilising supplementary supports such as motor diaries with meta-reflections, as well as a didactic pathway through specialised videos. These videos would integrate various levels of feedback to guide students in understanding lessons related to basic motor movements through practical and sensory comprehension. The videos would be structured around four explanatory levels and would focus on four fundamental movements: vertical jump, lateral shift, push-ups, and walking, common to many sports (Cowin et al., 2022; Bennet et al., 2006).

STRUCTURE OF ECRONY LEVELS

Each level includes pauses and structured questions to reinforce learning, allowing students to repeat tasks as needed.

Level One: exploration and proprioception

In this initial phase, the student would observe a simulation of one of the listed gestures, without specific indications of the muscles involved in the action. The observation would be designed to stimulate reflection on the causes behind the movement and to encourage proprioceptive stimulation. The level’s structure would thus invite the student to perform the movement, paying

particular attention to the body parts engaged during the practice. Subsequently, through questions and specially-designed feedback quizzes, the student would be prompted to imagine which muscles caused the action and in what sequence. Following this, the student would be able to watch the same gesture videos but with coloured indications of the muscles in action and activation sequences. The primary objective would be to improve proprioceptive and kinaesthetic awareness, enhancing the student's ability to perceive and understand their body in action.

Level Two: biomechanical analysis of causes

In the second level, the student would be introduced to a detailed biomechanical description of the selected gestures previously performed in the first level. Through visual simulations, the causal dynamics of the movement would be highlighted. This level would also use vectors and muscle-anatomical explanations related to the gestures, along with questions, quizzes, and even segmented execution of the gesture to perceive and study each unit individually. The aim of this phase would be to guide the student towards an in-depth understanding of the biomechanical mechanisms underlying the gesture.

Level Three: comparison of gesture effects and causes for teaching purposes

In this phase, the student would be invited to compare the movement between its causes and the visible effects of the gesture in question. This process would be supported by two simulations of the same movement analysed from both perspectives. For example, in the walking gesture, one video would show an analysis of the visible effects (e.g., thigh lifting, foot rolling), while a second video would highlight the generating causes (e.g., gluteal contraction, forward torso shift). This level would aim to encourage the student to reason about the differences between causes and effects, and, based on this, form structured hypotheses on how to approach the teaching and correction of the gesture itself. Specific questions and quizzes at this level would evaluate the best teaching strategies based on different levels of difficulty. The student would determine whether it is better to explain by causes or effects. Additionally, the ability to "see" both aspects simultaneously would allow the student to compare their ideal execution with their actual performance.

Level Four: movements in "Vacuum" – Physical forces

The final level would offer the student a unique experience: observing how movement would manifest in a "vacuum" or, more accurately, in the absence of terrestrial forces. This simulation would allow the isolation of acting forces, would enhance the student's awareness of their influences. At this point, the

biomechanical understanding acquired in previous levels would be further reinforced. Following this, explanations of the four planes of movement and teaching suggestions for improving the presentation and instruction of movement would be provided. This progressive approach would enable students to develop a profound and practical understanding of movements through a continuous cycle of exploration, analysis, comparison, and advanced application.

PILOT EXPERIMENT

For the pilot experiment, a group of 30-50 students enrolled in motor science courses would be selected, evenly distributed between in-person and online mode. Participants would be randomly divided into: Group 1, Experimental (eCRONY), with at least 15 students per mode (online and in-person), who would use the eCRONY system in their educational pathway; and Group 2, Control (traditional method), with at least 15 students per mode, followed using the conventional demonstration and imitation method. The experiment would unfold over four distinct periods.

Phase 1: Orientation and pre-test

This phase would include an introductory session where Group 1 students would receive a presentation on eCRONY, its objectives, level content, and self-reflection methodology via motor diaries. Group 2 students would attend a presentation but only covering the effect-based video explanations. Both groups would complete a preliminary biomechanics and proprioception knowledge questionnaire to assess the starting level. Their ability to execute key movements (vertical jump, lateral shift, push-ups, walking) would also be assessed with video recording on graded grids to evaluate initial motor control and quality, along with the Borg test. These data would serve as selection criteria and as a baseline for later comparisons.

Phase 2: Intervention

Group 1 students would view the complete course supported by eCRONY, including simulations and detailed explanations of biomechanical dynamics and proprioceptive perception across all four levels. Group 2 (Traditional Method) students would follow only the explanatory videos focusing on the visible effects of movements, with no references to internal dynamics or proprioceptive perception elements. Both groups would have the same allotted time to complete this phase, determined by the experimenters based on learning statistics, thus ensuring a standardised educational process between online and in-person modes.

Phase 3: Re-test and questionnaires

Data would be collected post-intervention for comparison with the baseline results. Additionally,

qualitative questionnaires would be administered to assess the overall educational experience.

Phase 4: Control Group access to eCRONY

The control group would subsequently have access to all eCRONY course content, following the same standardised learning timeframes. A final comprehensive evaluation, both qualitative and quantitative, would be conducted at the end of the learning pathway. Since the study is still in the developmental phase, the empirical results will be analyzed in subsequent stages and presented in future research.

3. The Expected Results

In light of the methodological premises and experimental framework, the adoption of eCRONY in physical education teaching is expected to yield a series of positive outcomes. The main expected results are outlined below.

Proprioceptive awareness: students will develop a heightened awareness of their bodily sensations during movement execution, which will facilitate the identification of specific muscle activations.

Biomechanical understanding: through biomechanical analysis, students will gain a deeper understanding of the forces at play during movements, even in the absence of previous quantitative data.

Self-Assessment skills: students will enhance their ability to self-assess and critically reflect on their performance, aided by the visual and proprioceptive feedback provided.

Active learning: using an integrated approach, students will engage in more active and meaningful learning, which will foster their motivation and interest in the subject.

4. Discussion and Conclusions

The anticipated results of the eCRONY project could highlight the added value of using a combination of proprioceptive and visual feedback to enhance motor learning, providing greater benefits compared to the traditional method based solely on imitation. Indeed, several studies have demonstrated that proprioceptive awareness, the ability to “feel” movement, facilitates practical understanding as it encourages a direct, attentive connection between body and mind during the execution of a gesture (Rosenkranz & Rothwell, 2012). In this context, eCRONY would address a specific need, as many students, particularly those learning in online environments or without consistent access to in-person feedback, may require additional tools of this nature.

Moreover, biomechanical understanding could further contribute by enabling students to comprehend the causes of movements, fostering a more critical and scientific mastery of movement that could aid in the recognition of potential errors (Sigrist et al., 2013; Le Naour et al., 2019). The analysis of top-ranked academic programs confirmed the absence of similar didactic tools, reinforcing eCRONY’s novelty in integrating proprioception and biomechanics into a unified learning system. Unlike existing approaches that primarily focus on visual observation, eCRONY actively engages students in both sensory perception and biomechanical reasoning, making it a pioneering model in digital motor education. Another aspect for the implementation of eCRONY concerns the scalability of the tool across various educational settings. In particular, it will be necessary to assess the platform’s accessibility for students with different levels of motor skills and varying familiarity with digital technologies. Additional comparative studies with existing tools could provide useful insights to optimize the process of integration into university curricula. In fact, an understanding of the forces at play, by enhancing error identification skills, could better prepare students with a corrective focus for a teaching role. Therefore, through visual and proprioceptive feedback, eCRONY would support the recognition and self-correction of execution errors, promoting critical reflection and autonomy (Henriques & Cressman, 2012) and reducing the need for external correction. In fact, if eCRONY were to promote active learning through a combination of motor diaries, simulations, and feedback, it could encourage students to engage actively in their learning process, stimulating greater motivation and involvement. Various studies support that an integrated approach of this type not only improves learning effectiveness but also fosters more sustained and critical engagement with the subject matter (Wong et al., 2011). So, the eCRONY project could represent a step forward in the teaching of motor sciences, offering a solution to overcome some of the limitations of the traditional method, which primarily relies on visual imitation and external feedback. With eCRONY, there would be the potential to support the development of proprioceptive awareness, allowing students to perceive and understand their movements more comprehensively. Access to a more in-depth biomechanical understanding of the forces involved in movement could make this process more objective and less dependent, with greater possibilities for self-assessment and self-correction. However, it should be noted that eCRONY would still be in the pilot phase, so its concrete effects on motor learning would remain hypothetical and would require further testing; additionally, the costs associated with its implementation could pose a challenge for widespread adoption. Moreover, it would be interesting to assess its effectiveness based on individual student characteristics, such as motor experience level and predisposition to sensory learning. In summary, if the expected results are

confirmed, eCRONY could become a valuable educational tool, capable of making the teaching of motor sciences more accessible and scientifically informed. Nevertheless, further experimentation is essential to fully understand the impact of eCRONY and the most effective methods for integrating it into training programs. Once the pilot study is completed, it would be valuable to apply eCRONY more broadly in motor education, integrating it with the latest innovations in biomechanics derived from the Sincrony methodology. This approach could transform the teaching-learning model by enabling access to and understanding of movement aspects that are not directly visible. While kinematics, widely used for studying motor gestures, is well defined, the dynamic component, such as muscle activation and the forces involved, often remains hidden and is typically studied separately. The use of tools that integrate dynamics and kinematics could therefore allow students to develop a greater ability to analyze movement, facilitating learning and the application of more precise corrective feedback. In this context, proprioception emerges as an essential element in motor learning, as its use would enable students to understand not only the executed action but also the internal processes that drive it. By integrating proprioception as a didactic tool, eCRONY could promote a deeper body awareness, enhancing self-assessment and self-correction abilities. This approach would also serve as a valuable foundation for training future motor science educators, equipping them with innovative tools for a more effective and scientifically grounded motor education.

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Avanguardie educative, a collaborative network for Italian teachers' professional development

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Abstract

The COVID-19 pandemic posed significant challenges to education, particularly in countries like Italy with limited prior experience in distance learning. To support the educational community during this crisis, a series of 41 webinars was organized, addressing key themes of educational innovation. Rooted in mentoring, knowledge exchange, and reflective practice, this initiative was part of the broader efforts of *Avanguardie Educative*, a network encompassing nearly 1,600 schools, to adapt to the shift toward remote teaching. Participants completed satisfaction surveys after each webinar and a follow-up questionnaire at the series' conclusion, enabling an analysis of emerging needs in professional development and training. Findings highlighted high levels of satisfaction with the program and confirmed its effectiveness as a tool for coaching and professional growth. The initiative also demonstrated strong networking potential, emphasizing its value in fostering professional learning communities. These results encourage further exploration of how webinar-based technologies can facilitate the exchange of practices and support professional development.

KEYWORDS: Learning Networks, Professional Learning Community; Professional Development; Teacher Training, Covid-19.

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1. Introduction

The academic years 2019/20 and 2020/21 posed unprecedented challenges for Italian schools due to the health emergency, which disrupted traditional practices and required rapid adaptation. The suspension of in-person teaching and the shift to distance learning highlighted both significant difficulties and opportunities for rethinking and innovating pedagogical and organizational approaches (Carretero Gomez et al., 2021; INDIRE, 2021; SIRD, 2020). The pandemic revealed a critical need for professional support, as most Italian teachers were unprepared for remote teaching and struggled to adapt their methods to the digital environment (Nigris et al.,

2020; Ranieri et al., 2020). Studies on the Italian educational system have highlighted not only a structural lack of preparedness but also a widespread deficiency in digital skills among both students and teachers (INDIRE, 2021; Lucisano, 2020). In response to these challenges, there emerged a grassroots demand for “just-in-time professional development” (Neumann & Smith, 2020, p. 527), often supported by digital technologies and diverse distance learning tools. Among these, webinar-based training played a particularly prominent role.

Although webinars, particularly as Massive Open Online Courses (MOOCs), have become increasingly prevalent in higher education, their adoption within school contexts remains limited. While distance learning technologies have been extensively researched in academic and professional settings, the use of webinars for teacher professional development is still underexplored (Toquero & Talidong, 2020), although existing studies indicate that teachers generally have positive perceptions of learning experiences mediated by these tools (Khanna & Thakarar, 2021). In their study, Shal et al. (2024) found strong positive opinions about webinars as a means of teacher professional development. During COVID-19 teachers attended several professional

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development webinars that enabled them to resolve some misconceptions about online teaching and learning, enhanced their critical reflection on their online teaching practices and formed some new practices (Al-Naabi, 2023).

During the pandemic, webinars fostered collaboration and solidarity within the school professional community. These interactions often took the form of peer tutoring and mutual support, characteristic of communities of practice. Scholars have emphasized the importance of these professional learning communities as key drivers of professional growth (Hord & Summers, 2008; Sjoer & Meirink, 2016). Indire leveraged its expertise in supporting educational innovation by designing activities and services, such as the initiative discussed in this study, which emphasized the value of networking as a mentoring system (Mangione et al., 2020).

The first part of this paper provides a theoretical framework to the case study described. The second part describes the research context. The third part examines the methodological approach of the study. In the fourth and fifth parts the results of a survey are presented and discussed. In the conclusions, the authors express some considerations on possible developments of the network experience set out in the following paragraphs.

2. The Network as a Training Tool

The research carried out by Indire has long been oriented toward the concept of the network, as both a guiding principle for its institutional actions and a fundamental element of its research activities in Education. Recognizing the value of practice networks as a lever for change and an essential tool for the development of teacher professionalism (European Commission, 2018), Indire has established two large school networks: *Avanguardia educativa* and *Piccole Scuole*. These networks find their distinguishing features in the exchange of best practices, reflective knowledge transfer among peers, and mutual support and guidance (Nardi et al., 2022), also in “non-standard” educational contexts (Mangione et al., 2023). Networks support informal learning and allow for the exploration of new self-guided learning modes for the involved parties (Nigris et al., 2020). Collaboration among schools can help overcome educator isolation by providing opportunities for sharing, professional development, and enrichment (Kools & Stoll, 2016). These networks typically engage educators, teachers, school leaders, along with others actors who, outside their regular practice community, employ collaborative learning to improve their teaching practices and student learning processes (Poortman et al., 2022). They are designed to bring

their systematic review on technologies for supporting knowledge sharing within learning communities, Zamiri and Esmaili state that the provision of training sessions, seminars, webinars and videoconferences are integral components of learning and community development methods. They provide a structured and interactive environment for knowledge sharing, skill development and continuous improvement (Zamiri & Esmaili, 2024). During the pandemic, these remote learning communities (Safi et al., 2020) led to increased cooperation among educators, encouraging peer tutoring and diverse self-directed training initiatives (Pagani & Passalacqua, 2020).

together individuals who share and critically examine their teaching practices continuously, reflectively, and collaboratively (Stoll et al., 2006), identify common actions and shared goals, develop collective plans and strategies, becoming “active agents of their own growth” (Schleicher, 2012, p. 73).

The two school networks promoted by Indire are configured as Professional Learning Communities (Vescio et al., 2008) and Professional Learning Networks (Trust et al., 2016), hubs, aggregation points that connect different practice communities to achieve overall improvement in the education system through processes of scaling up and systematizing best practices, routines, habits, and evidence of effectiveness. At the core of the networking concept there is always the concept of mutuality, mutual aid, and reciprocity (European Commission, 2018), as network cohesion and functioning largely depend on all actors recognizing the value derived from their participation.

Studies exploring the effectiveness of Professional Learning Communities (PLC) organized around common work practices, knowledge sharing, meanings, and languages (Sjoer & Meirink, 2016), have confirmed that belonging to the community (Hord & Summers, 2008) is a crucial factor in the development of teacher skills and professionalism (Singh & Loh 2024; Vangrieken et al., 2017). The implementation of these professional communities is considered one of the most powerful organizational strategies for achieving significant educational improvements, enhancing self-efficacy, satisfaction, and collaboration among teachers, which can then positively impact student learning outcomes (Darling-Hammond et al., 2017; Khasawneh et al., 2023).

However, the aim of these networks is not just to achieve better student performance but also to serve as places for reflection and research on educational issues, such as the role of teachers, school well-being, educational equity, and more. Here different actors collaborate in a critical examination and revision of the curriculum goals (Brown, 2020).

Professional communities are spaces for activating a reflective stance and thinking (Schön, 1993), allowing

their members to gradually emancipate themselves from top-down processes, become capable of analyzing and evaluating their own practices, and develop autonomous hypotheses for problem-solving and change. In this regard, professional learning communities act as “forces that promote teacher innovation” (Liu et al., 2022, p. 3), supporting reflective processes that encourage teachers to question their established routines, behaviors, and thoughts (Rubenstein et al., 2018). Shared responsibility for the school mission encourages the emergence of new ideas and approaches to improve organizational and instructional effectiveness, activating intrinsic motivations in teachers (Paletta, 2020) and promoting the consolidation of new practices, routines, and solutions without the need for material rewards (Lu & Campbell, 2021). Professional learning communities were found to be particularly functional in enabling timely adaptation to contextual changes during the lockdown (Paletta et al., 2022).

Indire has adopted the “Research-Practice Partnerships” framework as its guiding conceptual model for establishing its networks. The underlying idea is that the wisdom of practitioners, comprising their expertise, innovations, and professional culture (Mazzoni & Ubbiali, 2015) is a fundamental resource for realizing educational innovation. Innovation is understood as a set of intentional and systematic changes undertaken to better and more sustainably achieve the goals of an educational system or to identify new ones (De Landsheere, 1979). At the core of this vision is also the belief that School as Learning Organizations have structures that enable staff to grow as professionals, operating as communities based on a shared vision and the collective capacity of the staff to pursue continuous improvement (Senge, 1990).

The educational value of the Network is expressed in *Avanguardie educative* not only through the actual training and co-training activities promoted by its participants but also through collaborative research processes (Desgagné, 1997), where AE members (Alquati, 1993) are actively involved in the investigation processes. Collaboration helps to avoid the risk of “innovation without change” (Elliott, in Magnoler, 2012, p. 110).

In the concept of the School as a Learning Organization, the way a school collectively builds and enhances its knowledge is key to change and success (Giles & Hargreaves, 2006). In this perspective, engaging with other members of the educational community allows schools to assess the relevance, feasibility, and sustainability of their change trajectories, making necessary adjustments as needed. On the other hand, the comparison with school practitioners is essential for educational research, in order to intercept emerging trends, common challenges, and the innovations employed to address them.

3. Research context

The *Avanguardie Educative* Network, established in 2014 as a collaborative initiative between Indire and 22 founding schools that endorsed its Manifesto, now comprises nearly 1,600 schools of all levels across the national territory. The network was created to promote and support innovation processes within the education system. Long before the pandemic events required a forced rethinking of the school model, *Avanguardie educative* promoted digital integration, in order to hybridize the traditional transmissive lesson. The network has always been inspired by the encounter between the innovative drive coming from school institutions (bottom-up) and formalization processes and systematization of educational research (top-down). As underlined at the European level (OECD, 2013), the transformation of the school system implies the transition from a top-down approach to a more contextualized approach, based on the analysis of innovative experiences of schools.

It is a participatory and collaborative approach, in which all actors play a role towards change and innovation by generating sub-networks of schools that in their innovative performance are linked to the main network (the AE Network). The movement fosters didactic and organizational innovation through a *Gallery of Innovative Ideas*, as well as training and dissemination initiatives, which encourage continuous methodological reflection on the broader school system. By harnessing the “disruptive” and “generative” power of these innovative ideas, the traditional school model – primarily reliant on the expository teaching method – undergoes transformation. This process catalyzes changes in teaching routines, cultivates a culture of innovation, and introduces new frameworks that reconfigure socio-educational relationships. It also redefines the paradigm of the educating community, positioning the student as an active agent in their own educational journey.

The project functions as an evolving research laboratory, with approximately 200 new schools joining the *Avanguardie Educative* Movement each year, adopting at least one innovation idea. Notably, over 40% of participating schools have implemented at least three such ideas. The primary objective of the AE Movement is to advance knowledge and foster shared experiences among member schools, promoting “systemization” across three levels: the micro level (individual professional practices), the meso level (class councils and departmental practices), and the macro level (the entire school, including its sub-structures and relationships with the local community and stakeholders). Over its 10 years of activity, the AE Network has fostered extensive collaboration, significantly contributing to redefining the role of the

21st-century school as a flexible learning environment.

Avanguardie Educative is both a community of practice and research, and an opportunity for professional development in service. The transferability of organizational and methodological-didactic best practices, ensured through continuous observation, monitoring, and evaluation by researchers, is envisioned as a key strategy to address the “paradigm of complexity” (UNESCO, 2021). This approach enables schools to continuously evolve and adapt, thereby providing new and meaningful educational opportunities. Among its major objectives, the AE educational community of practices aims to bring to the center and problematize learning by experience, teaching as research in action, and the relationship between practice and theory, in terms of support for critical and profound thinking.

4. The webinar cycle and the survey

Teacher training during the pandemic not only revealed new needs but also opened new possibilities. Digital training provided immediate tools for remote teaching, and the shift to online education allowed access to a broader range of training opportunities than the traditionally localized in-person models (INDIRE, 2021). In December 2020, Indire released initial findings from a survey of Italian teachers, conducted between June 2020 and 2021, focusing on teaching practices during the lockdown. The results indicated that the instructors transposed their in-person lectures to the online modality without adapting their teaching methods to meet the specific needs of distance learning (INDIRE, 2021).

In response to these findings, and with the aim of enhancing training beyond the emergency phase, the free-access webinar series *Formarsi e confrontarsi con le Avanguardie educative* was launched in September 2020. This series, designed for a broad audience, sought to engage school leaders, teachers, and external stakeholders, while fostering reflection on key cross-disciplinary topics such as formative assessment, inclusion, Media Education, guidance, soft skills, the transformation of learning environments, and AE methodologies. The webinars, organized by Indire researchers and featuring contributions from scholars, industry experts, school principals, and teachers as trainers, provided a platform for showcasing innovative practices from AE schools. Special focus was placed on teaching methods during the Covid-19 pandemic, with in-depth analyses aimed at assessing the sustainability of innovation in the context of distance learning. To facilitate the exchange of impactful innovations and foster discussions on broader systemic issues, some events were held in collaboration with other regional

or national educational innovation networks. Between September 2020 and March 2022, 41 webinars were conducted, with an average of 157 participants per session. These webinars addressed key themes related to school innovation, each indexed under one or more specific topics: 1. Rethinking the curriculum and training offer; 2. Educational planning, innovative educational strategies and methodologies; 3. Redesign of educational spaces and learning environments; 4. Design and management of distance learning; 5. Design and management of integrated digital teaching; 6. Pathways for soft skills and orientation; 7. Media education, digital skills and digital educational content; 8. Equity, diversity, inclusion and didactic differentiation; 9. Competence-based teaching; 10. Rethinking assessment methods.

5. Methodology

5.1 Research objectives and questions

The study presented here aims to explore the usefulness of the webinar series *Formarsi e confrontarsi con le Avanguardie educative* and to intercept the emerging training needs of Italian teachers and Head of Schools during the pandemic, with a particular focus on innovative educational practices.

The study is based on the following research questions:

RQ1. What was the degree of satisfaction with the training received?

RQ2. What training needs emerged during the webinar cycle?

RQ3. What was the degree of satisfaction with the overall training offer?

RQ4. What was the participants' feedback regarding their professional development?

5.2 Research objectives and questions

To address the research questions, two questionnaires were developed: a satisfaction questionnaire and a follow-up questionnaire. Initially drafted by one researcher, both questionnaires were reviewed and validated by a group of three additional researchers. The satisfaction questionnaire combined closed and open-ended questions, while the follow-up questionnaire consisted solely of closed-ended questions. The satisfaction questionnaire included a section on socio-demographic data and closed-ended questions to assess participants' perceived usefulness of the training, both for individual sessions and the entire webinar series. The open-ended questions explored participants' training needs and requests for further in-depth study on specific topics during the pandemic. It was administered via Google Forms between September 2020 and March 2022. The

follow-up questionnaire, which also collected socio-demographic data (gender, age, professional role), included closed-ended questions to evaluate the perceived value of the training for professional development and its potential impact on professional networking. It was administered in May 2022 via Microsoft Forms. Both questionnaires were voluntary and anonymous. Descriptive statistical analysis was applied to the closed-ended questions, while open-ended responses were analyzed through textual analysis and categorization. These responses were then used to contextualize and clarify the themes identified in the closed-ended questions, supporting the interpretation of the quantitative data.

5.3 Participants

The questionnaires were administered to a convenience sample of participants who voluntarily opted to engage in the research. As such, the sample is neither probabilistic nor representative of the broader population of Italian educators, although it is considered significant due to the high response rate and geographic diversity of the respondents. Of the 6,476 participants in the satisfaction questionnaire, 3,185 (nearly half) responded. The majority of respondents were teachers, with smaller proportions of school leaders, educators, university students, and others. Most respondents worked in Secondary Schools, followed by Primary Schools, with smaller numbers from First Grade Secondary Schools and Pre-schools. Additionally, 1,450 participants reported being members of the AE Network, while 1,735 had not joined at the time of completing the questionnaire. The initiative reached all regions of Italy. The follow-up questionnaire received 1,068 responses, predominantly from teachers, with a small proportion of school leaders, students, and other professionals.

6. Results

RQ1. What was the degree of satisfaction with the training received?

The participants' response to the satisfaction questionnaire (no. 3185 responses) was very positive with respect to the training usefulness of the individual webinars they had attended. To the question "Please rate the quality of the meeting in relation to your expectations", the 46.9% of the respondents rated it as "Excellent", 47.6% as "Good", and only 5.9% as "Sufficient" or "Poor". To the question "Express a judgement on the webinar series' usefulness with respect to your professional interests" 49.2% answered "Excellent" and 46% "Good".

RQ2. What training needs emerged during the webinar cycle?

With regard to the thematic in-depth studies requested by the participants during the webinar series, the data collected through the satisfaction questionnaires, subsequently analysed and categorised, highlight a need for further exploration of practical aspects in the implementation of innovative methodologies from Distance learning and Integrated digital learning perspectives, focusing in particular on the first level of education (primary and lower secondary schools) and on inclusion. A first categorisation of the answers made it possible to identify "Distance learning and Integrated digital learning" (92%) as the most requested topic for further investigation, followed by "Assessment methods" (73.8%); other topics indicated by the participants were "Inclusion" (20%), "Media education" (10.7%), "ICT" (15.3%); "Childhood" (12.3%), "Pathways for soft skills and orientation" (9.2%) and "Innovative teaching practices" (12.3%), while the 43% of the respondents did not specify any topic. A further grouping of the requested topics has been made in view of drafting the follow-up questionnaire. The response of the participants who completed the follow-up questionnaire (no. 1068) to the question "Which of the following topics do you think were most useful?" (Figure 1) was the following: the 7.2% of the participants chose "Rethinking the curriculum and the educational offer"; the 22.8% answered "Didactic planning, innovative strategies and methodologies"; the 13.3% of the respondents indicated "Redesigning educational spaces and learning environments" the 7.1% answered "Design and management of distance learning"; 9.2% opted for "Design and management of integrated digital education"; 5% expressed preference for "Pathways for soft skills and orientation"; 9.2% of the participants answered "Media education, digital skills and digital learning contents"; 6.8% indicated "Equity, diversity, inclusion and didactic differentiation"; 9.9% responded "Competency-based teaching/learning"; and finally a 9.5% of the respondents considered "Rethinking testing and assessment methods" as the most significant topic.

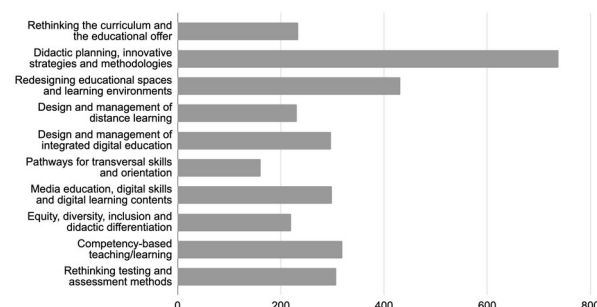


Figure 1 - Most useful topics according to the participants' responses.

RQ3. What was the degree of satisfaction with the overall training offer?

Responses (n. 1068) to the question “How do you judge the usefulness of the proposed initiative with respect to the following aspects” (Figure 2) are overall very positive. In relation to the webinar series’ usefulness in terms of “Training opportunities in the use of new teaching methods” 30.2% of the participants answered “Excellent”, 21.8% “Fair” and 40.5% “Good” and 7.2%. On the other hand, in relation to the initiative’s usefulness as an “Opportunity to fill the gaps in technological skills”, 20.4% of the respondents considered it “Excellent” and 41.9% “Good”. The participants were then asked to express their opinion about the webinar series’ usefulness “to integrate tools and teaching methods for distance learning” and for this item too the response was overall very positive with 21.4% of the participants answering “Excellent”, and 41.9% “Good”. The next item was aimed at probing the usefulness of the proposed webinars as a “Training opportunity on the use of new assessment methods “and the feedback was again more than positive with 20.8% of the participants considering it as an “Excellent” opportunity”, 27.6% as “Fair” and 37.2% as “Good”. The usefulness of the initiative as an “Opportunity to deepen relations between schools, their territory and the world of work” was then investigated, and the assessment on this item was slightly different from the previous ones, with the 18.5% answering “Excellent”, 23.6% “Fair”, 37.7% “Good”, 17% “Sufficient” and the 3.1% “Insufficient”. Finally, the participants were asked about the webinars’ training usefulness as a means for “Updating with respect to new ways of managing the classroom and educational relations online and remotely” and 24.4% answered “Excellent”, 24.3% “Fair”, 37.7% “Good”, 11.5% “Sufficient”, while only 14 participants (1.3%) considered the initiative “Insufficient”. The initiative's outcomes were also assessed from the participants' emotional and relational perspectives.

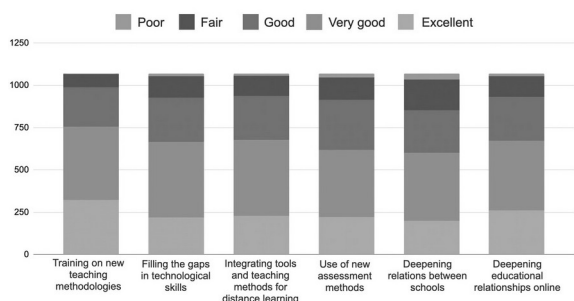


Figure 2 - Usefulness of the initiative with respect to various factors.

Participants were asked, “Which aspects of the proposed initiative do you consider most important?” (Figure 3): the 22.9% of the respondents answered

“The exchange of good practices among peers”, the 28.8% identified “Coaching and professional development supported by a research community” as the most important element, the 17.3% answered “The support in facing the challenges posed by distance learning”; the 14.9%, on the other hand, opted for “Feeling like a member of a community and diminishing the sense of distance and isolation”, while the 9% indicated “Sharing issues triggered by the pandemic”.

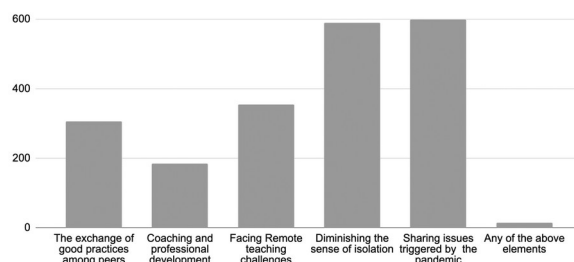


Figure 3 - The initiative’s most important achievements from a relational point of view.

RQ4. What was the participants' feedback regarding their professional development?

The feedback from participants who filled in the follow-up questionnaire (no. 1068) to the question “To what extent do you think the proposed content contributed to your professional development?” was very comforting. Most of the respondents thought that the proposed training contents contributed “A lot” (31%) and “Quite a lot” (64%), while 6% answered “A little” and only 2 participants (0.1%) thought that the webinars did not contribute to their professional development. The participants were then asked: “Did the initiative prompt new collaborations with your peers, with schools, organisations or associations that have expanded beyond your participation in the webinar series?” and the results (Figure 4) were encouraging, since 49% stated that they had established informal/individual collaborations with other participants in the initiative, and 9.9% answered that some agreements between schools were concluded, in the form of collaboration agreements, memoranda of understanding or twinning, networks.

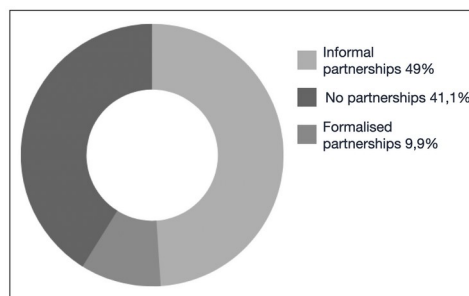


Figure 4 - Networking among participants following the webinar series.

7. Discussion

The Covid-19 pandemic led to significant changes in the management of educational practices. At the organizational level, two main scenarios emerged: in some cases, services were formally suspended, while in others, they were adapted to provide remote support. Where educational services continued, they were redefined and reshaped, often with the aid of digital technologies, to maintain and strengthen the educational relationship between educators, teachers, and their students, helping to alleviate feelings of isolation and abandonment (Kools & Stoll, 2016).

“Professional learning communities” (Vescio et al., 2008) facilitated connections among teachers, offering support during a time of professional uncertainty and enabling peer-to-peer exchanges and the sharing of “resilience” best practices. The shift to online teaching prompted educators to develop new learning needs, leading to the organization of various initiatives aimed at equipping them with the tools necessary for effective distance learning. Voluntary participation in these initiatives can be seen as a self-directed learning strategy, helping to bridge the skills gap within the educational community. This study examined the emerging training needs that motivated a group of participants to engage in an online initiative aimed at enhancing educational professionalism. The analysis of learning needs was followed by an evaluation of the initiative's usefulness in supporting coaching and professional development.

The study confirms the importance of professional learning communities in addressing the unprecedented conditions brought about by the lockdown (Paletta et al., 2022; Safi et al., 2020). The findings indicate a high level of satisfaction with the training offered, while also highlighting several thematic areas that warrant further exploration. Contrary to expectations, the need for support in adapting to new distance learning methods was less prioritized compared to other topics discussed during the sessions, such as instructional planning, redesigning learning environments, and integrated digital pedagogy. The data reveal, firstly, a notable level of professional maturity achieved by the respondents over the two years of the pandemic, with many now oriented towards integrated teaching methods that go beyond mere distance learning. Interesting enough, the most highly regarded topic among participants was the in-depth exploration of innovative teaching methodologies. Notably, over half of the participants had not yet joined the AE network at the time of the webinars, which underscores the positive feedback not only for the training initiative itself but also for the broader goals of *Avanguardie Educative*, which has consistently emphasized the importance of methodological innovation in the school model. Consistent with previous studies on the topic,

participants have demonstrated positive perceptions of learning facilitated by webinars (Khanna & Thakarar, 2021; Shal et al., 2024). They also regarded the initiative as a valuable tool for ongoing professional development, supporting the acquisition of skills relevant to their educational practice even beyond the health crisis (Al-Naabi, 2023). Respondents specifically highlight support, professional development, and the sharing of best practices among peers as the most valuable aspects of the webinar cycle. The value of training for professional development (Hord & Summers, 2008) is further supported by the networking and knowledge sharing opportunities it has facilitated (Zamiri & Esmaeili, 2024). A significant proportion of participants reported having established both formal and informal collaborations after attendance. In this regard, the peer-tutoring model used for the online training seems to be a promising approach to continue beyond emergency contexts.

8. Limitations of the study

This study presents a number of limitations, starting with the sample, which is not representative, while its size may still be deemed significant compared to similar studies. Additionally, the sample was predominantly composed of females, a factor we could not modify, as the Italian teaching population consists primarily of women. Finally, although the study's purpose was not to find correlational data or causal relationships but rather to explore participants' perceived usefulness and satisfaction, it would have been interesting to investigate differences within the sample and how these differences might have influenced the results. Since the initiative is still ongoing, we plan to conduct this type of analysis at the end of the new webinar cycle.

9. Conclusion

Online training represents a privileged field of experimentation that Indire has explored since its inception and which has become a cornerstone of its institutional mission. The Institute has capitalized on the experience gained over the years and supported schools in the transition to distance learning through diversified actions of massive online education. As shown by the survey analysed in this paper, in addition to the need for ongoing support for professional development, the will is revealed, already put into action in many schools, to use networking and peer collaboration as a tool for training accompaniment and effective educational planning. Oriented towards massive open education (Pilli & Admiraal 2016), the initiative *Formarsi e confrontarsi con le Avanguardie*

educative facilitated the sharing of professional development experiences that involve participants in the implementation of new teaching opportunities as well as of innovative solutions enabled by technology. With the guidance of Indire researchers and experts, teachers and school leaders of Italian schools shared their good practices, derived from concrete contexts and uses, offering their colleagues' practicable solutions that could be adapted to everyone's specific needs thus ensuring the continuity of activities despite the schools' closure (Mangione et al., 2020). This initiative supported schools first in the 'forced' shift to remote teaching, then in the process to digital transition, and now assists them in designing the initiatives outlined in the Next Generation EU and the National Recovery and Resilience Plan.

Avanguardie Educative as an educational network based on the exchange of practices has supported the Italian school towards a 'new normality' (Nardi et al., 2024) and continues to this day to support schools in the current context of transformation, helping them to adequately address the new challenges, such as spatial disparities, digitization, access to resources, design of learning environments, inclusive methodologies, skills development, and more.

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Designing a new teacher and educator training on Sexuality Education: the SETTE training course

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Abstract

The SETTE training course for teachers and educators on sexuality education addresses a critical gap in the Italian education system, aiming to provide scientifically accurate and inclusive training. This article presents the course's design, content, and methodology, developed as part of the European UNI-T project using the Blended Learning (BL) model to enhance accessibility and engagement. Structured across seven modules, the course equips teachers and educators with essential tools for addressing complex topics such as sexual identity, relationships and consent, homophobia, and sexual rights. Each module combines evidence-based knowledge with reflective practices, fostering personal and professional growth and preparing teachers and educators to cultivate inclusive, respectful, healthy, safe, and informed school environments. The anticipated outcomes include enhanced competencies, awareness of the importance of a gender-based perspective, and greater sensitivity to disabilities, neurodivergences, and individual differences. Additionally, it aims to establish a foundation for a respectful, human rights-oriented approach to sexuality education that is crucial in today's digital and social contexts. The conclusions highlight the SETTE course's potential to promote student well-being, gender equality, and critical digital literacy, contributing to a more inclusive school culture and supporting teachers and educators in addressing evolving societal challenges.

KEYWORDS: Sexuality Education, Blended Learning, In-Service Teachers, Teacher Training, Human Rights.

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1. Introduction

Sexuality is a crucial aspect of every stage of life. Any sexual activities – forming interpersonal relationships, recognizing emotions, respecting oneself and others, and developing skills and awareness around sexuality – are areas that require comprehensive and scientifically accurate education. The central sexuality education (SE) thematic areas are: Human body, development, and sexual identity; Sexual health, reproduction, and parenthood; Relationships, lifestyles, and consent-respect; Emotions and affection; Sexuality (behaviors,

health, and well-being); Rights, values, and norms; Social, cultural, and personal beliefs (IPPF, 2010; 2017; WHO, 2010). The gold standard approach is known as Comprehensive SE (CSE), which is more effective compared to the other two methods: Abstinence-only and Abstinence-”plus” (Goldfarb & Lieberman, 2021). The Abstinence-only approach considers sexuality solely as heterosexual intercourse, and it is tied to promoting abstinence from premarital sexual intercourse. This approach is often conservative and monosexual, relying on fear of sexual risks and shame to convey sexual information. However, these strategies can be ineffective regarding the aim – to avoid pre-matrimonial sexual intercourse or unwanted pregnancies – and may reinforce cisheteronormative stereotypes and false myths about promiscuity (Heels, 2019; Hoefler & Hoefler, 2017). On the other hand, the Abstinence-”plus” approach can be understood as a medical prevention one. It includes discussions on sexual health topics, such as contraception and sexually transmitted infections and diseases (STIs/STDs). However, it does not always address aspects related to sexual pleasure, relationships, or – for example – active engagement, auto-

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determination, consent, and respect during sexual intercourse. Instead, it focuses primarily on potential negative consequences. While aiming to provide information for safe sexual practices, the Abstinence-”plus” approach risks replicating the same effects as the Abstinence-only approach: fostering fear, shame, guilt, and anxiety. Additionally, the Abstinence-”plus” approach may hinder gender equality in contraceptive decision-making by emphasizing only the importance of male condoms (Carmichael & Amiri, 2024; Miedema et al., 2020; Petruccioli, 2002). Both approaches share a common perspective on sexuality in a broader sense, addressing the risks rather than its benefits and positive aspects (Hawkins, 2024). As a result, their impact is limited compared to the CSE approach. Conversely, CSE promotes individual and societal health, academic success, well-being, awareness, and informed decision-making (Basch, 2011; CDC, 2010; FoSE, 2020; Halliwell et al., 2016; Healy-Cullen et al., 2024; Osborn et al., 2019; Putri, 2022; Schneider & Hirsch, 2020; Scott et al., 2020; Wiefferink et al., 2005). CSE should be introduced within the school system to provide continuous education, helping young people grow in a safe and healthy environment, protecting all sexual identities in an intersectional manner (Epps et al., 2023; Formby & Donovan, 2020; O’Farrell et al., 2021). However, sexuality is often explored independently, sometimes in restrictive environments or through media, social networks, or peers (Fernández et al., 2016; Pizzi et al., 2019). In these cases – using the internet and other sources of information or different approaches than CSE – misinformation is common, which can lead to negative consequences (Döring, 2021; Lameiras-Fernández et al., 2021; Nikkelen et al., 2020). This highlights the importance of formal SE in schools that fosters open dialogue and discussion, capable of shaping reflective and informed individuals on both current and historical sexual and relational issues. It enables students to contextualize, recognize, and respect diversity and appreciate the progress made over time, ultimately promoting a positive, healthy, and safe view of sexuality. Global comparisons published by UNESCO (2021; 2023), in which Italy is not included, emphasize the need for professional training. Italy does not yet have mandatory CSE in school or professional educational and teaching courses, although several law proposals aimed to achieve CSE implementation in formal education and training contexts (Bruno, 2024). Teachers and educators can affect students’ lifelong learning and success, development of beliefs and attitudes, and well-being through teaching characteristics or the relationships they can create in school and classroom environments (Blazar & Kraft, 2017). These reports highlight the importance of investing in pedagogical knowledge, enhancing skills for offering CSE in schools and researching effective training models.

This need for training aligns with the UNI-T project¹, a collaborative initiative launched in July 2022 within the CIVIS alliance – a network of European universities to

enhance teachers’ and educators’ education across Europe through innovative, international, and practical approaches. Specifically, Work Package 2 (WP2) focuses on developing and implementing blended learning modules (BLMs) designed for pre-service and in-service teachers and educators. These modules emphasize European educational topics, fostering collaboration between educators and institutions locally and internationally. The four strategies of UNI-T enable several mobility mechanisms, including both physical and virtual formats. For the first time, starting in 2025, the project will introduce a course dedicated to SE. This pilot training will focus on Italian in-service teachers and educators, offering opportunities for mobility within the national context and online exchanges of knowledge, experiences, and practices among participants. The decision to begin with the Italian context is due to the legal, educational, cultural, and social differences among the countries involved in the UNI-T project. Italy is one of the few countries that do not include SE in their school programs (IPPF, 2018).

2. Research Methods

This study describes the design of a pilot teacher and educator training program on SE, a topic notably absent in the Italian educational context. For this reason, the project is framed as mixed-method action research (Lucisano & Salerni, 2002). It adopts an instrumental evaluative case study approach, meaning “it is a means to an end” (Thomas, 2021, p. 128), specifically to observe and understand how and whether the training would be effective. Regarding quantitative research tools, the study will employ pre- and post-training questionnaires designed ad hoc to evaluate teacher and educator knowledge changes. Additionally, feedback questionnaires will be used throughout the training to monitor progress. As for qualitative research tools, the methodology will prioritize active and constructive group discussions, complemented by observing group dynamics during in-person or online sessions. Moreover, the study incorporates a qualitative methodology to explore and express social representations (SR), conceptualized as a social construct that allows the analysis of what has been internalized at the individual and the sociocultural levels (Sammot, 2015). The in-person workshop activities will be grounded in the Theory of SR (Martikainen & Hakoköngäs, 2023), which investigates socially shared forms, contents, and functions of knowledge. The aim is to raise teachers’ and educators’ awareness of the beliefs and stereotypes surrounding sexuality using the drawing method and discussions, allowing them to externalize these SR (Moscovici, 2008) and deconstruct stereotypical social knowledge. Drawing encourages meaning-making processes and elicits rich, personally engaging data without requiring specific technical skills (Lyon, 2020). The training will explore SR at multiple

levels, granting access to deeply ingrained beliefs or knowledge (Martikainen, 2020). In this study, the drawing method will be specifically used to analyze the objectification process, aiming to make SR visible and tangible for group discussion; individually created images allow for analysis at the personal level while facilitating discussion at the broader level of shared and social meanings (Hakoköngäs, 2017).

3. Teaching method

The literature on SE teachers' and educators' education seems predominantly focused on intervention or workshops and specific emergency content to help teachers and educators address sexual topics in schools (Decker et al., 2022). However, the evaluation of educational projects shows positive results, indicating an increase in attitudes toward sexual topics, with teachers and educators more inclined to integrate CSE into their school activities (Hanass-Hancock et al., 2018; Gamba, 2020). Several studies show teachers' and educators' perceptions of the lack of knowledge and skills, the willingness to be trained and teach CSE in the future, and the factors that could facilitate or challenge its implementation (Ang & Lee, 2017; Balter et al., 2018; Brouskeli & Sapountzis, 2017; Bruno et al., 2024; Jiménez-Ríos et al., 2023; Klein, 2021). International recommendations state the importance of discussing CSE topics in a three-to-five-day training and educational intervention (Plan International, 2020a), to deconstruct own beliefs, and to challenge opinions, culture, and values that may impact and convey messages to students (Silva et al., 2021). In Italy, teacher and educator training in SE is independent; teachers and educators can decide whether to engage in courses outside of academic and university programs and whether to incorporate sexual health topics into their school activities or lessons. The high cost of these training programs is one factor that makes engaging in them difficult. The Italian Federation of Scientific Sexology (in Italian, FISS), established in the 2000s, has promoted training standards and programs tailored to various professionals: clinical sexologists, sexual counselors, and experts in SE. The latter program qualifies individuals as experts in promoting and protecting sexual health, equipping them to design and lead projects or interventions on sexual topics. It is also the only course accessible to those without a degree in Psychology. As a result, teachers and educators can opt for this 100-hour training program (Rossi et al., 2019), with an average cost of 1,400 euros in Italian institutions affiliated with FISS2.

The pilot teacher and educator training for the UNI-T project on SE had to consider the literature and the existence of training to design the pilot training with an evidence-based approach. Furthermore, the pilot teacher and educator training aligns with UNI-T's Blended

learning methodology (BL). The UNI-T project adopts this model to cater to the needs of teachers and educators in diverse contexts, offering a transformative experience that enhances both technological competence and pedagogical innovation.

The BL method chosen for the SETTE course is widely recognized as a practical methodology for teacher and educator training, as it balances face-to-face and online learning, creating a hybrid instructional approach and maximizing flexibility, accessibility, and resource optimization (Graham et al., 2003). This hybrid approach is particularly fruitful for SE training, providing a safe space to explore sensitive topics and allowing participants to reflect independently on complex content. Recent studies underscore the efficacy of BL in the social sciences, showing how it fosters more profound learning and the development of critical competencies, especially in educational contexts dealing with sensitive issues like SE (Coyle et al., 2019). Specifically, BL enhances interaction and collaboration among teachers and educators, building a support network and a culture of continuous learning, which is essential for promoting inclusive and responsible teaching practices.

As WP2 is led by the National and Kapodistrian University of Athens, it contributes significantly to the European framework of teachers' and educators' education, supporting the digital transition in schools and promoting the development of critical digital skills.

The BL model proposed in WP2 utilizes a remote framework, allowing for synchronous and asynchronous interactions between educators and learners across different geographies. This approach enables a rethinking of conventional teaching methodologies by combining various digital tools and face-to-face interactions to enhance collaboration and foster personalized learning (Kumar et al., 2021). The flexibility offered by BL is particularly suited for professional teachers' and educators' education, where integrating educational technologies and collaborative international projects is increasingly critical (Garrison & Kanuka, 2004).

WP2's BL modules are structured to provide participants with access to various digital resources (videos, documents, podcasts) hosted on the CIVIS Moodle platform, facilitating interactive and reflective learning processes. The modules encourage active engagement and a deeper understanding of European education topics using tools such as quizzes, forums, and collaborative activities. Furthermore, we integrate the Open Badge (OB) pedagogical strategies and framework into BL modules for the SETTE course structure. The OB certifications aim to enhance the competencies of pre-service teachers and educators through creative methodologies and participatory assessments, promoting skills aligned with educational and social needs and integrating informal and non-formal learning within the university framework. The certifications

support lifelong learning pathways, fostering dialogue between life contexts, academic experiences, and broader community settings while contributing to self-awareness and developing a multifaceted personal and professional identity (du Mérac et al., 2022; 2024). At the Sapienza University of Rome, the OB certificates have recently implemented the OB EduSex. We developed the SETTE training for in-service teachers and educators, combining this new OB pre-service teachers and educator training and the BL method for UNI-T.

This innovative, integrated, and intersectional pedagogical approach aligns with the broader goals of education for sustainable development as it incorporates various Sustainable Development Goals (SDGs). Specifically, by providing new teacher and educator training on SE, the global project aims to achieve goals number 3 (Good health and well-being), 4 (Quality education), and 5 (Gender equality), emphasizing the role of educators in fostering a more inclusive, equitable, and sustainable future (IPPF, 2016; UN, 2015; UNESCO, 2023). In this context, the UNI-T project aims to enhance teaching skills and build a strong community of professionals equipped to navigate and address complex global challenges through education. Aligning the literature on SE training for teachers and educators with the methodologies of the UNI-T project with a primary focus on the Italian context, the pilot teacher and educator training will offer several modules on specific CSE topics, which will be independently studied using the BL method. In designing the training, the decision was made not to impose a strict timeline for the conclusion of each module. This approach allows participants to reflect on their positions and beliefs, increasing their knowledge and awareness of CSE topics. In a typical three-to-five-day training, Italian teachers and educators could find it difficult to deconstruct their false sexual myths or misconceptions, challenging their beliefs, opinions, and attitudes while enhancing their knowledge and skills in CSE educational practices. By extending the days of training, teachers and educators can challenge and reconstruct their previous knowledge in a common setting and then independently study scientifically accurate information on CSE topics. The results section will provide further specific information regarding the SETTE course structure.

Therefore, this training extends the traditional format proposed by Plan International (2020a), offering an alternative program that requires only a one-time travel cost, providing a longer, more in-depth, socio-culturally contextualized, and school-specific learning experience.

4. Results

The Sexuality Education Training for Teachers and Educators (SETTE) course arises within and to move

forward the specific Italian context, innovating at the same time the international framework and expanding the training opportunity offered by the UNI-T project. The SETTE course is a BL course structured into seven modules to delve into each central CSE thematic area (Plan International 2020b; 2020c; UNESCO, 2018; WHO, 2010). Each module will include a summary of recommended activities and materials that can be implemented for different age groups, as well as videos, online references, or book recommendations. At the end of each module, there will be self-assessment questions on knowledge, expectations, and reflections regarding the module.

Below is a brief description of the module structure and the topics they will address.

The first two sessions will be in-person in 2025 – one on Friday morning and one the following Saturday morning. The sessions will introduce SE, the concept with the definitions, and the three known approaches. The course, beginning with the separation of the idea of sexuality as just sexual intercourse, will address application methodologies, strategies, and materials, sharing opinions and experiences or transversal practices applicable even to sexual topics. Furthermore, the approach utilized will focus on sexual rights, promoting how to protect themselves in the school context and ensuring safe and healthy sexual development for everyone. Lastly, school planning for interventions, projects, or lessons on CSE topics will be discussed. In these two days, teachers and educators will actively participate to challenge their social representations of sexuality. Additionally, participants will complete an initial questionnaire to assess their previous knowledge of CSE topics.

The course will continue online for the remaining six modules with more independent learning. The second module will cover consent and relationships topics, also addressing the school and classroom context by describing the phenomena of homophobia, transphobia, bullying, and discrimination regarding sexuality. Finally, the topic of online sexual activities will be addressed, with a specific focus on sexting, which has become increasingly popular among younger people in recent years. The third module will cover physical and sexual development, childhood sexual behaviors, emotions, body development and emotions toward it, and own self-determination. The fourth module will specifically address sexual identity with its four components – assigned sex at birth, gender identity, sexual and romantic orientation, and gender expression – and its development, with a focus on discrimination and existing forms of gender stereotypes, sexual stigma, heterosexism, and social heteronormativity.

The fifth module focuses on adolescence and adulthood, sexual pleasure and sexual dysfunctions, and desire. The sixth module will specifically address the theme of visibility, not inclusion because it will offer training on people that society includes but does not see or consider.

From disability to the importance of broad language according to the various sexual identities. Finally, the seventh module will conclude the training by covering contraception, sexually transmitted infections and diseases, and voluntary termination of pregnancy.

The SETTE course does not request a rigid timeline to complete the single modules; however, there will be an online meeting between the fourth and fifth modules to discuss the topics covered in the first modules. Teachers and educators must complete the first four modules individually before the day of the online middle meeting, which aims to monitor the development of their knowledge, competencies, awareness, and the ongoing course. At the end of the training, a final assessment questionnaire with closed and open questions will be administered; the questions will be on the specific topics of the SETTE course's modules and their perception of the general course structure, whether it was helpful, coherent, productive, sufficient, or interesting. The course is completed if all modules and the final questionnaire have been adequately completed. The final questionnaire will be matched for each participant to the initial questionnaire administered during the first two days of the face-to-face session. This will allow for the assessment of participants' knowledge, competencies, and awareness at the end of the training, as well as the assessment of the efficacy of the training self.

Each module provides a package that includes PowerPoint presentations, additional references, and material to explore the topic in greater depth. To those who want to explore the contents and increase their knowledge of the Italian context, it is possible to download the package in English. However, some pilot teacher and educator training steps are exclusively in Italian. Those are the two days of face-to-face meetings in Rome, the middle course online meeting, and the online final questionnaire.

5. Discussion and Conclusions

The SETTE course on SE will fill a critical gap in Italian teacher and educator training, providing the opportunity to enhance teachers' and educators' technical competencies and foster a reflective approach that is essential when addressing complex, sensitive subjects like sexuality. By covering diverse topics – such as sexual identity, consent, and anti-discrimination – the course intends to promote inclusivity, aligning with recent calls for educational and training programs that support social cohesion and equality (Jiménez-Ríos et al., 2023). Research increasingly highlights the role of Comprehensive SE (CSE) in reducing prejudice and fostering a safe, respectful school culture, which is crucial for student well-being and academic engagement (Epps et al., 2023; Osborn et al., 2019).

Furthermore, as global studies suggest, CSE plays a significant role in equipping young people with the critical thinking skills necessary to navigate the complexities of digital and social environments, where misinformation around sexuality often circulates (Döring, 2021). This is particularly relevant in the context of digital-native students who encounter sexual content online but lack the formal education to interpret it constructively. The SETTE course, therefore, will hopefully contribute to an important paradigm shift, positioning SE within a framework of human rights and digital literacy, both vital in contemporary education (Goldfarb & Lieberman, 2021).

In this sense, the SETTE course provides immediate benefits to teachers and educators regarding knowledge, skills, and strategies one can rely on. Moreover, it aligns with broader educational reforms that advocate for human rights-based education. Future studies and analyses will be necessary to assess the efficacy of the SETTE course once it is completed. Further research is encouraged to explore the long-term impacts on teachers, educators, and student attitudes, as well as the potential of the SETTE model to support a rights-oriented, digitally literate generation equipped to navigate complex social landscapes responsibly.

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STEAM, inclusion and engagement through makerspaces: the voice of students and teachers

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Abstract

Over the past few decades, there has been a growing interest in tinkering and making, also driven by environmental concerns that define this era. This has led to the rise of creative recycling, facilitated through Do-It-Yourself practices enhanced by digital technologies and practiced in equipped spaces, where commonly used tools and materials are shared by small communities. These makerspaces have also been established in schools, contributing to the adoption of active learning methods, which research shows to be highly effective. The European Erasmus+ “Steam2Go” project aims to create a mobile makerspace that is easily transportable, equipped with pedagogically effective instructions and detailed descriptions of consistent educational experiences. The goal is to make the teaching of STEAM subjects more active, engaging, and inclusive. The pilot experiments conducted with mobile makerspaces involved students (N=184) and teachers (N=15) from various school levels and grades across four partner countries (Cyprus, Greece, Italy, and Poland). The research, conducted through individual questionnaires completed by all participants at the end of the activities, focuses on perceptions and beliefs related to the empowerment achieved by students and teachers. The findings reveal a high level of enjoyment, a perception of improvement in STEAM subjects as well as transversal skills, and a positive appreciation of the Open Educational Resources, which transform the mobile makerspace into an effective educational tool.

KEYWORDS: School, Maker Education, Inclusive Teaching, Active Learning, Empowerment.

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1. Introduction

Makerspaces are equipped environments where people cooperatively experiment with innovative solutions for designing and making artifacts with unique characteristics, in a contamination of do-it-yourself, art, invention, and play. This DIY almost always makes use of digital technologies, but also involves the use of more traditional tools, enhances poor and recycled materials, and finds in the web the most appropriate

tool for research and for sharing ideas and products (Honey & Kanter, 2013).

Makerspaces implemented in schools are in line with the characteristics just defined, require students to practice the skills they have acquired, allow them to acquire additional ones in itinere, and are supported by the convergence of several constantly growing factors (Halverson & Sheridan, 2014; Rouse & Rouse, 2022; Vuorikari, Ferrari & Punie, 2019).

First of all, it is necessary to consider the evolution of the Maker Movement, a movement that, in opposition to the consumerism that particularly marked the last decades of the past century, recovers from the 1960s and 1970s an attention towards reuse, repair and creative assembly, nowadays enhanced by the increasingly availability of easy-to-use and low-cost technology (Hatch, 2013; Unterfrauner, Hofer, Pelka, & Zirngiebl, 2020).

Second, trying one’s hand at a makerspace means practicing not only skills related to the curricular

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disciplines – such as Science, Technologies, Engineering, Arts & humanities and Mathematics (STEAM) – but also many of the skills considered fundamental for the years to come: creativity, critical thinking, problem solving, communication, and collaboration. Skills sometimes considered “new” to school systems, but now recalled by all international frameworks (Frydenberg & Andone, 2011; WEF, 2015; 2023).

Finally, makerspaces also appear to constitute inclusive and effective contexts in which those teaching methods that the scientific literature shows as most conducive to skill acquisition are implemented. In fact, through a cross-curricular learning-by-doing approach, structured within a comprehensive experiential learning cycle (Kolb, 2014), they can promote intrinsic motivation and participation in dynamic communities of learners (Blikstein, 2013) and, at the same time, break down stereotypes and geographical and socio-economical obstacles frequently perceived in STEAM disciplines.

The Erasmus+ “Steam2Go” project aims to spread the Makerspace Movement in schools in the four partner countries – Cyprus (CY), Greece (EL), Italy (IT) and Poland (PL) – throughout the creation of a mobile makerspace model, that can be wheeled from classroom to classroom, equipped with low-cost technologies and other more traditional tools, plus a set of Open Educational Resources (OERs), including handbooks and guidelines for teachers, but also presentations and worksheets for students to develop the experience in itself and for guide the implementation of a replicable model.

This paper presents the results of the pilot applications of this mobile makerspace, conducted in schools, in order to validate the quality of the designed experiences, the suggested devices and the resources provided. To do this, the research focuses on perceptions and beliefs related to the empowerment achieved by students and teachers, through the detection of four aspects: (i) school practices related to STEAM prior to the introduction of mobile makerspaces, (ii) students’ level of enjoyment during the experience with mobile makerspaces, (iii) students’ level of perceived progress (in STEAM subjects as well as in other not suggested areas), and (iv) aspects of improvement and/or new ideas of using mobile makerspaces. Furthermore, the sustainability of the project is verified by asking teachers their intention to replicate the experiences with the mobile makerspace in different classes or schools, and the level of agreement or disagreement regarding the design of the experience.

2. Materials and Methods

The research is based on two questionnaires, administered to the participants in a mirror manner, to

explore the aspects indicated above from two different points of view: that of the students and that of the teachers. Both questionnaires end with a specific section on personal data, and the questionnaire addressed to students specifically investigates their personal interests in relation to STEAM subjects, also asking about future intentions in continuing academic studies or seeking a career in STEAM areas.

Most of the questions are closed-ended, according to a 4-point scale, in which participants are asked to express the degree of agreement relative to the referenced statements. A fifth point is introduced only in cases where the student or teacher may need to state that the item is not relevant to their context.

Within each discipline, to bring us closer to the teachings planned in the schools, the questionnaire goes into detail about the different areas: for example, within Science, Biology, Chemistry, Physics are distinguished; within Arts, Painting or Sculpting, Architecture, Music, Dancing or Performing Arts, Photography or Filmmaking, Other Arts are made explicit. In all the questionnaires, however, given the age of the participants and the countries’ school systems, the technology-engineering disciplines are included in one chapter, and then distinguished amongst Mechanics, Electronics, Electrical engineering, Informatics, and Automation.

The open-ended questions are mainly about appreciations, suggestions for improvement, further ideas that can be developed, and are categorized inductively through a content analysis (Berelson, 1952; Mayring, 2004; Merriam, 1998), conducted independently by two researchers. After an initial alignment phase, the level of agreement between the two evaluators is high, with a Cohen’s (1960) Kappa of 0.90.

3. Results

3.1 The sample

The pilots involve a total of 184 students and 15 teachers. Girls represent 36% of students, boys 60% (a 4% prefer not to declare their gender), and the average age is 16.0 years with a StdDev of 3.4 years. Among teachers there is parity in gender representation and the average age is 48.7 years with a StdDev of 8.4 years. More information can be found in Table 1.

Teachers – though with different distributions by country, partly determined by different school systems – teach technical and scientific disciplines (Computer Science, Technology, Electronics, Mathematics, Physics). Two-thirds of them have more than 10 years of teaching experience, the remaining have between 1 and 7 years experience (Figure 1).

The pilots monitored cover 7 experiences among the 12 proposed in the project handbook, chosen on the basis of the ages and skills already acquired by the students.

The experiences are evenly distributed across the different subject areas within STEAM and by levels of complexity (Table 2).

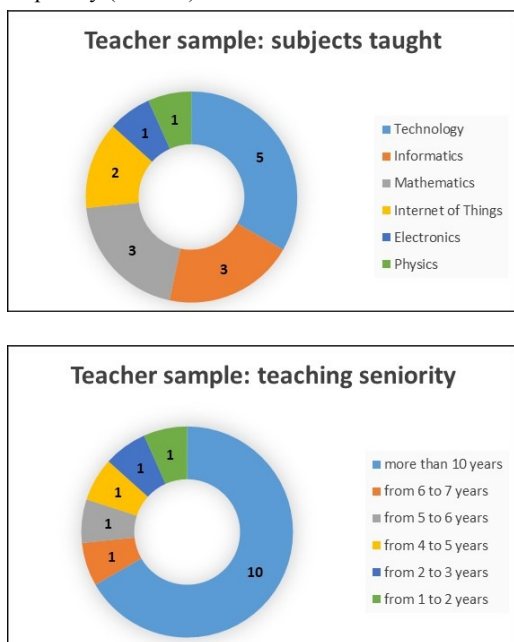


Figure 1 - Distribution of the teacher sample by subjects taught and teaching seniority.

Table 1 - Distribution by gender and age of participants – students (S) and teachers (T) – involved in the pilots.

		GENDER			AGE			
		TOT	W	M	N.D.	Min	Max	Avg
CY	S	38	19	15	4	12	14	12.3
	T	3	2	1	/	40	47	41.5
EL	S	20	11	8	1	13	15	13.4
	T	2	/	2	/	48	62	55.0
IT	S	61	5	53	3	17	28	19.4
	T	6	1	5	/	34	63	51.2
PL	S	65	31	34	/	14	16	14.8
	T	4	4	0	/	42	50	45.8
	S	184	66	110	5			16.0
	T	15	7	8	/			48.7

3.2 The students personal interests

The interests toward STEAM of the students participating in the pilot experiments are investigated directly, through discipline-specific questions, and indirectly, through questions related to intentions to pursue further education and job aspirations in STEAM areas.

Regarding interests, multiple choices are given. Considering the sample as a whole, it emerges that the areas of greatest interest are Mathematics and Technology/Engineering both with 51% of expressions

in favor (although a 14% state that they have never studied Technology/Engineering). Within the Technology/Engineering area, students express the highest degree of interest in Computer Science (66%) and Electronics (58%).

This overall picture, however, flattens out the differences found across countries:

- Cypriot students prefer Mathematics (66%) and Arts (61%), while confirming a high interest in Science (59%) and Technology/Engineering (58%) (Figure 2);
- Greek students report that Mathematics is clearly the discipline of greatest interest (85%), followed at some distance by Science (65%), Technology/Engineering (57%) and Arts (53%) (Figure 3);
- Italian students particularly like Mathematics and Technology/Engineering (59% both), followed by Science (43%) and Arts (39%) (Figure 4);
- The picture is significantly different for Polish students, who prefer Science (43%) and Arts (40%), followed by Technology/Engineering (37%) and to a very small extent Mathematics (25%) (Figure 5).

Declared interest in different STEAM subject areas does not result in similarly high prospects for further study or employment in the same domains. The area with the highest percentages overall is Technology/Engineering, both in terms of interest in continuing their studies in higher education (37%) and employment intentions (48%). Again, the aggregate analysis of the data flattens out the differences found in individual countries (the first percentage always refers to interest in pursuing studies, the second to that of the intended field of employment):

- Cypriot students direct their study and employment prospects predominantly toward Mathematics (53% and 53%), followed by Arts (50% and 58%), then Science (45% and 42%), and finally Technology/Engineering (37% and 39%) (Figure 6);
- Greek students express their preferences toward Arts (55% and 45%), followed by Mathematics (50% and 35%) and Science (40% and 40%), while in the Technology/Engineering area there are the lowest percentages (25% and 25%) (Figure 7);
- Italian students are most interested in Technology/Engineering (52% and 79%) and, to a much lesser extent, interested in Science (18% and 23%), Mathematics (18% and 21%) and Arts (15% and 18%) (Figure 8);
- Finally, Polish students return a fairly uniform picture, for Science (32% and 23%), Technology/Engineering (26% and 31%), Arts (20% and 20%), and Mathematics (17% and 18%) (Figure 9).

Table 2 - Distribution of experiences carried out in the pilots conducted among the four partner countries.

Experience name	Main disciplinary area	Student target age	Level of difficulty	Carried out in pilots
Solar robot	STEM	13-14	Low	Cyprus
Edward Hopper	Arts	13-17	Low	Greece
Musical keyboard	Arts	13-17	Low	Greece, Italy
Weather station	STEM	15-18	Medium	Poland
Plant watering system	STEM	15-16	Medium	/
Theremin	Arts	16-18	Medium	Italy
Alarm system	STEM	15-16	Medium	/
RPi & Scratch Traffic light	STEM	14-18	Medium	/
Arduino traffic light	STEM	15-18	Medium	Italy
MicroBit & MakeCode traffic light	STEM	14-18	Medium	/
Raspberry Pico & Python traffic light	STEM	16-18	High	Italy

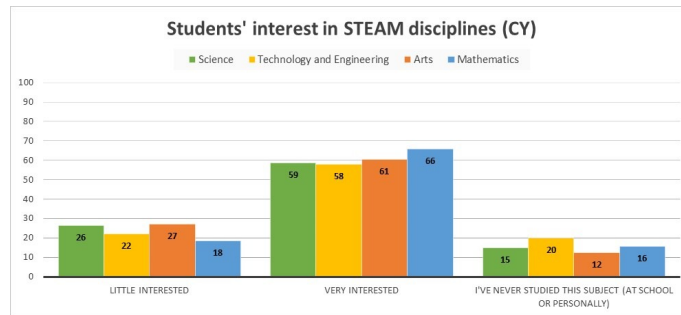


Figure 2 - Interests toward STEAM disciplines declared by Cyriot students.

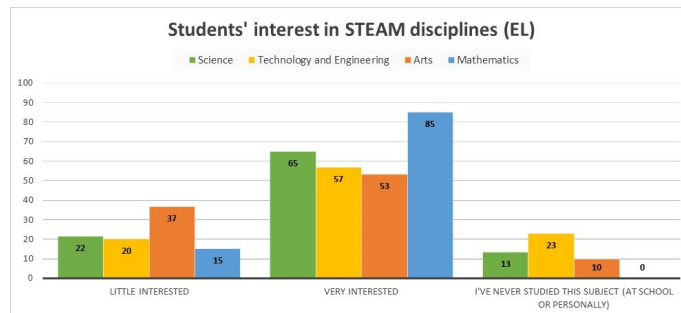


Figure 3 - Interests toward STEAM disciplines declared by Greek students.

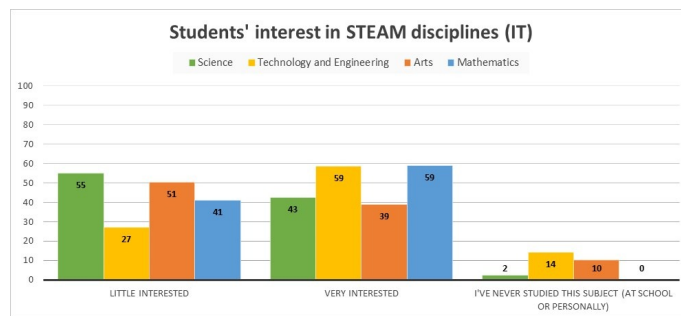


Figure 4 - Interests toward STEAM disciplines declared by Italian students.

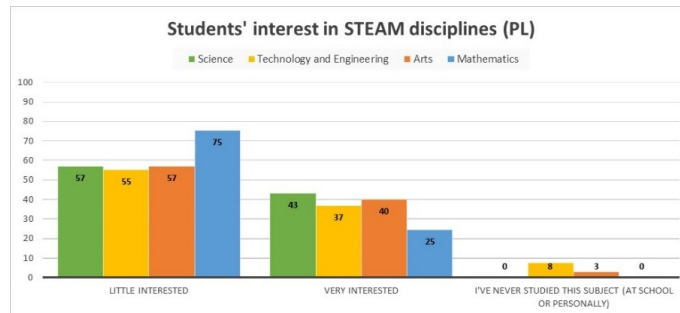


Figure 5 - Interests toward STEAM disciplines declared by Polish students.

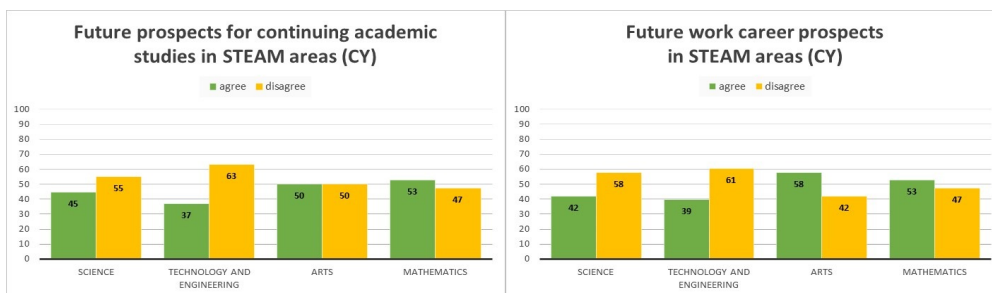


Figure 6 - Distribution of future prospects for continuing academic studies and work career in STEAM areas of Cypriot students.

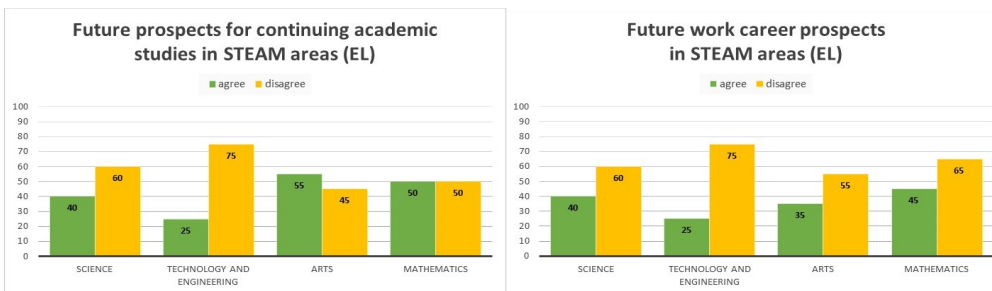


Figure 7 - Distribution of future prospects for continuing academic studies and work career in STEAM areas of Greek students.

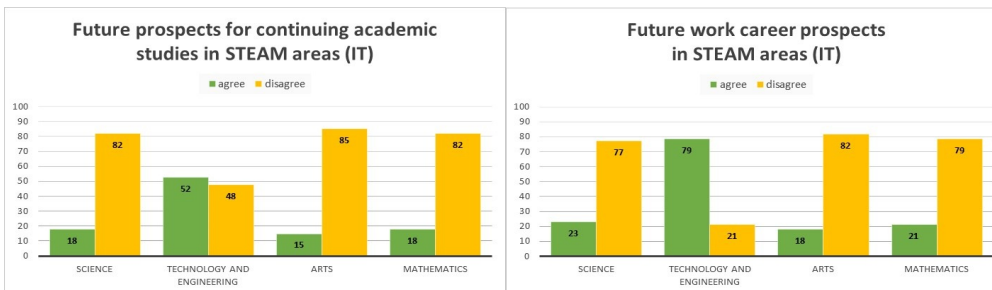


Figure 8 - Distribution of future prospects for continuing academic studies and work career in STEAM areas of Italian students.

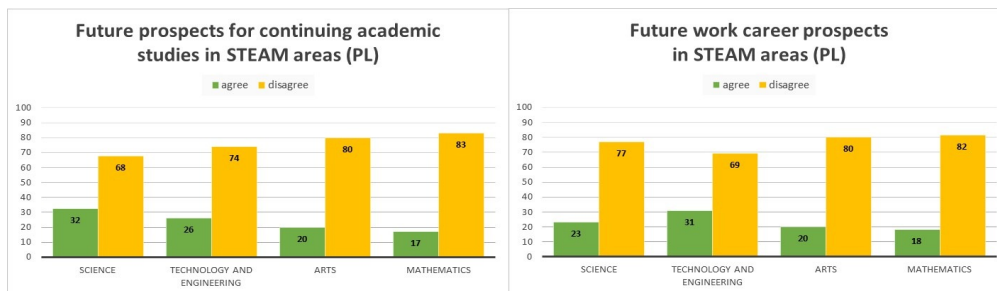


Figure 9 - Distribution of future prospects for continuing academic studies and work career in STEAM areas of Polish students.

3.3 School practices

The first question on teaching practices asks students, for each discipline, for an estimate about how frequently (never, rarely, frequently, always) they feel that the content covered in school was related to real-world applications.

52% of the students perceive that Technology/Engineering is frequently or always related to the real world. Conversely, 54% of the sample perceive that examples of real-world application are never or rarely given for Mathematics. Again, however, it is appropriate to examine the data by country:

- According to Cypriot students, they very frequently receive examples about the connection between STEAM disciplines and the real world. For Sciences, 92% of students believe they frequently or always receive examples. However, for Arts, which is the discipline where students perceive the least connection to the real world, the percentage of students who chose frequently or always is 76% (Figure 10);
- Greek students’ perceptions differ the most from the global results. Mathematics is perceived by 85% of students as a discipline frequently or always approached in a concrete way, while for Technology/Engineering only 60% of students frequently or always collect examples of connection to the real world (Figure 11);
- In the Italian sample, 64% of students say that in the technological-engineering disciplines they receive examples that connect the discipline to the real world, only 34% in Mathematics. The percentages referring to Science (28%) and Arts (7%) are even lower, but in this case the percentage of students who do not have these two subjects in their curricula significantly affects them (Figure 12);
- Few Polish students believe that the disciplines are treated with reference to the real world. The percentages of those who respond frequently or always ranged from 28% for Arts to 20% for Mathematics (Figure 13).

The next questions are related to the connection between Arts and STEM. A large proportion of students show that they like this connection: 62% say

they feel more involved in practical STEM activities when these are integrated with Arts; 70% feel that it is possible to make creative and useful artifacts using STEM knowledge. Analyzing by country, we find that it is mainly Cypriot and Greek students who consider this interdisciplinarity important:

- for Cypriot students the percentages are both 82%;
- for Greek students 70% and 90%;
- for Italian students 57% and 77%;
- for Polish students 52% and 51%.

Only 34% of the sample, however, say that in their daily STEM teaching the involvement of Arts is frequently or always expected, with significant differences by country (Figure 14): it is stated by

- 82% of Cypriot students;
- 85% of Greek students;
- only 10% of Italian students;
- only 12% of Polish students.

Regarding the integration of Arts in STEM, a mirror questionnaire is submitted to the teachers and they confirm what the students expressed. Two-thirds of teachers say that they do not frequently provide activities that integrate disciplines, and the picture within each country also exactly matches students’ perceptions: Cypriot and Greek teachers say they are more committed to this front than Italian and Polish teachers.

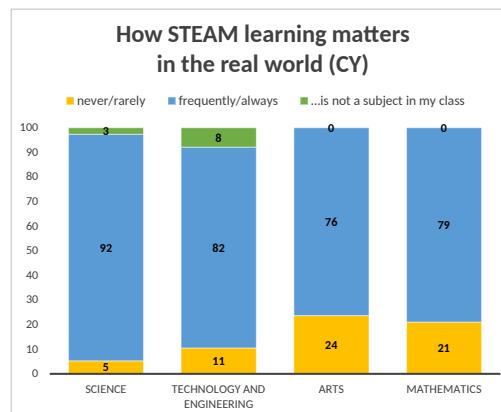


Figure 10 - Cypriot students’ responses to the question “How often in your class do you get examples of how STEAM matter in the real world?”.

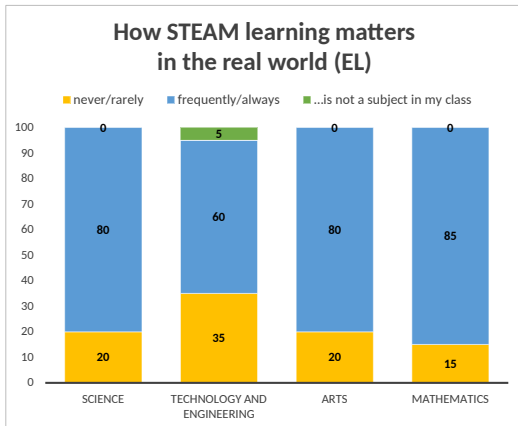


Figure 11 - Greek students' responses to the question "How often in your class do you get examples of how STEAM matter in the real world?".

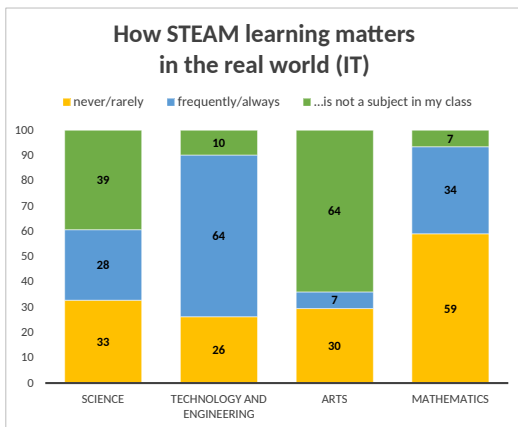


Figure 12 - Italian students' responses to the question "How often in your class do you get examples of how STEAM matter in the real world?".

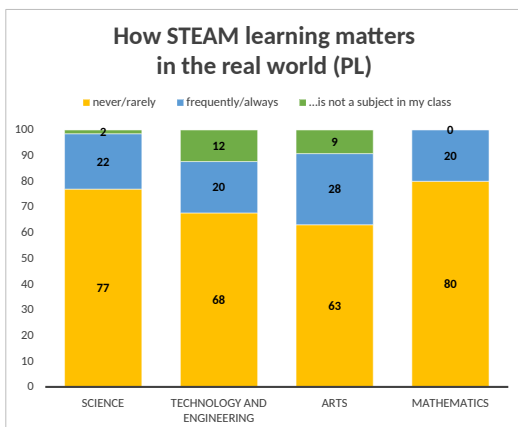


Figure 13 - Polish students' responses to the question "How often in your class do you get examples of how STEAM matter in the real world?".

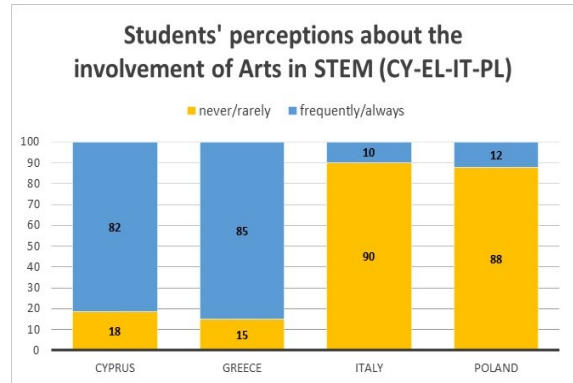


Figure 14 - Students' perceptions (among the four partner countries) about the involvement of Arts in STEM lessons.

3.4 The mobile makerspace experience

One section of the questionnaire focuses on the experience with mobile makerspaces, paying attention to satisfaction and any improvements in skills, through a verbal rating scale and some open-ended questions. This dual mode allows for a better capture of attention points that the project team might not have anticipated or underestimated.

In terms of enjoyment, students liked the project because it was fun (84%), allowed easy retrieval of materials (82%), prompted creativity (79%), and induced greater motivation to work (65%) (Figure 15).

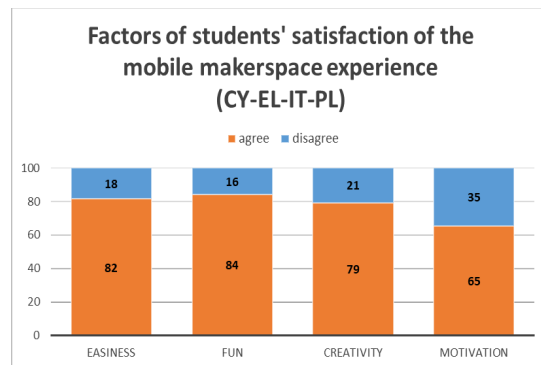


Figure 15 - Factors of students' satisfaction (among the four partner countries) of the mobile makerspace experience.

Cyprus, Italy, Poland, taken individually, express percentages substantially overlapping with those at the overall level; Greek students, involved essentially in projects with an appeal toward artistic disciplines, report creativity to a very large extent (95%).

A homologous questionnaire is submitted to the teachers who led the experiences and, after observing the students in action, they provide fully equivalent responses.

It is also recorded that according to students and teachers, the use of mobile makerspaces produce an

improvement in skills in STEAM areas, self-rated as significant in Science by 53% of students, in Technology/Engineering by 72%, in Arts by 35%, and in Mathematics by 33%. Looking at individual countries, the improvement is perceived as significant:

- To a greater extent for Cypriot students, in Science and Technology/Engineering for 79% of students, in Arts for 63%, in Mathematics for 66% (Figure 16);
- In Sciences for 60% of Greek students, in Technology/Engineering and Arts for 70%, in Mathematics for 65% (Figure 17);
- For Italian students, the nature of the experiences conducted is very much affected, with a low presence of Sciences and Arts, so that significant improvements occur in Sciences for only 13% of the students, in Technology/Engineering for 70% (peaking here), in Arts for only 8%, in Mathematics for 25% (Figure 18);
- For Polish students in Sciences according to 72% of students, in Technology/Engineering for 69%, in Arts for 28% of students, in Mathematics for only 17% (Figure 19).

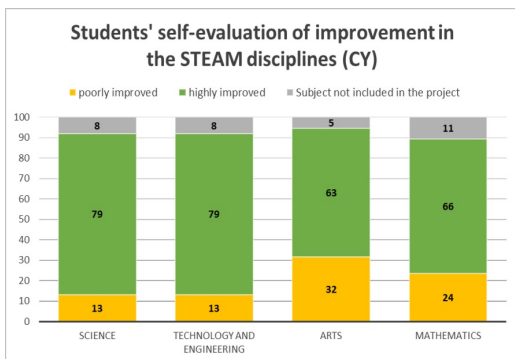


Figure 16 - Cypriot students' self-evaluation of improvement in the STEAM disciplines after the mobile makerspace experience.

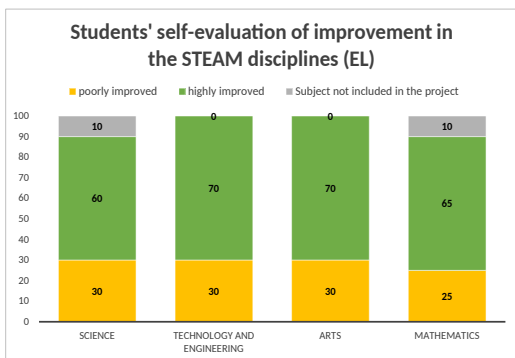


Figure 17 - Greek students' self-evaluation of improvement in the STEAM disciplines after the mobile makerspace experience.

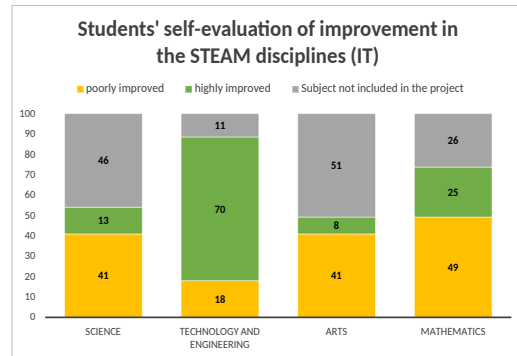


Figure 18 - Italian students' self-evaluation of improvement in the STEAM disciplines after the mobile makerspace experience.

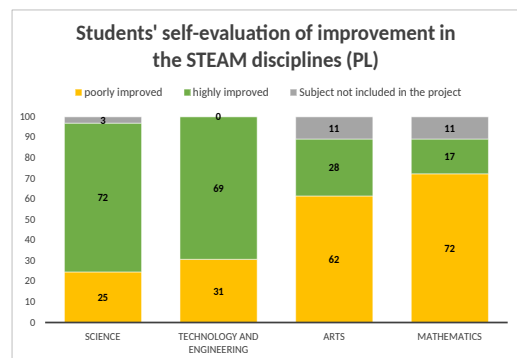


Figure 19 - Polish students' self-evaluation of improvement in the STEAM disciplines after the mobile makerspace experience.

To the open-ended question “Are there any other competencies/skills (not mentioned above) that you have improved thanks to the practice with the mobile makerspace?” 29% of students respond by referring to skills not directly related to the disciplines, but of a more cross-cutting nature. Students indicate two areas of improvement that they consider most significant: (i) in the sphere of cognitive skills, such as creativity and problem solving, the ability to focus or skills in design, linking them to the opportunity to engage in learning-by-doing; (ii) in the sphere of social skills, such as communication and interpersonal skills, leadership management, autonomy in work, linking them to the exercise of peer collaboration.

Teachers, too, in a questionnaire exactly matching the one proposed to students, are asked about their perceptions of improvement in students' skills as a result of their experiences with mobile makerspaces, and report in almost half of the cases that they have detected changes in the development of soft skills. The most frequently cited skills involve problem solving skills, also supported by improved ability to search for information, as well as an acquired ability to organize work, both independently and in collaboration with peers.

The questionnaire also offer students an open-ended question regarding the positive aspects of the experience with mobile makerspaces. The responses lead to results consistent with the previous statements. 20% of the responses refer to generic satisfaction factors (adjectives such as fun, interesting, engaging, useful, satisfying, practical); 22% focus on the acquisition of knowledge, skills, and competencies directly related to STEAM disciplines; 32% mention skills not directly related to disciplines, but of a cross-curricular nature, of which 14% refer to cognitive skills (problem solving, planning, error management) and 18% refer to social skills (collaboration and peer relationships); 13% appreciate the use of laboratory methods and innovative tools compared to those commonly adopted; the remaining 13% do not give significant responses (e.g. “don’t know”, “don’t have anything specific to state”). Some specificities are noted in individual countries:

- For Cypriot students, 23% of responses refer to positive personal feelings experienced during the experiences, citing general factors of satisfaction. 26% cite acquisitions of knowledge, skills, and disciplinary competencies as positive aspects. 36% report achievements related to soft skills (within which 21% addressed cognitive skills and 15% social skills), 3% mention the practical and innovative nature of the methods adopted. The remaining 13% are the evasive responses;
- For Greek students, 37% of the responses involve what are succinctly termed positive personal feelings, in which are gathered the perception of enjoyment, interest and greater generic pleasantness of the whole experience; 30% refer to new acquisitions and improvements in STEAM skills; 33% state acquisitions and improvements in soft skills (13% cognitive in character and 10% social in character); 7% the use of new methods and materials; only 3% are categorizable as no-answers;
- Italian students limit generically positive feelings of satisfaction to 11% of their responses; in 12% of responses they mention benefits at the level of disciplinary skills; in 46%, however, they report acquisitions and improvements at the level of transversal skills (20% cognitive and 26% social); in 19% of their responses they say they particularly appreciate the methodological approaches, which are more practical and linked with the real world. The remaining 12% can be categorized as “no-response”;
- Finally, Polish students, in 22% of the responses attribute the positive personal feelings (of fun, involvement, interest, etc.) to the meaningfulness and pleasantness of the experience with mobile makerspaces; in 28% they gain and improve their knowledge, skills and competencies in STEAM; in 20% they gain advantages in soft skills (6%

cognitive and 14% social); and 14% report that they appreciate the methodological elements of novelty (more practice and interaction) compared to the regular course of lectures. There is also a fair percentage – 17% – of “non-responses”.

The teachers who led the experiences are also asked similar questions. Two-thirds of the teachers are in their first experience with makerspaces, and 14 out of 15 are satisfied and inclined to repeat experiences with the mobile makerspace either in the same or different classroom settings. Teachers report numerous strengths of the mobile makerspace and associated OERs:

- The guidelines provided to support each experience. The learning scenario, i.e., the project sheet created for each experience, is unanimously recognized, by the entire sample of teachers, as a quality tool, well-structured and functional for teaching, relevant, and appropriate in its timing;
- The open and problematizing approach given to the proposed activities. Indeed, for each one there are questions of engagement and others of reflection;
- The engaging and challenging approach of the activities contained in the handbook, which foster work autonomy and sustain student motivation;
- The organized and easily accessible availability of materials and tools.

3.5 Suggestions of improvement

With the perspective of wanting to gather specific and timely feedback from those who participated in the pilots, the questionnaires addressed to students and teachers include an open section in which possible suggestions for improvement could be entered.

45% of the responses are generic or evasive (“don’t know”, “don’t have suggestions”, etc.). Otherwise, the following are reported among the main items for possible improvement:

- a greater availability of time (27%), both to conduct each experience and to be able to increase the number of experiences conducted;
- a richer supply of components and instrumentation (e.g., tablets and personal computers) (18%). In particular, proposals include the inclusion of a 3D printer;
- a better organization of working groups (10%), with a reduced number of members per group and with groups homogeneous in ability;
- a reduction in the amount of time spent on introductory explanations to some phases of work (1%).

The different combination of specific experiences addressed among those proposed in the project handbook, the different school systems and the different implementation contexts require an analysis of the data for each individual country:

- For students from Cyprus, most of the answers (51%) focus on the opportunity to equip the makerspace with additional devices, specifically computers, tablets and 3D printers; however, it is not indicated whether this could be functional to the activation of smaller groups that could work in parallel, or whether it serves to broaden the typology of experiences, or other. 14% of the answers concern the need to have more time, to dedicate not only to the processes of building the artefacts, but also to the entire design and organization of the implementation phases. 8% suggest the inclusion in the handbook of projects that would open up greater spaces for creativity. The remaining 27% of the answers are not significant (e.g. “I don’t know”);
- Among Greek students, 33% focus on the nature of the projects, urging the presentation in the handbook of a greater number of experiences, accompanied by very clear information and the proposal of technical solutions to control different devices. 10% of the suggestions concern the composition of the work groups, proposing a limited number of members with the same skills and/or age. Only 5% refer to the provision of additional devices or components and 5% also concern the request to increase the projects in the handbook that stimulate creativity. 48% do not provide significant answers;
- For Italian students, the most frequently provided suggestion concern the nature of the projects (25%), to extend their duration, increase their number during the school year, increase their complexity in order to cover more classes. 7% of the answers concern the composition of the groups, proposing greater homogeneity in terms of skills. 5% suggest proceeding with the enhancement of technical pre-knowledge strictly related to the study path. 3% of the answers contain the suggestion to open up to projects that greatly enhance creativity. The suggested improvements are not many, while 61% of the answers are completely empty or not significant;
- Polish students report details of the equipment provided inside the makerspace (6% of the answers); the possibility of having more time available to carry out the experiences (3%); the reduction of the start-up phases (3%); the reduction of the number of participants in the groups (2%). However, 86% of the other answers are empty or not significant.

Teachers are also asked to provide suggestions for improvement, both in relation to the technical aspects and in relation to the pedagogical aspects of the experience conducted with the mobile makerspaces. A large part of them state that they have nothing to add. For the technical aspects, the following suggestions are made:

- The indication of QR codes to guide more immediately in accessing the supporting documentation;
- The inclusion in the mobile makerspace of additional components and materials in terms of quantity and type.

For the pedagogical aspects, the following suggestions emerge:

- The specification of a time range to be dedicated to the various phases of the project that allows for more flexible management of time in relation to the different class groups;
- The assignment of specific roles to the members of the work groups;
- The gradual articulation and increasing difficulty of the learning objectives of the various projects that allows for an adaptation of the same teaching proposals to more and different school levels;
- The formulation already in the handbook of advanced and creative proposals, such as a solar-powered drone or an electric candle.

4. Discussion and Conclusions

The research presented in this paper is the result of the validation process of a mobile makerspace and related OERs, designed within an Erasmus+ project, intended for use in schools as pedagogical tools. The aim is to democratize STEM education and support the development of transversal skills through training paths based on problem-solving with a workshop approach. The introduction of Arts “increases learner empowerment, interest, and engagement; and students’ ability to make connections and transfer knowledge” (Huser et al., 2020, p. 1).

A convenience sample of secondary school students from the four partner countries was chosen to study the project pilots. When asked directly, the students expressed a high interest in all STEAM subjects; however, their preference for further study or employment in these areas was not particularly high, with a primary focus on Technology/Engineering. Students described the usual teaching practices in their classes as somewhat abstract and disconnected from the real world. Furthermore, they perceived that the introduction of Arts into their education could improve their learning, though Arts are often not integrated with STEM in school, as confirmed by the teachers who led the pilots.

It was in this context that the experiences with mobile makerspaces took place, during which the voices of both students and teachers were collected, crucial for understanding what they considered relevant to their learning and teaching experiences.

The students’ comments still reflected an approach based on individual disciplines, with a persistence of

separation between them. While they expressed a desire for school to be more connected to the real world and for a transdisciplinary approach, suggestions for improvement included proposals for homogeneous group work, remarks strictly related to their specific school context, and requests for expanded makerspace equipment aligned with the school's focus.

The experiences with the makerspaces were very positively received by the students, who found them fun, easy to use, and a catalyst for creativity. In the proposed formats, they were seen as effective in channeling engagement toward the study of STEM subjects. Some students also suggested spending more time on activities to gain more hands-on experience, while others asked for a more experiential handbook. In response to their questionnaire, teachers also reported satisfaction with the students' engagement during the workshop activities.

The analysis then shifted to self-assessment of learning. Students believe they have improved their skills in STEAM, particularly in Science and Technology/Engineering. The students' self-assessment also shows improvements in transversal skills: those mentioned by them (in response to an open question) are problem solving, expression and creative production, collaboration with peers, autonomy, engagement. Since the same improvements are also perceived by the teachers, all the prerequisites exist for a future evaluative study on the actual achievement of competence development goals, and awareness of these acquisitions.

The pilots were carried out in schools with a significant proportion of socio-economically and culturally disadvantaged or often gender marginalised people, especially in relation to STEM, who were able to benefit from unusual tools and experiences. The study did not reveal any peer differences in the results achieved, although this is not sufficient to state that the educational interventions conducted promoted full inclusion.

The teachers' comments highlight the need and importance of supporting hardware and software tools with guidelines that illustrate their pedagogically relevant use: in this sense, particular appreciation was given to the "learning scenario", a design sheet that not only describes in detail each experience, in its various phases and in its technical prerequisites, but also precisely underlines its purposes and objectives, application strategies, points of attention, subsequent openings and, in full makerspace logic, also suggests the stimulus questions for the teacher in his role as coach.

Looking ahead, several research directions are emerging, being addressed in different countries in relation to specific interests and contexts of use. For example, this includes developing a series of scenarios to encourage the challenging use of various hardware platforms for more technically advanced projects

compared to those in the initial development phase, or leveraging prototyping opportunities to support entrepreneurial thinking. The research group at the Università degli Studi di Firenze is working in two directions: testing the model in Primary Schools and developing tools to capitalize on the experiences conducted.

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Authors' contribution

In this paper, paragraphs 1 and 4 should be attributed to Laura Menichetti, and paragraphs 2 and 3 to Silvia Micheletta.

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Experiences of newly recruited educators in Early Childhood Services: a phenomenological-hermeneutic study

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Abstract

The initial training programs for educators in Early Childhood Services need to be integrated within specific training characterised by recursive self-sustaining circularity, able to produce professional skills. The present work analyses the model and the perspective realised in the municipality of Foligno (Italy). Such a pattern is found in phenomenological-hermeneutic research, a time of tight integration of the perspectives that guide the childcare workers, maximizing moments of action, reflection, and appraisal. This tool has made it possible to investigate the Early Childhood Educators' perception of their role, and the characteristics of the educational profession addressed to children up to three years old. Educators have been able to rethink their skills and practices.

KEYWORDS: Early Childhood Services, Self-Reflection, New Recruits, Training, Phenomenological-Hermeneutic Research.

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1. Introduction

In Italy, Early childhood education and care is organised in the 'integrated system 0-6' that was introduced by law 107/2015 and is regulated by the Legislative Decree 65/2017. The integrated system is part of the education system and is organised into two separate levels that welcome children according to their age: the 'educational services for childhood' for pupils aged between 0 and 3 years 'nursery school', for children aged between 3 and 6 years old.

Since the 2019/2020 school year, Italy raised the minimum qualification for early childhood educators (0– 3 years) to a 3-year bachelor's degree (ISCED 6) in educational science. As Miller (2008) and Nutbrown

(2012) stated, 'qualification is the foundation for quality'. The newly early years educators have therefore followed the same academic-training course, whereas the senior educators come from different educational backgrounds. This is important for further reflections of this article. Nurseries have organisational and operating methods that vary according to their opening times and sizes. However, their general purpose is to develop the autonomy, identity, and competencies of children, also ensuring their well-being, meals and rest. ECEC services for children aged 0-3 are run directly or indirectly by the municipalities, based on the criteria defined by regional regulations. The recruitment system for early childhood educators is also run at municipal level. The Ministry of Education and Merit (MIM), has a general responsibility for the allocation of financial resources to local authorities, for the provision of educational guidelines and for the promotion of the integrated system at the local level. However, irrespective of the recruitment situation, it is important to strengthen the quality of provision by developing and maintaining high expectations from the initial preparation period (Feinman-Nemser, 2001). While in the schools the service training and induction courses are partly coordinated at the ministerial level, this is not the case for Early Childhood Services. According to the most recent European and Italian studies and regulations and

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in line with the principles of lifelong learning and adult education the issue of in-service training of personnel involved in Early Childhood Education and Care (ECEC) is central to children's wellness. The importance of policies aimed at maintaining the quality of professional training was reaffirmed at a European level in the 2000s:

“Education and training have a crucial role to play in meeting the many socio-economic, demographic, environmental and technological challenges facing Europe and its citizens today and, in the years, ahead. [...] Efficient investment in human capital through education and training systems is an essential component of Europe's strategy [...]. High-quality education and training systems, which are both efficient and equitable, are crucial for Europe's success and for enhancing employability. The major challenge is to ensure the acquisition of key competencies by everyone while developing the excellence and attractiveness at all levels of education and training that will allow Europe to retain a strong global role” (CEU, 2009, pp. 2-3).

Steinnes (2014) suggested that obtaining qualifications helps to be ‘good’, but this is not enough. Steinnes asserted that other factors such as knowing the cultural background of the children and their families and experiences of working with children in different contexts are equally important. Nevertheless, the idea of nursery work as a professional occupation is undercut by the culturally and historically evolved common belief that working with younger children is a matter of ‘common sense’. Vincent and Braun's (2011) research also found that for students studying childhood, the emphasis was on work with young children being largely a matter of ‘common sense’ rather than a repository of a specific knowledge and skill set. Many studies, underline that the first years of teaching can be a critical period for the professionalization process of teachers (Feiman-Nemser, 2001; Wang, Odell & Schwille, 2008). What Snoeck says for teachers can also be extended to early childhood educators.

“Becoming a teacher should be seen as a gradual process, including initial education, the induction phase and continuing professional development. The point at which newly qualified teachers transfer from Initial Teacher Education and move to professional life is seen as crucial for further professional commitment and development, and for reducing the number of teachers leaving the profession” (ivi, p. 13).

Effective induction programs should provide all new teachers with systematic personal, social, and professional support in the early years of their careers (Langdon et al., 2016; Cumming, 2017; Cumming et al., 2022). They can therefore also help improve school and

teacher performance (ivi, p.13). Three areas can define the professional journey to ensure staff are fully supported in their employment. In the Initial training future educators study the most important theoretical approaches and understand the immediate competencies required at work through university traineeship activities. The induction period enables educators to decline and apply their knowledge and competencies to the needs and expectations of their employment context. Ongoing education and training are based on the existing skills in the context and respond to individuals' learning needs which may be identified through self-reflection, appraisal, the emerging needs of an employer or policy change. In summary, it can be said that while initial programs are focused on entry to a profession, the focus of induction is more contextualized and the emphasis is more practical and organised around the specific needs of an employer, groups of children and their families. According to the European final report entitled “Early childhood education and care: how to recruit, train and motivate well-qualified staff”:

“systems that are able to make clear links between the two stages of preparation are more likely to improve the quality of training, support retention and enable individuals to thrive in the sector. Typically, this development of clear links is achieved through:

- *the use of a common set of personal, professional, and social competencies for initial training and induction.*
- *the development and application of a clear set of ethical values.*
- *ensuring that every trainee/student has the opportunity to undertake significant periods of practice in ECEC settings as part of their initial programme.*
- *initial training programs whose content encourages reflection, analysis of effective practice and opportunities to learn from practice” (p. 95).*

Initial training experiences for early childhood educators working in the nursery sector are currently not widely available in Italy and are organized in a variety of ways. This paper focuses on Initial training experiences which is configured as a virtuous practice both for the organizational structure and for the contents and evaluation tools used.

2. The training course for newly early childhood educators in Foligno

In 2022, following the recruitment of fourteen early childhood educators, Maria Filomia, the coordinator of the Foligno Municipality's nursery services, designed a training course for new teachers. The participants were between thirty and fifty-five years old, with previous

educational experience (in nurseries and elsewhere). The course, which consisted of 10 meetings held mainly on Saturdays, dealt with many topics related to the educational profession, such as care, well-being, observation, educational planning, play and illustrated books. The lessons alternated between frontal teaching proposals and experiential workshops. As the literature on the subject highlights, the initial training programmes for teacher induction into school activity need to be integrated within a recursive self-sustaining circularity, able to produce professional skills (Mangione, 2016). Based on these assumptions, the course was enriched with tools to support professional reflection, self-analysis and comparison between peers. Specifically, it's been integrated into hermeneutic research activity.

3. Phenomenological-hermeneutic research: materials and methods

Within the framework of the training activities proposed by the Municipality of Foligno for newly hired educators in both public and private crèches of the same Municipality, phenomenological-hermeneutic research was proposed to encourage and support a reflection by the newly hired educators on their role as educators. The analysis of their experiences brings out critical and supportive elements in the relationship with children and their families (Langdridge, 2007).

The phenomenological-hermeneutic approach is concerned with the world of life and human experience as it is lived and is particularly suited to illuminating details and seemingly trivial aspects of experience that may sometimes or often be taken for granted in a person's life, to give meaning to these aspects and thereby achieve a sense of understanding (Wilson, 2015).

Phenomenological research contemplates the possibility of new meanings emerging about a phenomenon that brings "something forgotten to visibility" (Harman, 2007). What we can consider the real 'challenge' of phenomenology is the fact of describing what is given to us in the immediate experience without being 'hindered by preconceptions and theoretical notions' (van Manen, 2023). It is a type of research that is done with people and not on people, it places the individual with his experiences at the centre and supports him in activating his healthy resources. The researcher conducted an online introductory meeting with newly recruited educators. The researcher introduced herself to the educators and the objectives of the research were discussed:

- promoting reflection upon educational practice and intervention.
- exploring expectations of one's work.
- investigating any critical issues related to work at the crèche in relation to children and their families.
- bringing out the supportive elements in the relationship with families and children.

The subsequent phases of the research intervention were then co-organised with the educators. The agreed research plan consisted of three phases: the testimony collection phase, the content analysis phase and the restitution phase.

3.1 Testimony collection phase

To investigate the aforementioned dimensions and encourage reflection, a semi-structured open-ended written questionnaire was administered to the participants. This methodological instrument was chosen because it presents a survey scheme that is neither completely directive nor completely standardised but has intermediate degrees of both types. The questions are decided by the researcher but not the content. That is, the respondents do not have to choose from the response alternatives provided by the researcher before going into the field but can freely answer according to their own conceptual categories and in their logical order (Cellini, 2009), initiating a guided self-reflection process. The questionnaire was emailed to the educators who were invited to fill it in and send it in within two weeks. All 14 educators replied on time.

3.2 Content analysis phase

The questionnaires were read several times and after that the individual answers to the questions were analysed. The narratives were subjected to content analysis according to the phenomenological-hermeneutic method proposed by Montesperelli (1998). The contents relating to the same themes were systematised into a series of containers. The categories into which the testimonies were divided, according to the standards defined by the COREQ (Consolidated Criteria for Reporting Qualitative Research) CheckList (Tong et al., 2007), have a phenomenological character as they emerge through the criterion of evidence (Lauro Grotto et al., 2014). The narrative units that emerged from the questionnaires were organised into a series of phenomenological categories (Mantovani & Spagnolli, 2003; Smith, 2003; Reid et al., 2005). They were thus structured based on an analysis of the unravelling and meaning-making processes of the participants' experiences (Tringali et al., 2024). Here we will focus on the results grouped into four macro-categories: expectations, the relationship with the families, the relationship with the children and images related to one's work, as shown in the Table 1.

4. Restitution phase and result

The results were then shared with the educators during three online meetings lasting 1.5 hours each: the phenomenological categories were analyzed and discussed by the participants. In this phase, the hermeneutic circularity process was initiated. The hermeneutic process consists of a dialogue with the dimension of *Otherness* producing a constant

Table 1 - Structure of the narrative units identified in the questionnaires examined.

Categories	Subcategories
The relationship with the children	Difficulties in caring for the children (difficulties in settling in, difficulties related to managing children's anger, difficulties in managing conflicts, difficulties in helping children develop concentration, difficulties related to certain daily activities) Children's gifts (smiles, wonder, achievements, bonds)
Images related to one's work	Chaos- Heart and Mind- Colour and Warmth- The Sun- The Rainbow- A Mountain Landscape- A Seed- A Sunflower- A Butterfly- A Seagull- A Serene Child- The Foundations of a Home
Expectations	When expectations are not remembered When the job matches one's expectations When work exceeds one's expectations When one's expectations are disappointed
The relationship with the families	The importance of working with the families Difficulties (difficulties in gaining the trust of families, difficulties in understanding the peculiarities of each family, language difficulties, difficulties when families bring sick children to school) Gratitude and trust

reshuffling of concepts and interpretations (Ferro Allodola, 2014; Tringali et. al., 2021) It is worth emphasising the participative and collaborative climate that characterised these meetings. Through a dynamic and circular process, it was fostered the new recruits' reflection on the subjective reworking of their being educators. As a further development of the research plan, a request was made to have a specific exploration of the experiences not only of the newly recruited but of all the educators of the nurseries in Foligno. The results are described in this article by quoting what the educators themselves said. Opinions are described as op.

4.1 Expectation

About expectations, it is possible to identify three polarities of responses in which: the job corresponds to one's expectations (Op.12; Op.8) or exceeds them (Op.5) and when expectations are disregarded (Op.8). These three areas are analysed below.

WHEN THE JOB MATCHES ONE'S EXPECTATIONS

For most educators, the work they do seems to fully correspond to their expectations. These narratives are emblematic:

"Express myself at my best, it is stimulating and allows me to grow continuously... Fortunately, thanks to my university path and the acquired skills during the internship, I have had the opportunity to choose and practice a job that satisfies me" (Op.12).

"Living with children daily, accompanying them in their growth and achievement of autonomy, and supporting families in the very first years of

life is an emotion that has remained unchanged over time" (Op.8).

WHEN WORK EXCEEDS ONE'S EXPECTATIONS

In some cases, expectations are exceeded:

"The expectations I had before starting this work were far exceeded" (Op.5).

WHEN ONE'S EXPECTATIONS ARE DISREGARDED

An educator recounts how her expectations were disregarded, highlighting a gap between the theory learned during her studies and the work in the field:

"I suffered from the disconnection between theory and practice. It was a disillusionment. I had expectations that were partly shattered" (Op.7).

Another educator highlights how the world of the nursery is proving to be more complex than expected:

"Some relationships have turned out to be more complex than expected. Especially regarding the relationship with parents and the difficulties in making the context more inclusive" (Op.8).

4.2 The relationship with the families

As Silva underlines "another front on which it is possible to evaluate the positive effects of in-service training is the educators' attitude towards parents: the strengthening of skills and a willingness to listen to the point of view of other social actors on the educational scene, leads educators to become more interested in how parents educate young children at home" (Silva, 2019,

p. 382), even to the extent of adopting some family practices in the service where they work (Peeters & Vandembroeck, 2011).

THE IMPORTANCE OF WORKING WITH THE FAMILIES

The educators seem to have an awareness of how important it is to recognise and value work with the families:

“The nursery-family relationship is an aspect that I consider to be of paramount importance as there can be no meaningful and profound education with children if the relationship with their parents is not taken care first. I am strongly aware that being an educator doesn’t only mean working with children, but also with their families” (Op.6).

Working with children’s families involves important values such as sincerity (Op1), trust (Op 4), support without judgment and empathy (Op 11). These narratives are exemplary:

“My relationship with the families tends to be sincere” (Op.1).

“Already in the first interview and settling-in week I try to lay the foundations for trust, reciprocity and transparency” (Op.4).

“I build an ongoing dialogue without judgement, respecting everyone’s time, trying to support their identity as parents” (Op.11).

To foster a fertile ground for exchange and cooperation, the planning of sharing moments become essential.

Initial meetings are a valuable opportunity to get to know each other:

“I usually do... with all the parents and the education team, specific meetings, so that we can get to know each other, but tiptoeing into the lives of two parents who leave, in my arms, what they hold most precious. Everyone can tell their stories, ask questions, remove their doubts, and I always try to answer them calmly, creating a calm situation, a positive climate, looking them in the eyes. I hope that they feel welcomed, trying to create that mutual relationship of trust, collaboration, and involvement, which will then be consolidated over time” (Op.11).

It is also appropriate, as evidenced by some testimonies, to carve out moments of exchange daily, making parents participate in the educational context:

“The moments of sharing, exchange and confrontation with the parents take place daily both at the children’s entrance and exit. It is

especially at this last moment that the relationship with the families is best nurtured and consolidated. I tell the parent how the educational day went, any progress and achievements of the child and various aspects that I consider significant. Parents can express themselves by asking questions, sharing experiences at home, asking for information, advice, clarifications, ex-pressing doubts, uncertainties, fears, etc” (Op.6).

The parent-child workshops represent a significant opportunity within the educational project by creating a bridge between the family world and the nursery:

“parents, children and teachers can share moments with the aim of enhancing a relationship of trust and authentic educational continuity” (Op.12).

Some educators also set up receptions for parents during the year to foster dialogue:

“Twice a year we organize meetings with families, to have real time to dedicate to each other and also to give each other a line to follow in the educational and formative choices of the children. Despite these meetings, the relationship with the families is complex” (Op.1).

DIFFICULTIES IN RELATIONSHIP WITH THE FAMILIES

The construction of the relationship with families is not always easy and educators have been able to return the elements of complexity. These difficulties can be grouped into the following macro-areas:

- **DIFFICULTIES IN GAINING THE TRUST OF THE FAMILIES.** An educator recounts the difficulty she encountered in gaining the trust of the families. “This year I took on a group of children who had already attended one year of the crèche and who left an educator who had moved to another crèche. Initially, I had to win the trust of the families, who had another contact person” (Op.3).
- **DIFFICULTIES IN UNDERSTANDING THE PECULIARITIES OF EACH FAMILY.** Each family represents a world of its own: with its own culture, its own values, its own peculiarities, whose specific needs are not always easy to recognise and identify, as witnessed by the narratives: “In all these years of working in the nurseries I have been able to learn and understand that every single family has to be welcomed with all its peculiarities, which is not always an easy concept to understand or to accept especially at the beginning, each family being a world of its own”(Op.9).
- **LANGUAGE DIFFICULTIES.** Difficulties increase especially in the presence of language barriers: “due to misunderstandings at the linguistic level caused by a different spoken language, situations were created that I could define as

'uncomfortable' ... I remember an episode of a little girl who came to the nursery, suffering from pediculosis. The dialogue with her parents to point out the health problem was impossible because the family spoke only Arabic and, even if they understood, it did not seem to be a reason for them to leave the nursery. This situation went on for a long time and could only be resolved thanks to a figure who acted as a 'linguist-tic bridge' between the nursery staff and the family" (Op.9).

- **DIFFICULTIES WHEN FAMILIES BRING SICK CHILDREN TO SCHOOL.** A particularly acute problem seems to be that of having to accommodate sick children in the nursery: *"I find that the subject child no longer has the right to 'be sick', there are more and more cases of children attending in poor health, few work permits, little family network and we are seen as mere caregivers" (Op.4).*

One educator adds that according to her, this happens because parents see the kindergarten as a 'car park': *"for some parents, the crèche is solely and exclusively the place where they can leave their child during their absence due to work and other commitments. The non-recognition of the professionalism of the educators and the non-attribution of an educational value to the crèche inevitably generates a difficulty in the relationship, at least as far as I am concerned. To give an example, one only has to think of the bad habit, now rampant, of taking children to nursery school in a less-than-optimal state of health" (Op.7).*

GRATITUDE AND TRUST. Some educators not only expressed the difficulties they experienced in dealing with families, but also talked about what they receive from them in terms of gratitude and trust: *"Parents also give us very precious gifts: they entrust their little ones to us, placing extreme trust in us, they listen to us and ask for our advice" (Op.5).* Gratitude that can become a supportive element for educators: *"Even though it is a job, it is the family's thanks that makes all the difference, because it means that the task you are doing is a positive one and that the relationship that has been established is genuine, one of empathy and trust" (Op.2).*

4.3 The relationship with children

Difficulties in caring for the children. While taking care of children at the crèche, the educators reported encountering multiple difficulties.

INSERTION DIFFICULTIES

The insertion of the child at the nursery is a particularly delicate moment. It is crucial to be able to offer a continuum between parental care and the care offered by the educator, avoiding potentially damaging breaks. The following narrative tells of the difficulties encountered in this regard:

"Let me give you an example: a one-year-old child arrived at nursery school accustomed to being constantly in his mother's arms. The child refused to leave his mother's arms, even to play or go in the stroller. We asked ourselves many questions about this situation, and many times we had to hold back from responding immediately to his requests. At home, the process is still ongoing. In about six months at nursery school the child learned to approach other children, today he is calm and independent. The work we are doing with the parents is still ongoing and he needs daily sweetness" (Op.1).

The child experiences the suffering of separation during the insertion period. But this also happens in later stages for example when children return after a long absence. The following testimony highlights the difficulties encountered by the educator dealing with this situation:

"I remember the episode in which a two-year-old child returned to the nursery after twenty days of absence due to illness. The separation from his mummy was difficult, the child had always been with his mother during all these days and breaking this mother-child bubble seemed almost impossible. When he arrived with his mother in nursery, he was calm but after he understood that his mother had to go away. Suddenly, he started to get angry and cry desperately, so much so that his mother was worried and, taken by a moment of anxiety she wanted to take him home. I tried, calmly and firmly, to explain that the reaction of the child was normal but slowly we would help him to calm down and relax, then involve him in our usual routines. The mother did not seem very convinced by my explanation but slowly we managed to calm the child and face the day with serenity" (Op.12).

DIFFICULTIES IN MANAGING AGGRESSION OF SOME CHILDREN

The educator's task at the crèche is extremely delicate as he or she must find a balance between two types of interaction with the child: on the one hand approval, affection, tolerance, reassurance, encouragement, and on the other hand prohibition of certain behaviours, empowerment, demands, control. The words of this educator are meaningful:

"in taking care of children in the facility I often encounter difficulties. Many times, it takes a long time before we get to the reason for certain behaviours and finding a calm and balanced way to express them is not easy. The main incidents that occur in the daycare centre concern aggression" (Op.1).

This difficulty is illustrated by the following account:

“In my group there is a child with whom I get along well, but sometimes it is difficult to manage his moments of frustration. He would shout, cry, wriggle, throw objects and hit his classmates. He is a highly intelligent and exuberant child, but sometimes difficult to contain during play moments and to monitor so that he does not hurt himself” (Op.3).

Expressions of anger by young children are normal and are often related to their inability to recognise their wishes, their frustrations, and their speech difficulties. It would be desirable for educators to have the time to be able to recognise the specific needs of the child at these junctures. However, as the following account points out, sometimes due to workload they do not have the opportunity to do so: “I find it difficult to take care of such young children who have different needs from each other. This year, I have a group of younger children (3 months-1 year). There is a very lively child who is going through a particularly aggressive phase, she bites and often pushes the others... Her management is complicated in the large group. The difficulty lies in making her understand that certain behaviour is not appropriate to the place, and she mustn't hurt others” (Op.2). If the educator, due to too many work burdens, leans towards control and reprimands the child, children will tend to rebel.

DIFFICULTIES IN CONFLICT MANAGEMENT

Some educators have reported finding it particularly difficult when aggressive situations arise within a group of children, whereby a child hits, pulls hair, or pushes a peer: *“Dealing with peer disputes: shouting, pushing, biting, etc” (Op.6)*. Educators do not always seem to be aware that peer conflict is a fundamental moment in the child's psycho-affective development, as witnessed by this account:

“I often witness quarrels, pushes, and spitefulness, and this hurts my heart because in them, even though they are so small, I already see the competition, rivalry, and frustration of adults. I try to teach them tolerance, respect, and sharing because this is what school, family, and society should teach. They must be helped to develop a certain sensitivity for each child. How? Perhaps by teaching them to be more compassionate, and less selfish” (Op.14).

The educator's role should not be to avoid conflict in the peer group, because in this manner they deprive the child of an important growth moment. Rather, they can provide child tools to manage conflict.

DIFFICULTIES IN HELPING CHILDREN DEVELOP CONCENTRATION

Two educators dwelt on the children's difficulty in *“staying focused on things”* due to too many stimuli:

“they are not used to stay on top of the things, experiences and activities that are offered. The level of concentration is lowered because there are too many stimuli” (Op.4).

“The use of tablets, mobile phones from a very early age causes children to have difficulty using their imagination. they have shorter and shorter attention spans, and they struggle to move independently in free play” (Op.8).

DIFFICULTIES RELATED TO DAILY ACTIVITIES

There are specific moments that appear to be more critical, bathing routine and nap time for example, as one educator well explained:

“The management of the bathing routine was also a critical moment last year when I had a group of 12-24 months children... this moment is very delicate, and each child would need more individual attention and maximum calm” (Op.2).

“Many children quickly get used to sleeping together. Some children overreact, this year we had to have one child sleep outside the sleep room. This way he is calmer and does not wake up repeatedly” (Op.2).

CHILDREN'S GIFTS

Alongside the difficulties encountered are the gifts the educators receive while working with the children. These include spontaneity, smiles (Op.12), wonder (Op.4), achievements (Op.3) and ties (Op.2). These statements are exemplary: *“The smile of children is the greatest gift they can give me” (Op.12); “the continuous astonishment of their eyes, the ‘wonder’” (Op.4); “Children's achievements, their first experiences, the moment when you see the satisfaction of being able to do something that was previously difficult for them” (Op.4); “With the children you create good bonds, particularly with your own section the children create a real bond of attachment as they recognise you as a reference figure” (Op.2).*

4.4 Images related to one's work

Finally, in Table 2 are the images used by educators to represent their work at the nursery school.

5. Discussion and Conclusions

The research has limitations due to the small number of subjects involved and the focus on only female participants, which may warrant further study. Future studies should aim to expand the number of participants. The data collected through the interview show a profession complex not only for the audience it addresses but for the personal involvement that entails. Starting the reflection on the answers of educators'

Table 2 - Images used by educators to represent their work at the nursery school.

Image	Opinion
<i>Chaos</i>	"The image it evokes is one of chaos, or disorder only present where one feels free and at home" (Op.1).
<i>Heart and Mind</i>	"Heart (first) and Mind' at the service of children, a bodily in dialogue, between bodies in a relationship, where the child feels free to create and express him/herself" (Op.11).
<i>A colourful painting</i>	"A kind's painting the that children know how to do with brushes, where many colours that overlap and mix together, always in a different and magical way" (Op.3).
<i>The Sun</i>	"It is the sun rising on my new day even though there are clouds in the sky" (Op.13).
<i>A rainbow</i>	"A rainbow in the beginning and end of which there is me, but in the middle of which there are the colours of all the children, each with their own hues, shades and attitudes: red carefree vivacity, indigo sweetness, yellow politeness, green sharing, blue determination, orange patience and violet selflessness, or that's how I like to think of them" (Op.14).
<i>A mountain landscape</i>	"A beautiful mountain landscape with Tibetan bridges, climbs, streams, small animals... an explosion of nature with its beauties and criticalities, where everything is possible and can be experienced by having Respect and Care for oneself and all that is part of it" (Op.4).
<i>A seed</i>	"A seed that is planted and watered every day until it grows and blossoms. Ours is a work in progress in which the child grows, and we as educators grow every day together with the children" (Op.10).
<i>A sunflower</i>	"Sunflower is my favourite flower. The sunflower is the most joyful of all flowers in nature. It conveys cheerfulness with its yellow colour. As the legend of the sunflower goes, it was not always a bright colour, it was an ugly flower, and no one wanted to be near it until the sun decided to help it. It embraced it and with its shining rays, it immediately glowed a bright yellow almost like gold. From that day on, the flower became the tallest and most beautiful in the garden. I want to be the sun for the children, to accompany them through this short stretch of life, to stimulate their curiosity, to bring out their interests, to face fears and challenges together, to help them believe strongly in themselves, and I, a step back, look at them admired" (Op.10).
<i>A butterfly</i>	"A butterfly which, having emerged from its cocoon, unfurls its large, colourful wings and makes its first flight. For me, the butterfly is a symbol of constructive effort" (Op.10).
<i>A seagull</i>	"That of a seagull slowly preparing to take flight to new horizons" (Op.7).
<i>A serene child</i>	"A calm and competent child, placed in an environment he/she knows and in which he/she feels free, respects rules, other children and learns" (Op.2).
<i>The foundations of a house</i>	"The foundations of a home, it is in the daycare centre where, in cooperation with the parents, the foundations are laid for forming the child's identity. Moreover, we educators also grow and learn new things together with the children" (Op.5).

backwards, that is, from the last question analysed (about the image of one's work), we observe a romantic vision of one's work and sometimes an idealized vision of childhood. The dynamics of confrontation and quarrels between children, for example, are part of the growth processes and are positive steps (Di Pietro, Savio, 2021). Early childhood educators have a job in which unforeseen events can become a resource if welcomed and managed through group dynamics, but they can also be very frustrating. Although many difficulties have been identified, educators possess all the emotional and professional resources to find effective solutions. Physical and emotional care seems to be perceived as more important than educational design and organizational activities in general. While the literature shows a strong relationship between all components (care and educative design) of the profession (Bosi, 2015). The basis of any educational design is the sharing of visions and underlying values. Some aspects of the professional vision should be shared and explained further with more experienced educators. We believe that this model can favour this type of sharing and personal reflection. For this reason, future activities may benefit from the presence of senior educators during the discussion phase. The model here

described proves to be functional to the exploitation of a great diversity of newly qualified educators and to set a moment of realignment given the following professional development in the educational context. The model represents a mode for reflecting on their competencies and defining new training developments. Within the framework of ECEC, induction training of educational staff can increase the general well-being of the children, the educators themselves, and the children's parents, thanks to a real engagement of all the staff operating in ECEC services. Therefore, this cannot be training imposed top-down; on the contrary, professional training must be bottom-up, involving all the subjects in the selected context, according to generate reflexive processes (Balduzzi & Lazzari, 2015). In this paper, we have shown educators' reflections related to perceived professional effectiveness, but the number of subjects involved is limited. Nevertheless, some confirmations can be found in the literature on the topic (Halle, 2010). It could be functional to extend similar experiences (Garvis & Manning, 2015). In which the first advantage is to give yourself time for reflection, comparison, and professional growth. A gift that every profession deserves.

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Professional learning to support digital transformation and change in education: an integrated, systematic literature review

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Abstract

Digital technologies have been identified as critical in facilitating the development of contemporary, inclusive educational systems that support the UN sustainable development goals (ITU, 2023). Internationally governments have developed ambitious policies and competency models to support educators and teachers to develop the relevant knowledge, attitudes and behaviors to critically engage with learners in an educational environment that is extensively impacted by a digital society. Despite the prevalence of digital learning technologies, education has been slow to embrace these at a systematic level, with research highlighting the lack of professional learning opportunities to support educators to make change. There is a disconnect between education and society regarding the adoption of digital technology. This paper sought to investigate the research around professional learning and digital transformation over a ten-year period (between 2013 and 2023). It aims to answer the question, what elements of professional learning support educational professionals to facilitate digital transformation and change? It found that professional learning longer than 12 months that had clear goals and incorporated a variety of models was more likely to support educators to transform their contexts.

KEYWORDS: Professional Learning, Digital Transformation, Change.

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1. Introduction

At policy level nationally and internationally, digital education has been recognised as a means to enable governments to meet their educational targets. For example, action 2 of the European Digital Education Action Plan, sets out how digital learning can facilitate flexible forms of learning, leading to a more inclusive educational system (European Commission, 2020). In addition, many national policies also acknowledge the potential for technology to support diverse learning approaches, for example as the Digital strategy for schools in Ireland (Pillar 1, Department of Education 2019). In addition, digital skills have been

acknowledged as critical to support sustainability and climate action (Usero, 2022). Digital competence is a critical part of the future educational landscape. This is evident throughout the literature and national policy with surveys indicating the digital competency of teachers facilitates more equitable and inclusive access to digital learning (OECD, 2022).

Despite dialog at policy level, little has changed in terms of digital competence levels. A common theme is that educators lack the professional learning to enable them to teach digital skills (EIT Digital, 2022; OECD, 2020; Montero-Mesa et al, 2023). Many digital competence frameworks are focused on the integration of technology and the associated levels of integration (for example, TPACK and SAMR: Koehler & Mishra 2009; Puentedura, 2006). However, it is not known how to support educators or educational leaders to progress to higher levels of technology integration or leadership competency levels. This research aims to contribute to this gap in the literature by seeking to understand the characteristics of professional learning that can support educators and educational leaders to progress to higher levels of technology integration in their practice. It also considers how these characteristics can support the

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progression to leadership competency levels and facilitate systematic change. A shift to digital learning requires a change in identity, mindset as well as practice/role and so professional learning needs to encourage educators to consider the societal, professional, technological and cultural context of change as well as the broad learning environment both formal and informal and how it influences students. In addition, professional learning needs to enable educators to keep pace with change that is ever increasing today. This requires educational institutes to engage in collaborative professional learning beyond their immediate context to keep informed of such change. Therefore, digital competence frameworks need to consider what professional learning characteristics support teachers to make the required changes to practice, who they need to collaborate with and how.

Teacher Professional Learning (TPL) has been widely studied in the literature not only at school level but also within the Early Learning and Care (ELC) context and higher education. Several studies have also systematically explored the impact of professional learning on digital competence, with others considering the role of professional learning (PL) on student and teacher outcomes.

Regarding student outcomes research has illustrated that professional learning supports more inclusive education (Poekert et al 2022). However other systematic literature reviews demonstrated it was difficult to measure student outcome as it was so varied and due to the lack of measurable instruments (Ventista & Brown, 2023). This aligns to a more recent systematic study that explored to how professional learning was evaluated and found lack of rigorous and reliable approaches to measuring impact (Ahadi et al, 2024).

Systematic approaches that explore the impact of the data used from PL on teacher outcomes found that it can change teachers attitudes and beliefs and instructional change (Ansyari et al, 2020). However, it did not consider the characteristics of professional learning that supported this. Other studies looked at the role of professional learning and social capital and found that it increased the teacher's network and access to knowledge (Demir, 2021). Considering online professional learning and teacher outcomes, Bragg et al. (2021) conducted an SLR of 11 papers they found that online professional learning largely improved teachers content knowledge and their instructional practice. However, the elements of the professional learning that supported such was not examined.

Regarding the characteristics of successful PL that supports to digital competence or change, one systematic review was identified that explored the characteristics of studies around professional learning and educational technology as well as the role of the academic in the context of educational technology, however this was in a Higher education (HE) context. It was highlighted that within HE, academics in professional learning have different guises such as a

learner, designer, and a researcher, and these are reflected in PL (Lindolf & Pasco, 2020). In terms of the types of studies most of these were qualitative. Qualitative studies were also prominent in a review of studies in digital competence and professional learning (Fernades et al., 2022).

Another characteristic explored was that of the length of professional learning, which was examined in an ELC context, it identified that found short term PL had very little impact on practice (Machado & Oliveira, 2024).

Most systematic approaches to examining the research and literature are concerned with professional learning and impact broadly and do not specifically examine the elements of professional learning that support educational change. Although educational change has been widely studied in the literature, theories of change highlight the need for contextual consideration, individual negotiation, incremental pace, and continued support to enable individuals reflect on beliefs and attitudes as well as time for practical experimentation (Ajzen, 1991; Hall, 1998; Clarke & Hollingworth, 2002). However, the language used to describe technological change centers around fast, constant and radical transformation which contradicts such theories. Little research has been conducted in professional learning that supports digital transformation and change. Despite the widespread availability of digital competence frameworks and dialog at national and international level there is no common understanding of how to support change in the context of digital learning. This research aims to consolidate existing studies in professional learning and change to identify the elements of professional learning that support change and digital transformation. This research will provide guide the development of professional learning activities to support the implementation of digital competency model. It is expected that it will facilitate teachers on the journey of PL and how to leverage from professional learning to support teachers to evolve as digital leaders.

2. Methodology

2.1 Purpose and scope of the research

Significant research has already been conducted on professional learning within the teaching profession, therefore, it is important to consolidate and build on this in the context of supporting transformation. In addition, research has also been conducted on digital transformation, however the majority of such is in the private sector. There are several successful frameworks adopted with regards to supporting technology integration in education such as digital competency frameworks (DigCompEdu and many more), TPACK and SAMR models, and how they have been used to support professional learning. However, it is not clear what professional learning activities support change Therefore it was decided to adopt a systematic approach

to understand the professional learning elements favorable to digital transformation and change.

The purpose of this research is to determine:

RQ: What elements of professional learning that support educational professionals in digital transformation and change?

Much of educational research is qualitative as a result it was decided to include studies that describe the professional learning model and how the professional learning has change practiced. Therefore, the studies included were:

- Quantitative studies quasi experimental, observational analytic studies, and longitudinal studies
- Qualitative studies qualitative design, case study design, ethnography, phenomenology, narrative analysis (grounded theory will not be included, unless it has undergone a quant study) and longitudinal studies

2.2 Search strategies

Databases in education and business were both included in the search strategy. This is because digital transformation has not been widely researched in the education context and professional learning models in other contexts with a view to supporting change may be used to inform educational models. Also, it was decided to include professionals in the search terms to enable the team to leverage from practices in other contexts. In Table 1 is an overview of the search strategy.

Table 1 - Search strategies.

Databases
Academic Search Complete Business Source Complete Education source ERIC EBSCO ProQuest
Search Strings and Filters
(Professional* OR "Teachers" OR "Educators" OR "Teaching" OR "Training" OR "Trainers") AND ("informal learning" OR "formal learning" OR "Teacher education" OR "Teacher Pedagogy" OR "Teacher Training") AND ("Digital" OR "Technology" OR "Technological") AND ("Change" OR "Innovation"))
(Professional* OR "Teachers" OR "Educators" OR "Teaching" OR "Training" OR "Trainers") AND ("Professional Development" OR "Professional learning" OR "continuous professional development" OR "continuing professional development" OR "learning and performance" OR "Training and development" OR "learning and development") AND ("Digital" OR "Technology" OR "Technological") AND ("Change" OR "Innovation"))
Filters: Peer Reviewed, Full Text, Academic Journal articles, English Language, Year 2013-2023

2.3 Screening

The team screened, analyzed and reported through four phases, identification, abstract screening and full screen, data extraction.

In total four databases were searched Academic Search Complete; Business Source Complete; Education source; ERIC; EBSCO using the search terms outlined in section X.X. A total of 1, 971 articles were found. Of these 37 were duplicates. The remaining 1, 934 went through an initial screening of titles and abstracts using the screening criteria in Table 2.

In this process (Figure 1) 1491 articles were excluded, and 443 articles were fully screened. From the full screening stage (In which full articles were reviewed using the screening criteria) 265 articles were excluded. In total 178 articles were analysed for the integrated literature review and were part of the extraction stage.

Within the screening process below is an overview of the inclusion and exclusion criteria applied. It was important that professional learning models and their impact on change was evident in the research. Furthermore, given the context of change and the nature of educational research it was critical that qualitative studies that described models and approaches and the associated impact were included in addition to quantitative studies.

2.3 Data extraction

Following screening data was extracted for each article using the Table 3 below. This provided an overview of the characteristics of the research, a critical analysis of the research and the characteristics of the professional learning and associated impact.

The reason for extracting the pedagogical pathway was to determine the proficiency level that the participants attain through engaging in professional learning. This is based on existing proficiency levels identified in competence frameworks such as DigCompEdu as well as other models of levels of technology integration.

Regarding competency frameworks, DigCompEdu (Punie & Redecker, 2017) uses 6 levels of proficiency: Newcomer (A1); Explorer (A2); Integrator (B1); Expert (B2); Leader (C1); Pioneer (C2). Whereas UNESCO use three levels knowledge awareness, knowledge deepening and knowledge creation (UNESCO, 2018).

Many of these proficiency levels map to phases of technology integration such as that outlined by (Christensen et al, 2001); Stage 1 Awareness, Stage 2 Learning the process, Stage 3 Understanding and application of the process, Stage 4 Familiarity and confidence, Stage 5 Adaptation to other contexts, Stage 6 Creative application to new contexts. The SAMR model- Substitution, Augmentation, Modification and Redefinition (Puentedura, 2006). Both of which end with redefining and remodeling learning through technology.

Table 2 - Screening criteria.

Inclusion	Exclusion
<p>Terms: IMPACT/EFFECT study explores impact/effect of professional development models in a rigorous manner.</p> <p>-There are details about advancement during professional development? There are elements of explanation of the impact and change. - Context and socio-technical environment is considered There is an empirical evaluation of the professional learning</p>	<p>Rigor Recommendations or discussions are not evidence based Rigor: Not a peer reviewed journal article Terms: Study Does not measure impact/effect of the proposed intervention in a rigorous manner.</p>
<p>Terms: MODE/CHARACTERISTICS of professional learning studies</p> <p>At least one of them:</p> <ul style="list-style-type: none"> - The type of Professional Learning - The characteristics of the Professional Learning - A description of the Professional Learning environment - The means / tools used (type of platform, media or other) 	<p>Terms: Study does not include details of the characteristics of professional learning</p>
<p>Sample type: All professionals</p>	<p>Sample type: students that are in higher education or schools</p>
<p>Qualitative studies</p> <ul style="list-style-type: none"> - Sample size: Above 2 - Type of study: qualitative, phenomenology, case study, ethnography, narrative and longitudinal - Year: post 2013 - Rigour: Studies that address validity and reliability in particular bias that may impact the study 	<p>Qualitative studies</p> <ul style="list-style-type: none"> - Sample size: 2 minimum - Type of study: Grounded Theory that has not been tested in other studies - Year: pre 2013
<p>Quantitative studies</p> <ul style="list-style-type: none"> - Sample size: Above 200 - Type of study: experimental, quasi experimental, observational analytic studies, and longitudinal studies - Year post 2013 - Rigour: Studies that address validity and reliability through statistical measures 	<p>Quantitative studies</p> <ul style="list-style-type: none"> - Sample size: below 200 - Type of study: experimental - Year: pre2013

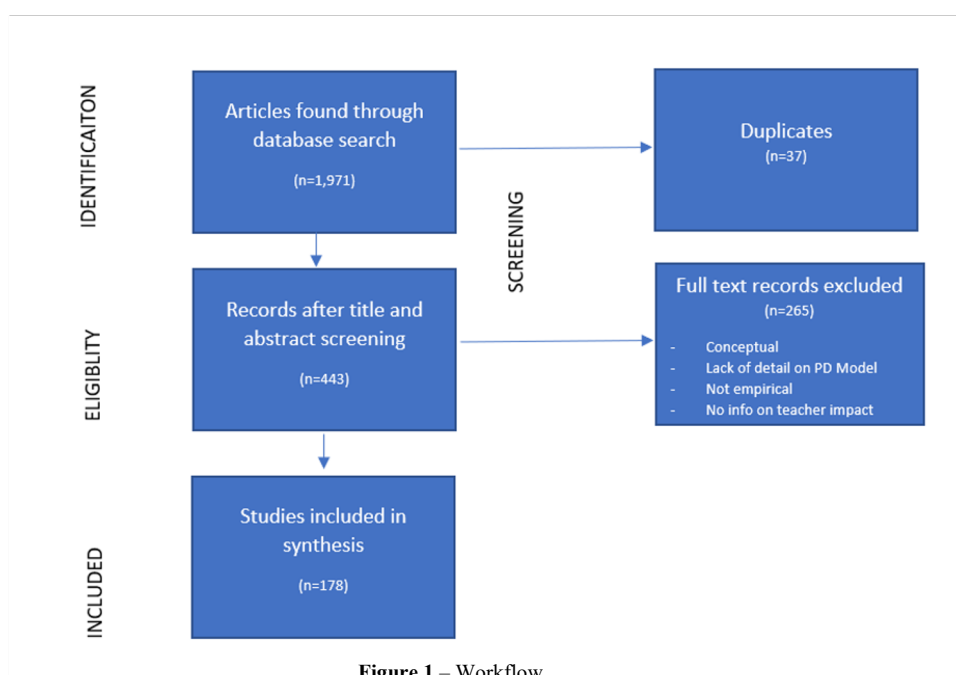


Figure 1 – Workflow.

Table 3 - Data extraction table.

Theme	Data extracted
Type of study	
Country	
Sector	
Level of education	
Duration of Professional learning	
Strengths of research	
Weaknesses of research	
Characteristics of model	
Impact of model	
Enablers to implementation/success	
Pedagogical learning pathway the professional learning model aligns to Knowledge Awareness/Knowledge Deepening/ Leadership	

They also relate to elements outlined within theories regarding models of change such as the stages of concern in the Concerns Based Adoption Model (CBAM), which again an outline six stages ranging from awareness to refining or developing new ideas (Hall & Hord, 2020).

It has been acknowledged in the research that change is complex and often not linear, in addition sometimes people need to be reassured, and information or awareness may need to be provided, thus phases may overlap. (Sansom, 2020; Fullan, 2016). It is important that this is considered within the analysis. Furthermore, apart from DigCompEdu many of these descriptors do

not consider the progression to leadership or innovators. To enable overlap between the levels and map profession to leadership it was decided to map existing models to three levels Knowledge Awareness, Knowledge Creation and Leadership.

This amalgamates the proficiency levels in the DigiCompEdu framework, to create consistency between frameworks and allow for broader definitions to remove the concept of linearity. It also considers models such as technology integration levels SAMR. See Table 4 for an overview of these.

3. Findings

3.1 Study characteristics

The number of studies in professional learning and innovation/change/digital transformation has increased exponentially over the past ten years-peaking in 2021. It is important to note that COVID had a significant impact on the number of articles being published in digital leaning and professional learning (Figure 3).

Many studies were US based, followed by international or cross-country studies and thirdly studies in Australia (see Figure 4).

Qualitative studies dominated the literature followed by mixed methods. There was only one experimental study in the articles that were screened (see Table 5). This data is reflective of the discipline of the research which is education or social science based.

Table 4 - Pedagogical Pathways Descriptors for Data extraction.

	Outcome	Extraction criteria
Knowledge awareness	Awareness of the pedagogical and professional potential of digital learning technologies	Evidence of <ul style="list-style-type: none"> • An understanding of the role of digital learning technologies in education, • Applying professional learning directly • Skills development • Seeking more knowledge, • Sharing experiences.
Knowledge deepening	Engage in critical discourse with stakeholders regarding the selection and application of digital learning. They will discuss with peers, students, and other stakeholders about their experiences with digital learning to date, empathize with these and adapt their practice based on this dialog, observations of their own experimentation and reflection	Evidence of <ul style="list-style-type: none"> • Reflecting on practice, • increase in self efficacy, • innovating practice at an individual level • Sharing innovative practices • Identifying further opportunities for change.
Leadership	Critical thought leaders Question the adequacy of contemporary digital and pedagogical practices and challenge current systems. Support culture of innovative practice within and beyond their own context	Evidence of <ul style="list-style-type: none"> • Supporting innovative practice at a whole school, district or sector level • Supporting other teachers to lead change • Collaborating with other stakeholders to make change e.g. students, in other sectors, schools etc • Significant transformation to practice (redefinition of SAMR) e.g. learning environment, role of the teacher etc • Culture change.

Of those articles the average Qualitative study had a sample of 42 with mixed studies having an average sample of 72. As expected, Quantitative studies averaged significantly higher.

Of the studies the majority impacted the participants knowledge deepening level of proficiency in that those that engaged with the professional learning discussed resulted in the ability to adapt learning and apply to their own practice in a collaborative and critical manner through dialog, observations of their own experimentation and reflection (see Table 6: studies by level of proficiency).

Studies that considered the experiences of in-service teachers dominated the research with 71% of papers exploring professional learning for this cohort. Only 33 papers of 178 considered the experiences of preservice teachers (Figure 5).

Those studies that considered pre-service professional learning impacted the knowledge awareness and deepening levels of proficiency with few progressing to the leadership stage (Figure 6).

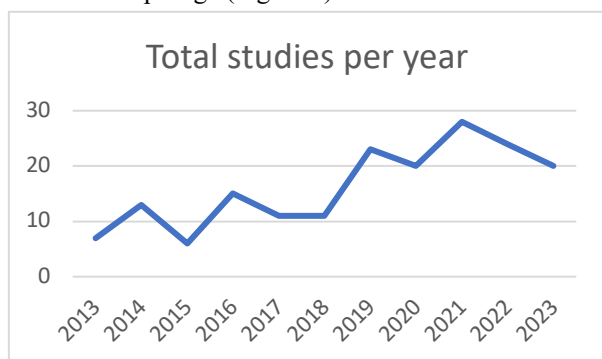


Figure 3 - Studies published by year between 2013-2023.

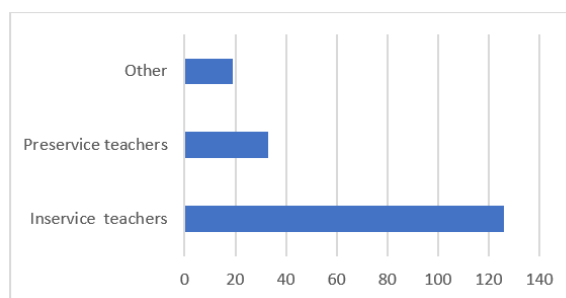


Figure 5 - Papers by research participants.

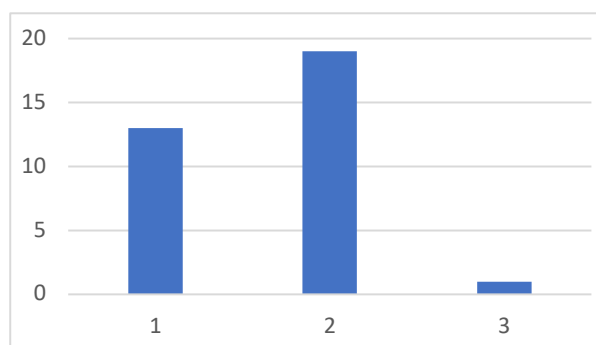


Figure 6 - Studies with pre-service teacher as research participants by level of proficiency.

3.2 Theoretical frameworks

A review of the theoretical frameworks' studies leveraged from was conducted in the analysis. Many of the studies did not have a theoretical frame. Of those that did the majority leveraged from TPACK (Technological, Pedagogical and Content Knowledge), particularly regarding content design and evaluation. In addition, social learning models such as the

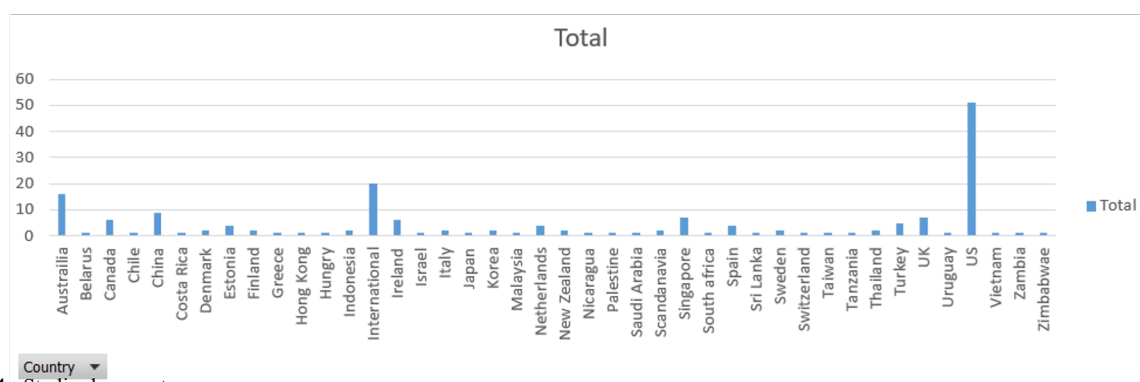


Figure 4 - Studies by country.

Table 5 - Types of study and sample size.

Type of study	No of publications	Average of Sample Size	Type of study	Number of publications	Average of Sample Size
Experimental	1	4	Qualitative	101	42
Mixed	56	72	Quantitative	20	2428
Total			178	Total Average sample	319

communities of practice, inquiry and learning communities featured quite highly. Theories of change and innovation including the Interconnected model of professional growth and other models for example Rodgers Diffusion of Innovation theory (Rodgers, 2003), mentored innovation model (Kárpáti & Dorner, 2008) teacher centered systematic reform (Gess-Newsome et al., 2003) were also considered within studies. As the studies were about professional learning for change, transformation and impact it is expected that these models would inform many of the studies.

Table 6 - Studies by level of proficiency.

	No of studies	% of studies
Knowledge awareness	60	34%
Knowledge deepening	95	53%
Leadership	23	13%
Total	178	100%

Table 7 - Summary of theoretical frameworks informing the study.

Theoretical frame	Number of studies
None	90
TPACK	15
Communities of Practice/Communities of Inquiry/Learning communities	13
Interconnected model of professional growth (IMPG)	6
Change/innovation theories (other than IMPG)	6
Social learning/network theory/networked learning	6
Design based research	5
Schon reflective learning	4
Cognitive apprenticeship, social cognition, social constructivism	4
Learning culture/organisational learning	2
Technology acceptance model	2
Culture context theory	2
Identity formation	2
Other	21
Total	178

3.3 Characteristics of Professional Learning

Regarding the characteristics of professional learning that support change, transformation or impact practice an analysis of studies under the categories of Knowledge Awareness, Knowledge Deepening and Leadership were constructed. An overview of these descriptors used for the analysis is available in Table 8.

One of the characteristics explored was who do teachers collaborate with during their professional learning (Table 9). This varied between those at different levels of competency. For those engaging with learning at the level of knowledge awareness collaboration was within their own organisation or international – note many of the international research was around Massive Open Online Courses (MOOCs) and so this may have been

international collaboration driven by individual’s interest. In addition, this cohort engaged in more individual learning. In comparison those at the knowledge deepening level of proficiency engaged in more collaborative professional learning across their own organisations, locally or nationally. Finally, those engaging in the leadership proficiency level were more likely to engage in professional learning nationally, with students, industry and other external partners. This aligns to research that highlights those with a greater social network are more likely to innovate (Kim et al., 2021; Cangialosi et al., 2023; Konstantinidou et al., 2022).

Table 8 - Descriptors of criteria for knowledge awareness, deepening and leadership.

Proficiency level	Description
Knowledge awareness	Awareness of the pedagogical and professional potential of digital learning technologies
Knowledge deepening	Engage in critical discourse with stakeholders regarding the selection and application of digital learning. They will discuss with peers, students and other stakeholders about their experiences with digital learning to date, and adapt their practice based dialog and reflection
Leadership	Collaborate with organizations at national and international levels both in education and beyond to develop novel pedagogical and professional practices within education within whole organisations (schools or educational institutes) and across the sector.

Table 9 - Professional learning collaboration by level.

Type of collaboration	Knowledge awareness	Knowledge Deepening	Leadership
Cross org industry partner; Uni Partner	2%	1%	0%
Cross org local	10%	22%	20%
Cross org national	16%	17%	28%
Cross org national; Industry partner	0%	0%	4%
Cross org national; Student	0%	0%	8%
Cross org National; NI partner	0%	4%	4%
Cross sector	2%	1%	0%
Individual	11%	4%	0%
International	23%	9%	8%
Interprofessional	0%	3%	0%
Within own org	36%	37%	24%
Within own org; Student	0%	1%	4%

The average duration of professional learning across all levels was 11.6 months. When broken into the levels of proficiency, those at the more advanced leadership levels had a longer duration and sustained professional learning experience (Figure 7). Within leadership levels professional learning averages at 19 months compared to an average of 6 months at knowledge awareness levels. This aligns to existing research that advocates for sustained long term professional learning models, as often change happens over time rather than in a transformational manner (Prestridge, 2017; Nespore, 1987, Darling-Hammond, Hyler & Gardner, 2017; Becker & Reil, 2000).

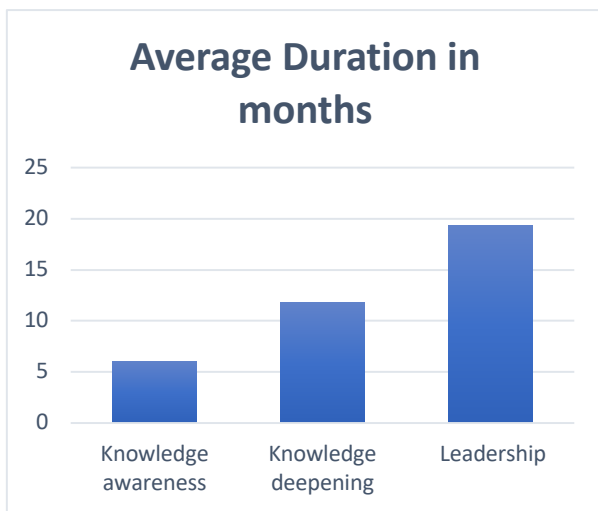


Figure 7 - Average duration of professional learning by level (in months).

The average duration of pre-service training was 6 months. Most professional learning for pre-service teachers is in the form of Initial teacher education within a university course and so often digital learning is 3-month modules. Of the 33 pre-service studies 25 of these were three months or less.

Furthermore, the characteristics or types of learning activities individuals engage with at levels of professional learning varies. Those at the higher levels

of proficiency engaged in a larger number of activities in their professional learning; those at the knowledge awareness level engaged in an average of 3.22 activities, knowledge deepening an average of 4.53 and leadership 5.07 activities.

In addition, there was a broader range of learning activities in the deepening level of proficiency compared to the awareness and leadership levels. For Deepening the activities ranged across 39 different types compared to 28 at knowledge awareness and 34 at leadership.

The type of activities had some similarity with formal and reflective based activities being widely used across all three levels of proficiency. Innovation and co design activities were more prevalent at knowledge deepening and leadership levels. With dissemination, piloting, leading professional learning and modelling activities being adopted mainly at leadership levels. This indicates as levels of proficiency increase so does collaboration networks and outward dissemination and knowledge sharing.

Furthermore, it must be noted that there was no specific sequence for these activities, some started with formal learning others initiated professional learning through reflection or collaboration. Bolstering the need for non-linear professional learning activities.

On review of the qualitative comments regarding each study a thematic analysis was conducted (Figure 8). The main impacts of the professional learning were adaptations to practice (36), application to practice (11), increase in self-efficacy (17), understanding the complexity of technology and learning (8), sharing (6). In some instances, it was noted the impact was different depending on the beliefs or broader contextual factors of those engaging in the professional learning indicating that professional learning impact is nuanced and complex (Sansom, 2020).

For much of the formal learning it took place in dedicated blocks either during summertime, weekends or dedicated periods that released educators. Furthermore, professional learning was routine and regular, even though formal learning was in dedicated blocks other activities such as discussion, meetings, reflection took place weekly or monthly. For all levels

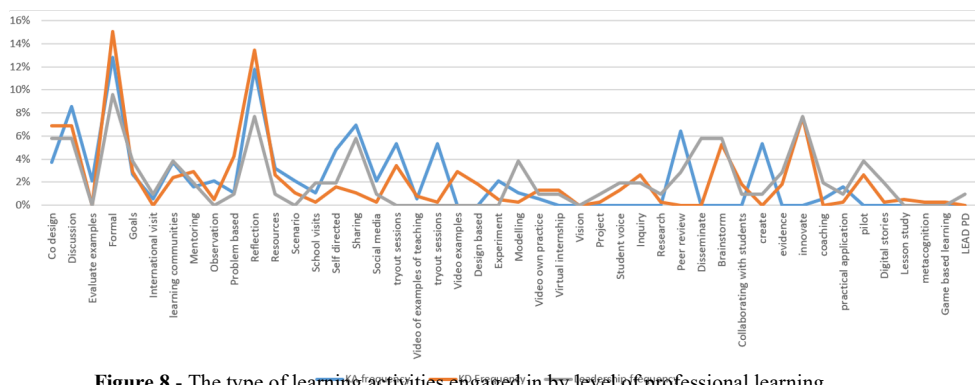


Figure 8 - The type of learning activities engaged in by level of professional learning.

of proficiency participants engaged in several activities. These were mostly prescribed however in some cases participants had a choice of activities they wanted to engage in. This enhanced agency and autonomy, key to this was balancing autonomy and structure as often choice can lead to an additional cognitive load and decision for participants who are already overwhelmed. Critical to this was goal setting or creating a vision for both individual participants and the communities for which they are part of this should be aligned to the digital learning goals of the educational organisation of which they are part of to ensure harmony and consistency as well as opportunities to apply learning in practice (Hubers et al., 2022; Fullan, 2016).

4. Discussion

From the review it is evident that the elements of professional learning that support educational professionals to facilitate digital transformation and change requires sustained, varied activities (that support innovation to practice, dissemination and collaboration with a variety of individuals). Professional learning that was regular and had clear goals supported educators to progress to higher levels of proficiency and change practice. This correlates to findings associated with existing SLRs that explored challenges associated with educational change and transformation, these highlight importance of clear goals and professional learning to support change. (McLure & Aldrige, 2022; Yuliandari et al., 2023). Furthermore, SLRs that have considered the impact of professional learning on students found that frequent CPD over a sustained period had the most impact on students learning. However, this was largely focused on work-based learning and CPD (Ventista & Brown, 2023).

This research provides additional insight to complement such research by exploring the types of professional learning activities that can support educational change. It found that there are few studies to date that illustrate how professional learning can support leadership levels of proficiency around change. Also, many papers lacked theoretical underpinnings which capture the complexity associated with supporting change. However, the limitations of the SLR must be acknowledged, the review was conducted by an individual researcher as part of a wider project, due to time commitments it did not exploit reliability measures such as inter-reviewer reliability and so may be subject to bias, particularly regarding the interpretation of the proficiency level element of the data extraction phase. Although extraction criteria were applied there is potential for bias regarding interpretation of these.

Based on the findings it is recommended that professional learning supports teachers across a continuum of change, it encourages them to engage in incremental continuous change that is supported over time. Critical is dialog at various levels, it can be seen

from the study that collaboration at various levels individual, organizational, cross organizational and interdisciplinary is required. The types of learning activities that support change in the study are indicative of this and requires a variety of professional learning activities that provide support for dialog and experimentation including openness about negative experiences and the wider environment that might influence different outcomes associated with change.

This research aimed to depict the trajectory of the professional learning journal in terms of change and what elements of successful elements of professional learning are conducive to leadership and change in a digital context. It is evident that professional learning needs to relate to an overall goal or vision for an individual, school and educational system, that needs to be negotiated at each of these levels. Policy needs to recognise that professional learning (PL) is multilevel and needs to balance the needs of the individual teacher with that of the school and overall educational change within the system, articulating a long-term vision and the role of PL in supporting the attainment of this is key. A sustained approach to PL that encourages a variety of learning approaches to encourage teachers to experiment in a safe space is critical to change and supporting transformation in a digital context. It is also evident from the review that educational research with regard the use of professional learning to support change is largely qualitative, and lacks experimental data, in our review only one experimental study was found. There were several quantitative studies however many of these were based on self-assessment questionnaires regarding the professional learning. Further experimental studies that compare different professional learning characteristics and their impact on practice is critical.

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Mentoring and networking for innovation in the school ecosystem: from enabling conditions to *MentorQ* Self – Evaluation Tool

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Abstract

This study explores the potential of mentoring as a key lever for fostering innovation and systemic improvement in education, focusing on school-to-school mentoring models and the enabling factors that influence their sustainability and effectiveness. Using a mixed-methods approach combining exploratory and confirmatory research, the study identifies ten key enabling factors essential for the success of mentoring practices. These include shared objectives, the comparison of practices, access to resources, and the enhancement of professional skills among stakeholders. Special emphasis is placed on the “hub-and-spoke” model, which has demonstrated effectiveness in promoting collaboration and disseminating innovative practices while adapting to local contexts. Based on the findings, a self-assessment tool, *MentorQ*, has been developed to support schools in systematically evaluating their mentoring practices, identifying areas for improvement, and strengthening their processes. *MentorQ* will be piloted within INDIRE’s innovation networks, such as *Avanguardie Educative* and *Piccole Scuole*, enabling the evaluation of its adaptability across both standardized and non-standardized educational environments. The results underscore the importance of investing in professional development, fostering a collaborative culture, and enhancing the capacity of schools to engage in effective mentoring practices. Future research will focus on validating *MentorQ* in diverse contexts and further developing a mentoring toolkit, including operational resources and case studies. This work contributes to building sustainable and inclusive mentoring networks, offering concrete tools and insights for driving continuous improvement and innovation in education.

KEYWORDS: Mentoring, Innovation, School-to-School Collaboration, Mentoring Enabling Factors, Self-Assessment Tool, Educational Improvement.

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1. Mentoring in the Context of School Ecosystem Innovation

In recent years, the concept of the school as an ecosystem has gained significant relevance in educational research, emphasizing the interdependence among actors, institutions, and contexts that contribute to learning and development (Bronfenbrenner, 1979; Fullan 2001; Mangione et al. 2024). Within this perspective, the school is no longer seen as an isolated

entity but as an integral part of a broader system interconnected through networks of collaboration and continuous exchange. These school ecosystems are dynamic environments where the synergy among institutions, teachers, students, and local communities forms the foundation for addressing contemporary educational challenges, such as digital and pedagogical innovation (OECD, 2015, 2017).

The concept of the networked ecosystem, promoted by the OECD, further extends this vision by emphasizing a fluid connection among schools, universities, local authorities, and other educational organizations. Educational networks foster the sharing of resources, knowledge, and experiences, acting as catalysts for systemic change. Unlike traditional hierarchical models, educational networks promote greater autonomy and responsibility among their members, creating spaces for shared reflection and experimentation that transcend institutional and territorial boundaries (Hargreaves & Fullan, 2015; Nardi et al., 2024; Mangione et al., 2024).

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Additionally, these networks provide a platform for addressing common challenges, such as inclusion, diversification of pedagogical practices, and the transition to more integrated digital teaching (OECD, 2017).

Within this framework, *school mentoring*, particularly in networked settings, emerges as a crucial tool for facilitating innovation and continuous improvement (Chapman & Muijs, 2014; Muijs et al., 2010; Rossi et al., 2024; Mangione et al. 2024). Defined as a structured process of mutual support and learning, school mentoring involves institutions with advanced expertise in specific practices guiding other schools in adopting innovative strategies and overcoming organizational and pedagogical challenges (Hargreaves & O'Connor, 2018).

The mentoring approach can be particularly effective in fostering change at multiple levels of ecosystem (Ainscow et al., 2019; OECD, 2017).

Micro level: At the individual school level, mentoring provides direct support to teachers and school leaders, assisting them in implementing innovative practices. Recent studies highlight how inter school collaboration strengthens schools' adaptability to local and global challenges, fostering more personalized and inclusive learning. For instance, schools that have already integrated digital technologies can support others in adopting similar tools by sharing practical models and solutions to common obstacles.

Meso level: At the network or cluster level, mentoring facilitates the dissemination of knowledge and best practices, creating genuine professional learning communities. This approach helps to mitigate the isolation experienced by some schools, promoting the sharing of resources, experiences, and innovative strategies. School networks supported by mentoring processes have been identified as key drivers for developing collective capacities and distributing leadership. In transnational contexts, such networks have demonstrated their ability to enhance coherence and quality within educational systems by exchanging effective practices across diverse schools.

Macro level: At the systemic level, school mentoring contributes to building a systemic learning infrastructure, aligning educational policies, school practices, and local needs more effectively. This approach accelerates the adoption of large-scale reforms while maintaining attention to the specific contexts of individual schools. Moreover, mentoring acts as a bridge between central policy guidelines and the operational realities of schools, ensuring that reforms are implemented effectively and sustainably. International studies, such as those conducted by UNESCO (2021), highlight that well-structured mentoring programs can contribute to building more resilient, equitable, and inclusive educational systems.

Several school mentoring models have been developed to address the needs of different educational contexts and systems. These approaches reflect diverse strategies

to promote resource sharing, collaborative learning, and continuous improvement. As example:

“RECIPROCAL EXCHANGE” MODEL. This model emphasizes equitable exchange between schools with similar contexts and characteristics. Each school acts as both mentor and mentee, fostering a collaborative dynamic based on mutual trust and shared objectives. It is particularly effective in enhancing teaching quality and adopting new technologies through direct comparison and the transfer of practical experiences (Johnson & Alamaa, 2012).

“HUB-AND-SPOKE” MODEL. In this approach, a central school (hub) serves as a guide for other schools (spokes), providing support through resources, training, and tools for adopting innovative practices. Successfully implemented in the Teaching School Hubs Programme in the United Kingdom (Roberts, 2023) and in the Mensi European Project (Rossi et al., 2024; Mangione, 2024) this model is particularly effective for disseminating large-scale strategies while requiring structured coordination and strong leadership.

“CASCADE” MODEL. The cascade model involves a school, after acquiring specific competencies through mentoring or training programs, transferring this knowledge to other schools within the network. Used in international initiatives (Turner et al., 2017), this model allows for a broader reach to more schools but requires rigorous monitoring to maintain the quality and consistency of the transmitted information.

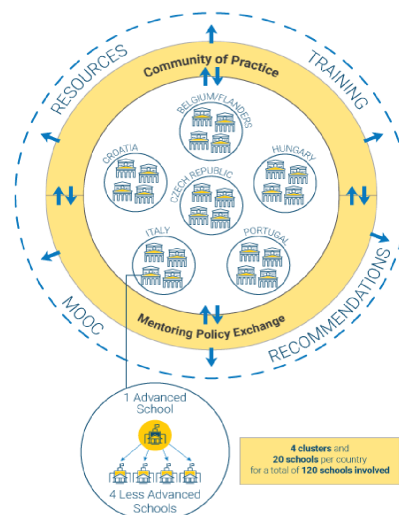


Figure 1 - Hub-and-Spoke Model implemented in the Mensi Project (Rossi et al., 2024; Mangione, 2024).

These models, despite their diversity, share the goal of promoting systemic improvement through the strengthening of educational networks. However, their effectiveness depends on specific enabling conditions, which vary according to the contexts and stakeholders involved.

2. The European experience and the Italian model

The MenSI (Mentoring for School Improvement) project, funded by the European Union's Horizon 2020 program, represents a comprehensive exploration of whole school mentoring models designed to foster innovation across European primary and secondary schools. This initiative, carried out between 2020 and 2023, sought to establish frameworks that enable the dissemination of effective teaching practices, support professional development, and create a sustainable foundation for educational progress. By engaging 24 Mentor schools and 96 Mentee schools in six European countries, the project highlighted both the potential and the challenges of implementing school-to-school mentoring models in diverse contexts (CUREE, 2005; Camberwell, 2016; Armstrong, Brown & Chapman, 2020).

Mentoring between schools is conceptualized as a collaborative process in which more experienced or resource-rich institutions support others in improving teaching methodologies and organizational practices. This structured relationship is built on mutual commitment and is facilitated through direct support, training, reciprocal observation, and feedback. The MenSI project identified three primary mentoring models (Panzavolta, Garner & Nencioni, 2022). The top-down model, often directed by central institutions such as ministries or national educational organizations, emphasizes a common scientific and technological framework while offering tools and strategies for both Mentors and Mentees. In contrast, the bottom-up model allows schools greater autonomy, with strategies derived from experiential knowledge rather than shared scientific validation. The mixed model, combining aspects of both approaches, seeks to balance the benefits of structured oversight with localized adaptability. One of the critical strengths of mentoring, as highlighted in the project, is its role in spreading innovative practices and solutions, enabling transformative professional development. It differs from networking, which fosters horizontal connections between institutions for shared learning and resource optimization. While networking emphasizes collaboration among peers or nodes, mentoring involves an asymmetrical relationship focused on specific developmental goals. This distinction is pivotal, especially when addressing significant transitions, such as integrating new teaching methodologies or managing institutional changes (Granovetter, 1998). The research underpinning MenSI employed a mixed-methods approach (Creswell, 2003), combining quantitative and qualitative analyses to evaluate the project's impact. Key tools included pre- and post-intervention surveys to measure digital maturity (e-maturity) - such as the SELFIE questionnaire (Kampylis, Punie & Devine, 2015; Costa, Castano-Munoz & Kampylis, 2021) - and interviews conducted in Mentor schools across participating countries. The findings confirmed the importance of

robust leadership, clear role delineation, shared responsibility, and a supportive environment as foundational elements for successful mentoring. MenSI's findings resonate with broader discussions on educational innovation and its scalability. While micro-level innovations often proliferate within individual schools, scaling these practices to the meso (organizational) and macro (national) levels remains complex. The structured mentoring approach of MenSI provides a potential solution, enabling a gradual transition from mentoring to peer learning and, eventually, networking. This evolution fosters a culture of shared expertise, where Mentee schools can transition into mentoring roles, creating a sustainable, fractal-like structure for educational improvement. Therefore, the MenSI project highlights the transformative potential of school-to-school mentoring in promoting systemic change (Murray, Caulier-Grice & Mulgan, 2006). By bridging the gap between local adaptation and centralized oversight, it offers a model that balances flexibility with structure, enabling schools to address unique challenges while contributing to broader educational goals. However, its success depends on sustained investment in professional development, the cultivation of collaborative cultures, and ongoing research to refine and optimize mentoring methodologies and deal with national and local models that fit in the specific education system (Harris, 2008). Despite the logistical challenges posed by the COVID-19 pandemic, which necessitated a shift to online interactions, the project successfully demonstrated the adaptability of mentoring frameworks. The use of digital platforms for documentation and feedback, such as the "cluster diaries", proved instrumental in sustaining engagement and fostering professional growth among participants. However, the absence of in-person interactions during much of the project was perceived as a limitation, underscoring the importance of face-to-face exchanges in building trust and facilitating deeper collaboration.

The Italian school-to-school mentoring model, as piloted in the context of the MenSI project, is deeply rooted in Italy's longstanding tradition of networking and innovative practices, exemplified by national communities of innovative schools, such as *Avanguardie Educative* (Laici et al., 2015) and *Piccole Scuole* (Mangione & Cannella, 2018). It emphasizes the importance of structured, reciprocal relationships between schools to address challenges, share expertise, and implement effective strategies tailored to diverse educational contexts. In particular, Italy has experimented with forms of school mentoring inspired by the 'hub and spoke' model, where a central school (hub) acts as a guide and support for other schools (spokes), fostering the sharing of resources and innovative strategies. One of the key features of the Italian mentoring model is its reliance on a structured framework to guide the collaboration between Mentor and Mentee schools. The framework, inspired by the Deming Cycle (Plan-Do-Check-Act) of continuous

improvement (Deming, 1986), divides the academic year into distinct phases: planning, implementation, reflection, and adjustment. During the planning phase, schools worked together to identify shared goals and challenges, developing an action plan that reflects their unique needs and priorities. The implementation phase involves the enactment of these plans through classroom activities, workshops, and collaborative initiatives, all of which are supported by Mentor schools' expertise. Reflection and adjustment phases enable schools to analyze their progress, evaluate the effectiveness of their strategies, and refine their practices based on observed outcomes and feedback (Panzavolta & Cannella, 2024). The Italian model stands out for its focus on thematic clusters, which allow schools to concentrate their efforts on specific areas of innovation. These clusters are often aligned with national priorities in education, such as the integration of digital technologies, innovative methodologies - such as outdoor education (Giunti, Orlandini & Panzavolta, 2022) and the one based on Making Learning and Thinking Visible (MLTV) (Mughini & Panzavolta, 2020). For example, outdoor education initiatives encourage schools to engage students in learning experiences outside traditional classroom settings, fostering creativity, critical thinking, and environmental awareness. Similarly, digital content creation initiatives empower teachers and students to explore new tools and platforms for collaborative learning. These thematic focuses enable the mentoring process to remain both relevant and adaptable to the evolving needs of the Italian educational system. A defining aspect of the Italian mentoring approach is its emphasis on professional development. Mentor schools not only provide direct support to Mentee schools but also engage in their own continuous learning processes. This reciprocal relationship ensures that both Mentors and Mentees benefit from the collaboration. Training sessions, often facilitated by researchers, helped educators from both types of schools refine their practices and adapt innovative methodologies to their local contexts (Panzavolta & Cannella, 2024). For instance, professional development opportunities related to MLTV have proven particularly effective in promoting critical reflection and collaborative problem-solving among educators. The Italian model also highlights the role of leadership in successful mentoring. Effective leadership is essential for establishing clear goals, fostering a culture of collaboration, and ensuring accountability within the mentoring process. School leaders play a crucial role in facilitating communication between Mentor and Mentee schools, mobilizing resources, and creating an environment conducive to innovation. In the Italian context, school principals often act as catalysts for change, leveraging their strategic vision to drive the implementation of innovative practices and foster a shared sense of purpose among teachers and students. Despite its successes, the Italian school-to-school mentoring model faced challenges, particularly in terms of scalability and sustainability. The diversity of Italy's educational landscape, which

includes schools from urban, rural, and remote areas, and a strong school autonomy legislation allowing the designing the educational offer necessitates highly tailored approaches that can address specific local needs. Additionally, resource constraints and regulatory barriers sometimes hinder the full realization of mentoring initiatives. For example, the COVID-19 pandemic posed significant obstacles to in-person collaboration, as in all the partners' countries, requiring schools to share their practices only in digital platforms. Other structural barriers were also in place, such as the absence of experience-based professional progression in the teachers' career, while in other EU countries this is foreseen (the senior teacher is a job position). The mentoring tools that were piloted in the Italian model proved to be very useful and very much appreciated (Panzavolta & Cannella, 2024). This is one of the reasons that pushed the Indire researchers to invest in a Mentoring Toolkit, including a Mentoring Self-evaluation system (called MentorQ) against which schools can measure their progress as for mentoring practices. The tool is presented in Paragraph 6. Ultimately, the Italian school-to-school mentoring model offers valuable insights into how structured collaboration can drive educational improvement. By leveraging the strengths of Mentor schools and fostering reciprocal relationships, this approach enables the dissemination of innovative practices and the development of professional communities. As the MenSI project illustrates, the success of this model depends on a combination of strategic planning, thematic focus, professional development, and strong leadership. These elements work together to create a dynamic framework that not only addresses immediate educational challenges but also lays the foundation for sustainable, system-wide improvement.

3. Research question and methodologies

3.1 The research question

The construction of the research question is a critical step in any empirical investigation, as it guides the entire study process and ensures methodological coherence.

In this case, the formulation of the question resulted from a systematic review of the literature that highlights the importance of certain "enabling factors" that contribute to the sustainability and effectiveness of these mentoring models. However, there is also a lack of empirical studies that systematically validate these factors and investigate their applicability in various contexts. The long-term sustainability of mentoring networks is another area where studies are limited. While many studies focus on the initial stages of building networks, few examine how these networks can be maintained over time and what mechanisms are necessary to ensure continuity in mentoring. Leithwood et al. (2020) note that many school networks disband once initial funding or support is exhausted, suggesting

that the lack of sustainability strategies represents a significant challenge for mentoring networking.

The hub-and-spoke model, observed in Mensi Project and in Italian school clusters, in which a hub school assumes a guiding role for a cluster of less advanced schools (spokes), was chosen as a reference framework to explore the conditions that ensure its sustainability. The definition of the research question followed two main directions. The first concerned the need to identify the structural, relational, and organizational factors that make school mentoring an effective and sustainable process. The second focused on exploring these factors within school clusters, contextualizing them within diverse and real educational systems.

This process led to the formulation of the study's central question: under what conditions is school mentoring sustainable, particularly within the hub-and-spoke model implemented by Italian schools?

This question reflects the intent to investigate not only the outcomes of mentoring practices but also the mechanisms and dynamics that enable their effective and replicable application in heterogeneous educational contexts.

3.2 Research Methodologies and Instruments

To address this question, an empirical methodological design was adopted, structured in two main phases: an exploratory study and a confirmatory study. This approach aligns with established principles of educational research, which emphasize the value of exploratory inquiries to generate preliminary knowledge on complex and understudied phenomena (Cresswell, 2007) and confirmatory studies to consolidate and generalize such knowledge on a larger scale (Cohen, Manion & Morrison, 2017).

3.2.1 Exploratory Research

The exploratory research phase was essential for gaining an initial understanding of the dynamics that characterize school mentoring. As highlighted by Stake (1995) and Ponce & Pagán-Maldonado (2015), this type of inquiry is particularly well-suited to capturing the complexity of educational phenomena in real-world contexts, providing an empirical basis for subsequent investigations.

In this study, the exploratory phase involved six schools, one from each country participating in the MenSI project. The selection of a small yet representative sample allowed for an exploration of diverse educational practices and the identification of common elements and specificities related to the hub-and-spoke model. The primary objective was to understand how relational and organizational dynamics contribute to the sustainability of mentoring.

A mixed-methods approach was employed to collect data, integrating both quantitative and qualitative tools. The initial questionnaire, consisting of 40 items, was

administered to teachers and school leaders, exploring four main areas: whole-school experiences, teacher experiences, student experiences, and the role of tutoring. Additionally, semi-structured interviews were conducted with 63 participants (11 mentors and 52 mentees), providing detailed qualitative insights into perceptions and practices related to mentoring. Field observations, conducted both face-to-face and virtually, complemented the data collection, enabling direct analysis of interactions between mentors and mentees.

A significant contribution came from the Cluster Diaries, compiled by 19 advanced schools (mentors) and 82 less advanced schools (mentees). These narrative diaries documented challenges, reflections, and best practices, offering a rich perspective on the internal dynamics of the school clusters. The data collected were analyzed using thematic analysis, supported by the Nvivo software, which facilitated systematic coding and the identification of significant patterns.

Confirmatory Research

The confirmatory research represented the second phase of the methodological design, aimed at validating the results of the exploratory research within the Italian context (Jaeger & Halliday, 1998; Foster, 2024). Specifically, the questionnaire used in the confirmatory phase was developed based on the 10 enabling factors identified during the exploratory research. This approach ensured methodological consistency between the two phases and allowed for a deeper investigation into the validity and relevance of the identified factors across broader contexts.

This study, inspired by the descriptive and evaluative empirical model (Trincherò, 2002), sought to analyze the applicability and significance of the enabling factors in a larger and more specific sample. It focused on examining potential differences between mentor and mentee schools, across school levels, and among the various regional clusters.

The sample consisted of 18 schools, organized into four clusters, each led by a hub school. Data collection was conducted through a questionnaire, administered to 158 teachers and 18 school leaders, with 81 respondents (16 from mentor schools, and 65 from mentee schools). A questionnaire asked participants to rank the 10 enabling factors on a priority scale from 1 to 10. Additionally, participants could propose new factors or suggest modifications to the existing ones, enabling a critical and participatory analysis. The data collected were analyzed both quantitatively, to identify significant trends, and qualitatively, to deepen the understanding of the dynamics influencing the sustainability of mentoring. This approach validated the findings from the exploratory research, adapting them to the Italian context and providing practical insights for improving school mentoring networks.

In the following sections, the results of the two research phases and their discussions will be presented, with the

aim of supporting the development of a reflection tool for schools to evaluate their positioning concerning the identified enabling factors.

4. What the Exploratory Research Tell Us?

4.1 Context and Results

The identification of “enabling factors” for mentoring between school clusters was achieved through a comprehensive data analysis conducted across three levels of the educational ecosystem targeted by the intervention: the individual school level, the cluster level, and the national education system level. Emphasis was placed on gathering narrative evidence for this project, highlighting the articulated thoughts and reflections of participating school staff as a credible representation of the concept of “teachers talking to teachers”. This approach underscores the essence of a collaborative, peer-focused professional learning community. To preserve the authenticity of the real-world impact of the project, we deliberately avoided representing these interactions in the form of metrics or quantifications, which might obscure the depth of the qualitative insights. Instead, Figure 2 provides an abbreviated summary of data derived from transcript analyses of narrative evidence collected from various sources. This summary underscores the relative priority assigned to each enabling factor across the school clusters involved in the project. Ten principal enabling factors were identified for each level of analysis. Below, we present the results obtained specifically at the cluster level. The analysis identified ten enabling factors that were crucial for the success of ICT mentoring within school clusters. Below, each factor is discussed in detail, with its significance contextualized through narrative evidence and frequency data.

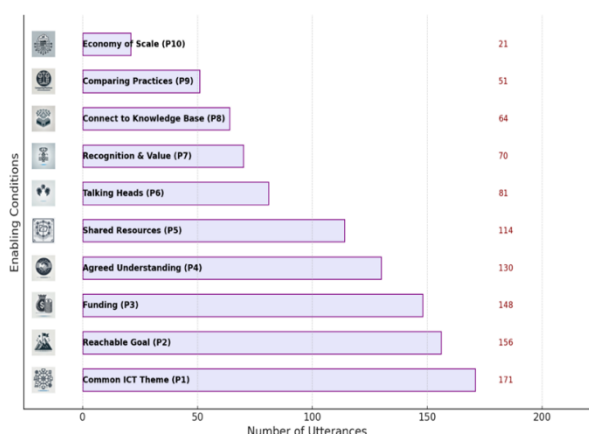


Figure 2 - Mentoring networking enabling conditions and priority.

Common ICT Theme. The most frequently cited enabling factor, with 171 utterances across the dataset, was the establishment of a common ICT theme. Teachers working collaboratively on a shared, well-

defined issue reported a heightened sense of investment and purpose. This shared focus strengthened the critical mass of collaborative activities, transitioning from the mere exchange of practices to the co-development of innovative ICT solutions (Ravhuhali, Kutame & Mutshaeni, 2015). Mentor schools led the way by embedding ICT themes into their curricula and pedagogy, offering mentee schools clear models to emulate.

Reachable Goals. With 156 utterances highlighting its importance, the adoption of goal-oriented approaches was pivotal to the success of cluster activities. Goals were tailored to reflect the unique contexts and constraints of each school while considering individual teacher motivations. This alignment not only facilitated engagement but also fostered collaboration over competition. Teachers noted that clearly defined and achievable goals gave them confidence to experiment with ICT, creating a pathway for sustained progress (Zwart et al., 2008; Louws et al., 2017).

Funding. Funding emerged as a vital enabler, referenced in 148 utterances. Financial resources provided by mentor schools played a key role in supporting mentee schools, particularly in rural or economically disadvantaged areas. Teachers and leaders emphasized that access to updated ICT equipment and professional development opportunities, made possible through targeted funding, was instrumental in driving digital transformation within their schools.

Agreed Understanding. The importance of shared protocols and a clear understanding of collaboration principles was noted in 130 utterances. These protocols ensured consistency and equity within the clusters, creating a structured framework for mentoring. The “flip the system” approach (Evers & Kneybar, 2016) underpinned these efforts, allowing schools to address systemic inequalities and build sustainable collaboration models.

Shared Resources. Resource sharing was highlighted in 114 utterances as a core practice within the clusters. Mentor schools provided open access to ICT toolkits, materials, and solutions that mentee schools could adapt to their specific needs. Teachers noted that this approach was particularly impactful in overcoming resource limitations in remote and rural schools, fostering innovation through collective efforts (Kurelovic, 2016).

Talking Heads. Professional dialogue and mutual engagement were emphasized in 81 utterances as key components of successful mentoring. Mentor schools created environments that encouraged open communication, trust, and active participation from all stakeholders. This collaborative atmosphere fostered a sense of shared responsibility and empowerment, enabling teachers to learn from one another effectively (Bolam et al., 2005).

Recognition and Value. With 70 utterances reflecting its significance, recognition emerged as a motivating factor for teachers. Mentor schools introduced certificates of participation and completion to acknowledge

contributions, alongside informal recognition practices such as social events and feedback sessions. Teachers reported that these measures reinforced their commitment to cluster activities and strengthened their sense of belonging.

Connect to Knowledge Base. Clusters provided a critical mass of collective knowledge, referenced in 64 utterances, that helped teachers overcome barriers to professional growth, such as the Dunning-Kruger effect (Dunning, 2011). This shared knowledge base enabled teachers to reflect on their practices and access a wealth of expertise, fostering growth and innovation across the cluster.

Comparing Practices. The opportunity to compare teaching practices and curricula across diverse cultural and educational contexts was highlighted in 51 utterances. These comparisons enriched professional development by exposing teachers to new approaches and insights, often facilitated through EU-funded initiatives. Participants noted that this exchange of practices inspired them to adapt and refine their own teaching methods.

Economy of Scale. While referenced less frequently, with 21 utterances, the concept of economies of scale addressed the financial challenges faced by smaller schools. Clusters leveraged shared resources, such as equipment loans and collaborative training sessions, to optimize costs and ensure equitable access to ICT tools and strategies. Teachers in smaller schools noted that these practices enabled them to participate in digital initiatives that would otherwise have been out of reach.

4.2 Discussion and limits

The exploratory study provides valuable initial insights into the enabling factors for mentoring within school clusters, particularly in the context of the hub-and-spoke model implemented at international level. This phase was instrumental in identifying the elements that contribute to the sustainability of mentoring processes (Figure 3).



Figure 3 - Icons for mentoring enabling conditions.

However, it is essential to consider the methodological and contextual limitations of this initial exploration.

The exploratory study involved a small sample of six schools, one from each participating country, which, while diverse, is not sufficient to capture the full variability and nuances of educational systems. The contexts in which mentoring emerged as effective may

have been shaped by several key factors, such as the characteristics of the national education systems, the schools' prior experience with networking and collaboration, their orientation toward innovation through networks, and the presence or absence of institutional support for such practices. These elements emphasize the need to interpret the findings as situated within specific environments rather than as universally applicable conclusions.

Moreover, the exploratory nature of the study prioritized hypothesis generation over hypothesis testing. While this approach effectively uncovered initial patterns and relationships, it does not provide the depth or breadth required for robust validation or generalization of the findings. The identified enabling factors, while promising, are intrinsically linked to the particular contexts and interactions observed during the study.

These limitations highlight the importance of conducting further confirmatory research to rigorously test and refine the identified factors in a variety of educational settings. This subsequent phase would enable a deeper understanding of how systemic, cultural, and organizational differences influence the effectiveness and sustainability of ICT mentoring practices. Only through such contextualized validation can the findings be adapted to inform broader and more robust applications in diverse educational systems.

5. Confirmatory research in the Italian context

5.1 Context and results

In particular, the study aims to answer three key questions:

1. Are some factors more important in the Italian context than in the international one?
2. Are there significant differences in the perception of “enablers” between different school levels or between schools with different roles, such as Mentor and Mentee schools?
3. Do the specificities of different school contexts influence the importance attributed to the different enabling factors?

The “Mentoring ICT Survey” questionnaire was developed to collect empirical data on the perceptions and experiences of schools participating in the project, with particular attention to the priority scale attributed to key factors for mentoring success. The instrument is divided into different sections, each of which contributes to a detailed and contextualized analysis.

1. *Basic information on participants and schools.* The first section of the questionnaire collects basic data on respondents (e.g. role, experience, position) and the schools they belong to. This information allows us to correlate participants' perceptions with specific institutional characteristics and to understand any differences between school roles,

- such as managers, teachers or technical staff, as well as between types of schools.
2. *Adoption of the Deming cycle in schools.* A section of the questionnaire explores the application of the Deming cycle (Plan-Do-Check-Act) (Deming, 1986) in school processes. The cycle is analyzed as a potential tool for continuous improvement, with the aim of verifying its degree of adoption and the perception of effectiveness in Italian school contexts.
 3. *Prioritization of mentoring enablers.* The central part of the questionnaire focuses on the analysis of mentoring enablers, at two levels: cluster and individual school. Participants are asked to rank ten key enablers using a priority scale from 1 (highest priority) to 10 (lowest priority). This section provides an overview of participants' perceptions of the elements deemed most crucial for mentoring success, both at network and institutional levels. Additionally, participants have the opportunity to propose an alternative enabler, evaluating its importance in relation to those already identified. They are also asked to indicate which enablers they would eliminate to make room for the new proposal, thus contributing to a process of reviewing and customizing the mentoring model.
 4. *Willingness to participate in further research activities.* The last section of the questionnaire investigates the willingness of participants to continue their involvement in the project, through further research and in-depth study activities.

In this contribution, we specifically focus on the analysis of the results related to the enabling factors identified at the cluster level. Through the classification of priorities and the analysis of the perceptions emerged from the participants, the study aims to highlight the dynamics and specificities of online mentoring, while providing useful indications for the improvement and implementation of mentoring practices in different Italian school contexts.

The questionnaire was administered to a total sample of 176 participants, including 158 teachers and 18 school principals. Of the 81 actual respondents, 16 came from Mentor schools and 65 from Mentee schools. In terms of school level, 53.1% of respondents belonged to secondary schools, while 46.9% belonged to primary schools. In terms of geographical distribution, respondents were divided into the following regional clusters: Emilia-Romagna (13.6%), Sicily (33.3%), Campania (24.7%), and Puglia-Lazio-Sardinia (28.4%).

The collected data were analyzed through descriptive statistical techniques, with the aim of identifying the priorities perceived by the participants regarding the enabling factors for the success of school-to-school mentoring. The percentages reported represent the sum of the preferences attributed by the respondents as first, second and third choice for each enabling factor, thus providing a detailed overview of the perceptions that emerged. While the international survey highlighted

how the most relevant factors for the success of mentoring are a common theme, achievable objectives and access to resources, in the Italian context school mentoring was configured around three main enabling factors (Figure 4):

1. comparison of practices (15.8%);
2. willingness to learn from others (15.4%);
3. active learning (12.9%).

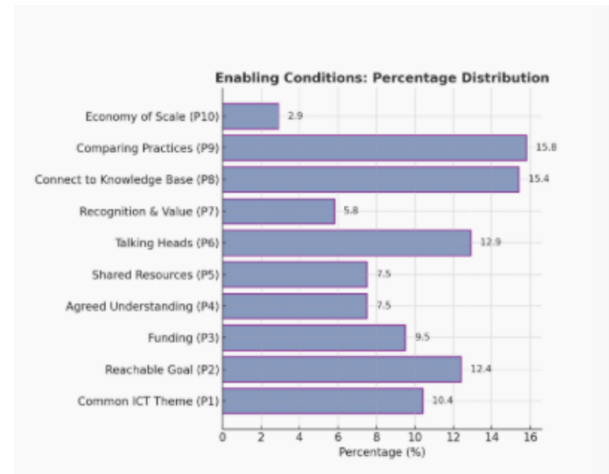


Figure 4 - Cluster level: Enabling Factors in the Italian Context.

These results reflect the cultural and pedagogical peculiarities of the Italian educational system. In Italy, the comparison of practices represents a key opportunity for schools to share experiences and teaching methodologies. By comparing with different contexts, schools can identify innovative solutions and adapt them to their specificities. The willingness to learn from others is a factor rooted in a collaborative culture. This factor enhances the contribution of each member of the school community, fostering mutual growth and greater cohesion among schools in the network. Finally, active learning, i.e. the direct participation of teachers in mentoring activities promotes an experiential approach, stimulating the adoption of innovative and interactive practices that can be integrated into everyday teaching. These enablers not only support the success of mentoring between schools but also contribute to creating a more equitable and flexible educational system, in which innovations can be shared and adapted to the needs of different school contexts.

The analysis of the data at the cluster level shows that, although there are some common enabling factors between the first and second cycles, such as comparison of practices and achievable goals, there are also significant differences. In the first cycle, in addition to comparison of practices (16.7%), there is a greater emphasis on active learning (15.8%) and willingness to learn from others (15.8%). In the second cycle, greater priority is given to access to the knowledge base (9.1%), sharing of resources (10.6%), and recognition and valorization of individual participants (8.3%).

The analysis of enabling factors for mentoring at cluster level reveals key differences between mentor and mentee schools. Both categories recognize the importance of comparing practices and the willingness to learn from others, but mentor schools place more emphasis on active learning (14.6%) and sharing resources (10.4%). Mentee schools, on the other hand, prioritize achievable goals (13.5%) and agreed protocols (8.3%). These differences highlight how mentoring is not a uniform process, but rather a path that needs to be adapted to the specificities of schools and their contexts. While Mentor schools tend to favor an approach based on active collaboration and the exchange of resources, Mentee schools need more guidance and support through clear goals and defined structures.

These findings offer valuable insights for designing more effective mentoring programs, capable of responding both to the specific needs of participating schools and to the challenges posed by the Italian educational context.

To better understand the enabling factors in mentoring networking between mentor and mentee schools, a qualitative analysis of the open-ended responses provided by the participants was conducted. The questions focused on the factors considered crucial at the cluster level (Q20). This type of analysis allowed us to go beyond numbers and percentages, offering a detailed look at the perceptions, experiences and motivations of the teachers involved. Through a thematic approach, the responses were read and coded, revealing recurring themes that reflect the key concepts shared by the participants. A central theme that emerged from the analysis concerns the sharing of resources and best practices. Many teachers highlighted how the comparison between mentor and mentee schools made learning more active and meaningful. This comparison allowed not only the experimentation of concrete teaching practices, but also continuous professional growth through mutual learning. A teacher from a mentor school described this experience in very positive terms, highlighting how the process facilitated the development and achievement of a common theme among the participating schools:

“The comparison of best practices between mentor and mentee schools was very productive and made learning active and meaningful. There was sharing between schools, and the common theme was developed and achieved by everyone”.

This type of collaboration helped create a real “community of practice”, where knowledge is not only transferred, but shared and co-constructed. Another element considered crucial by the participants is the definition of a common theme and the pursuit of achievable objectives. Clarity in the definition of objectives was often cited as a factor that favored motivation and concreteness of learning. Some teachers highlighted that working on clear and shared objectives strengthened group dynamics, creating a sense of more

effective collaboration among the schools involved. As a teacher from a mentor school observed:

“It is necessary to share a common theme and pursue an achievable objective to be concrete in learning”.

This aspect played a key role in ensuring that mentoring produced tangible results, going beyond the simple sharing of ideas. Willingness to learn from others was identified as a key prerequisite for successful mentoring in clusters. Several teachers highlighted how openness to discussion facilitated a real collaborative dialogue, essential to promote professional improvement. A teacher from a mentor school described this attitude in simple but incisive words:

“Availability and discussion with others were very important for the development of the common project”.

This openness not only allowed a fruitful exchange of ideas, but also fostered a climate of mutual trust, essential to establish authentic and meaningful mentoring relationships. Comparison of practices also played a key role in the process. Teachers highlighted how this comparison gave them the opportunity to reflect on their teaching methods and to introduce concrete changes in their daily practice. This reflective dimension was perceived as one of the main benefits of mentoring, capable of stimulating authentic learning aimed at continuous improvement. A particularly interesting aspect that emerged from the open-ended responses concerns the importance of emotional and relational collaboration. Many teachers noted how collaborative work within the clusters allowed them to grasp the emotional dynamics that characterize daily school life. This strengthened interpersonal relationships, creating a favorable environment for active learning and reflection on educational processes. A teacher from a mentor school highlighted this aspect by stating:

“Active learning was the priority factor in the cluster, as it was necessary to be open to learning and experimenting with the teaching practices proposed by the mentor school”.

Finally, several participants highlighted the importance of agreed protocols. These tools were described as essential to ensure a clear and defined structure for group work. The use of protocols allowed them to establish precise steps, phases and objectives, avoiding dispersion of energy and resources. As a teacher from a mentee school observed:

“The use of agreed protocols makes requests and objectives clear, avoiding dispersion on too many fronts”.

This structured approach allowed them to concentrate efforts on well-defined interventions, improving the

overall effectiveness of mentoring. In summary, the qualitative analysis of open-ended responses provided an in-depth picture of the enabling factors that contributed to the success of mentoring at cluster level. Resource sharing, clarity of objectives, openness to discussion, reflection on practices and the adoption of agreed protocols were identified as key elements to create a collaborative and productive environment. These findings offer important insights for the future design of mentoring paths, highlighting the need for an integrated approach that enhances both relational and organizational aspects.

5.2 Discussion of the Results and future prospects

The results of the national survey highlighted significant differences between the Italian and international contexts regarding the factors that facilitate school-to-school mentoring. In Italy, the enabling factors focus more on the comparison of practices, the willingness to learn from others and active learning. This dynamic reflects an educational tradition that privileges collaboration and sharing as the main levers for professional improvement and innovation. Previous studies, such as those by Stoll and Louis (2007), underline the importance of such approaches in promoting mutual interaction and active involvement in mentoring activities. On the contrary, the international context seems to be oriented towards more structural elements, such as the definition of clear and achievable objectives, access to specific resources and the construction of a well-defined common theme around which to develop mentoring activities. These differences highlight not only the cultural and educational peculiarities of each school system, but also the different needs that emerge depending on the local context. The discrepancies highlight the importance of adapting mentoring policies and educational strategies to the specific needs of the schools involved. In Italy, for example, the emphasis on comparing practices and active learning fits into a framework that strongly values sharing experiences as a tool for growth. This suggests that mentoring initiatives should be designed to strengthen and capitalize on these characteristics. For this to be possible, schools must be able to identify the mentoring strategies that best suit their needs, resources and objectives. As highlighted by Hargreaves (2021), there is no one-size-fits-all approach to educational success: each context requires customized and flexible solutions. The data collected offers valuable insights for designing more effective educational policies and mentoring practices. However, it is important to recognize some limitations of the study. Although representative, the sample of schools involved could be expanded to include a greater variety of contexts and situations. Furthermore, it would be useful to explore the long-term impact of school-to-school mentoring, analyzing how these practices influence the improvement of teaching methodologies and innovation. Future research should further explore these dynamics, ensuring that school-based mentoring can fully express

its potential for transformation and growth. The qualitative responses collected offer an interesting perspective on the dynamics and effectiveness of mentoring networking. At cluster level, mentoring is particularly beneficial when it is implemented in an inter-institutional dimension. Sharing resources, collaborating between schools and comparing practices are key factors that contribute to creating a fertile environment for learning and innovation. Participants frequently highlighted how the existence of a common theme and shared objectives fosters dialogue and cohesion between different schools. Active learning and the willingness to experiment with new methodologies emerge as essential components of successful mentoring. This openness to change allows schools to break down institutional barriers and create opportunities for mutual exchange. However, inter-institutional relationships need to be carefully managed and agreed protocols adopted to ensure that the process maintains a clear and coherent direction. Mentoring at cluster level is particularly useful for strengthening links between schools and promoting a culture of shared innovation. However, the diversity of contexts and resources among participating institutions requires careful coordination. Although peer review and resource sharing are key elements, they risk remaining episodic or limited to specific projects, if not supported by a broader strategic vision. In this framework, INDIRE's research perspectives are articulated in two main directions. The first concerns the development and validation of a mentoring toolkit designed for innovation networks. This tool will aim to support the professional growth of school actors through the sharing of mentoring models, operational guidelines and training materials. It will also focus on self-reflection, helping schools and clusters to identify their strengths and areas for improvement. The second direction involves the international validation of mentoring enabling factors. This initiative will involve schools of the Mensi Community in different countries, with the aim of culturally adapting the identified factors and assessing their effectiveness through comparative studies and longitudinal evaluations. The process will be characterized by a collaborative approach and will focus on the long-term impact of mentoring practices in educational contexts. These actions are crucial steps to ensure the sustainability of innovation networks and promote continuous improvement of educational practices. Through specific tools and rigorous validation of enabling factors, it will be possible to offer schools increasingly effective resources to address innovation challenges and improve student outcomes.

6. The MentorQ self-evaluation tool

Toolkits are tools used across many fields, from education to medicine to corporate training. Their primary purpose is to enable the transfer of practical knowledge through a complex system of interactions

between researchers and knowledge users, within a dynamic and iterative process that includes the synthesis, dissemination, exchange, and ethically sound application of the knowledge produced (Yamada et al., 2015). This aims to improve existing practices provide more effective services and products, and strengthen the considered system (in this case, the educational one). One of the most comprehensive toolkits was developed by European Schoolnet, a European consortium of Ministries of Education and associated organizations, called the “Future Classroom Toolkit”. This highly structured toolkit includes video testimonials, suggestions for digital tools to use, and practical guidelines. The toolkit supports an innovation approach that involves the entire school, fostering the creation of an ambitious yet realistically achievable educational vision, engaging all stakeholders, focusing on advanced pedagogical and change management practices, designing engaging learning activities through the use of digital technologies, and assessing the use of these learning activities. It is a toolkit that addresses the various dimensions of innovation in schools in a systemic way.

The idea stemming from the MenSI project is to support mentoring practices by providing a Mentoring Toolkit for the Italian innovative communities of Avanguardie Educative and Piccole Scuole, made up respectively of thousands of schools, in order to scaffold mentoring practices that Indire researchers could never be able to monitor, support and boost. Therefore, in this case, a mixed model mentoring would be as such: letting Mentor and Mentee schools proceed on their own yet providing them with a set of tools for checking the quality of the mentoring process, self-evaluating the state-of-the art of their implementations and acting in order to cover important dimensions that are scored as little developed. In order to do so, the Indire Toolkit for school-to-school mentoring will be composed of:

1. supporting documents on what school mentoring is and what are the challenges of it;
2. tools to implement school-to-school mentoring practices (such as instructional rounds, lesson studies and onsite observations);
3. case studies of mentoring practices, with videos and testimonials.
4. MentorQ, a tool of self-evaluation for schools to reflect on the maturity of their mentoring practices.

The latter tool is inspired by the SELFIE (Self-reflection on Effective Learning by Fostering the use of Innovative Educational Technologies), a tool developed by the European Commission (Costa, Castano-Munoz & Kamylyis, 2021) to help schools assess how effectively they are integrating digital technologies into teaching, learning, and assessment. It gathers anonymous feedback from school leaders, teachers, and students through a series of tailored questions. The results provide a comprehensive snapshot of the school’s current digital practices and areas for improvement, enabling schools to develop targeted strategies for

enhancing their use of digital tools. The rationale behind it is that integrating technology effectively requires a clear understanding of current practices, strengths, and challenges. By fostering self-reflection among school leaders, teachers, and students, the tool encourages schools to align their digital strategies with their broader educational goals. As feedback, schools receive a detailed, customized report that provides a snapshot of their digital practices. The insights are both quantitative and qualitative, offering a clear picture of where the school stands in its digital journey. The feedback acts as a foundation for strategic planning, enabling schools to set achievable goals and monitor progress over time. It also provides schools with comparative insights, helping them understand their performance in a broader context, such as within their region or country. Additionally, the results guide schools in identifying areas where targeted professional development is needed, empowering educators and leaders to enhance their practices and support meaningful digital transformation. In essence, SELFIE equips schools with the tools to take a data-driven approach to innovation (Figure 5), fostering a culture of continuous improvement in the integration of technology.

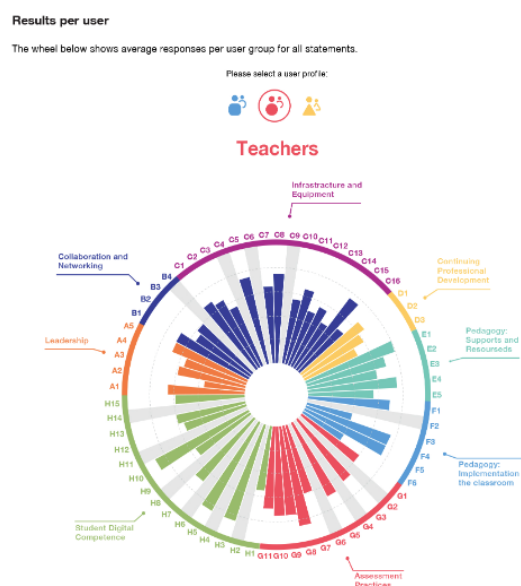


Figure 5 - One of the infographics provided by the SELFIE questionnaire concerning the perceptions of teachers.

The rationale of MentorQ is pretty similar. Its objective is to support school organizations to self-evaluate their mentoring process and practices and improve them according to the dimensions that have been validated, considering the most important enabling conditions that derive from evidence. Each condition will be scored by a number of teachers participating in the process, both from the Mentor and the Mentee schools. The means resulting from all the questionnaires will provide a Mentoring Index, and a detailed measure for each dimension so that weak dimensions can be visualized, addressed and improved. In order to validate the

MentorQ questionnaire, a factorial analysis is being employed (Schmitt, 2018). Factor analysis is a statistical method used to validate the items in a questionnaire by examining the underlying patterns in the data. It helps determine whether the items group together in ways that reflect specific latent variables, often referred to as “factor”. These factors represent the conceptual dimensions that the questionnaire aims to measure. The primary purpose of factorial analysis is to ensure that the questionnaire is both valid and reliable. Validity means that the questionnaire accurately measures the intended constructs, while reliability ensures that the measurements are consistent across different contexts or populations. By identifying how items relate to each other and grouping them into factors, factorial analysis ensures that the questionnaire is well-structured and that the items collectively provide meaningful insights. To perform a factorial analysis on MentorQ, data has been first collected from a large enough sample to ensure robust results, as explained above. In this case all the Italian teachers participating in the MenSI project were asked to participate in the first phase of the analysis. This exploratory factor analysis confirmed the ten dimensions presented above (common theme; reachable goals; funding; agreed understanding; shared resources; talking heads; recognition & value; connect to knowledge practices; comparing practices; economy of scale). The factors are now being refined using rotational methods to simplify and clarify the relationships between items and factors.

At present, the process of factor analysis is in progress and statistical measures such as factor loadings, and goodness-of-fit indices will be considered to assess the strength and validity of the factor structure. Factor loadings, which indicate the correlation between each item and a factor, will be critical in deciding which items should be retained or revised. Items with weak or ambiguous associations may be removed to improve the overall structure of the questionnaire. The proportion of variance explained by each factor provides additional insights into the importance and relevance of each construct. For each factor, a total of 5 items will be tested against a 4-point Likert scale. A 4-point Likert scale was preferred to a 5-point Likert scale in order to oblige respondents to take a clearer position. The 5 items are slightly different and encompass nuances in the dimension, with different phrasing. Redundant or poorly performing items will be deleted, refining the constructs being measured, and improving clarity for respondents.

The methodological approach for validating the questionnaire involves several sequential steps. Firstly, the reliability of the questionnaire will be measured by using Cronbach’s alpha. This statistical indicator is widely applied in psychometric tests to assess the reliability and reproducibility of results under consistent conditions over time. Secondly, correlations will be examined among items, both within individual scales and across the entire questionnaire. This analysis will help researchers to determine if a global score, calculated by summing all items, is justified and

meaningful. Next, factorial analysis will be performed to explore the underlying structure of the questionnaire. A Confirmatory Factor Analysis (CFA) will be performed to test the pre-established structure based on theoretical foundations and existing literature, given that the 10 dimensions (factors) have been identified and confirmed within the Italian sample. This approach will evaluate whether the hypothesized 10-factor model fits the data adequately or whether item removal is necessary to maintain the integrity of the model. Additionally, standardization of scores may be considered, including the establishment of cutoff thresholds, provided the sample size is sufficiently large to support this analysis. Typically, a robust sample size is required for such standardization. Finally, supplementary analyses may be conducted to examine sociodemographic differences, such as gender, education level and school type. For this purpose, additional demographic questions could be included at the beginning of the MentorQ questionnaire Alpha-version.

In this way, the factorial analysis on MentorQ will ensure that the questionnaire is both focused and effective. The method also validates the ability of the questionnaire to perform consistently across different groups in different schools, regions and school level, making it a powerful tool for researchers and practitioners aiming to assess quality mentoring processes.

7. Conclusion

This study has explored the potential of mentoring as a lever for innovation and systemic improvement in school contexts, with particular attention to school-to-school mentoring models and the enabling factors that influence their sustainability and effectiveness. Through a combination of exploratory and confirmatory investigations, a clear vision has emerged of the necessary conditions for building solid and resilient mentoring networks capable of supporting the adoption of innovative practices and the continuous professionalization of teachers.

The results highlight ten key enabling factors that underpin the success of mentoring experiences, including the adoption of shared objectives, the comparison of practices, access to dedicated resources, and the enhancement of the professional skills of all involved stakeholders. In particular, the analysis conducted within the Italian context revealed that elements such as the comparison of practices, openness to learning from others, and active learning are fundamental pillars for the success of mentoring within school clusters.

An additional significant element is the role of the “hub-and-spoke” model, which has proven effective in organizing and disseminating innovative practices while ensuring the necessary flexibility to adapt to the specificities of local contexts. However, it has also

become clear that the sustainability of these networks largely depends on the existence of specific enabling conditions and on each school's ability to monitor and critically reflect on its own practices.

Based on these findings, a self-assessment tool for schools, called MentorQ, has been proposed. This tool will enable schools to systematically reflect on their mentoring experiences, assessing the maturity level of the practices adopted concerning the ten identified enabling factors.

MentorQ will not only provide a clear picture of the current state of mentoring practices but will also help schools identify areas for improvement and adopt targeted strategies to enhance their processes. The tool is designed to be flexible and adaptable, allowing schools to use it in different educational contexts and with customized approaches.

In particular, MentorQ is planned to be piloted within INDIRE's innovation networks, such as Avanguardie Educative and Piccole Scuole, which allow for observations in both standardized educational environments and non-standard scenarios characterized by high geographical, cultural, and infrastructural variability. This approach will offer a unique perspective on the adaptability and effectiveness of the tool across diverse school settings.

The evidence gathered thus far underscores the need for further investment in professional development, school support, and the creation of a collaborative culture that fosters mentoring and the sharing of best practices. Future research can focus on applying MentorQ in diverse contexts, exploring its effectiveness in promoting continuous and systemic improvement. Furthermore, it will be crucial to further develop the mentoring toolkit, including operational materials and case studies to support schools in their innovation journeys.

This research represents a significant step toward the construction of sustainable and inclusive mentoring networks, offering concrete tools and valuable insights for the continuous improvement of the educational system. It supports the transformation and guidance of schools toward their envisioned futures.

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Empowering (e)ducators, inspiring learners: a cross-cultural exploration for interprofessional development through the lens of the Capability Approach

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Abstract

The development of interprofessional capabilities has become a crucial strategy for addressing the multifaceted challenges of today's increasingly interconnected and volatile workplace environment. This study examines Martha Nussbaum's Capability Approach (CA) as a framework for cultivating key tangible outcomes—such as communication, critical reasoning, empathy, and collaboration—that are vital in the interprofessional context. Methodologically, the research adopts a quantitative approach to validate a life skills evaluation instrument and assess its effectiveness in diverse cultural settings. To achieve this, a Confirmatory Factor Analysis (CFA) was conducted on a dataset comprising 138 online instructors, complemented by statistical tests to identify significant cross-cultural differences in the prioritization and implementation of key skills. The main findings underscore the potential of e-learning practices, grounded in the CA framework, as a powerful tool for fostering the development of crucial capabilities essential for cultivating competent and well-rounded professional human beings. The findings of this study provided information on how to design teaching and learning for interprofessional development in the context of Pakistan, Portugal, Spain, and the United Kingdom.

KEYWORDS: Capability Approach, Cross-cultural, e-learning, Interprofessional development, Life skills.

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1. Introduction

Interprofessional development has emerged as a crucial strategy for addressing the multifaceted challenges of

today's dynamic labor market, characterized by increasing complexity and rapid change. By promoting collaboration among professionals from diverse fields, interprofessional development fosters the integration of varied expertise, facilitating innovative solutions to the pressing issues facing society. While InterProfessional Education (IPE) has traditionally been emphasized in health care due to its multidisciplinary, team-oriented nature, the core principles of IPE—effective communication, collaboration, and respect for diverse perspectives—extend far beyond health care (Saragih et al., 2024; van Diggele et al., 2024). Fields such as business, law, engineering, and education increasingly recognize the importance of interprofessional skills in tackling interdisciplinary challenges, including sustainability, technological advancement, and policy

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development (Alexandru, 2018; Franklin et al., 2012; Rider et al., 2023; Watkins, 2016).

In light of this context, broadening research on IPE to include insights from diverse disciplines presents an invaluable opportunity to deepen our understanding of how interprofessional competencies can drive effective problem-solving and innovation within collaborative environments (Ganotice et al., 2023). This study contends that education plays a critical role in preparing future professionals for the interprofessional landscape, advocating for the integration of Martha Nussbaum's Capabilities Approach (CA) as a conceptual framework to realize this goal (Nussbaum, 2011). Originally formulated to address human development and social justice, Nussbaum's CA has been increasingly adapted to various fields, including education, where it has been widely recognized as a foundation for fostering essential life skills (Elkhayat, 2018; Garcia-Calvo et al., 2022; Lozano et al., 2012; Walker, 2003). Within the educational domain, Nussbaum's CA emphasizes a range of core capabilities – such as practical reasoning, communication, empathy, and the ability to work collaboratively – that resonate strongly with the competencies needed in interprofessional settings. These capabilities, by cultivating an orientation toward others and a capacity for reflective thought, provide a robust foundation for interprofessional engagement. Although existing literature underscores the importance of CA in shaping educational practices, discussions have largely remained theoretical, with limited exploration of its practical application within curricula, particularly in relation to IPE. This gap suggests an untapped potential for CA to inform and enhance IPE by providing a values-based framework that aligns with essential interprofessional skills, thus enabling educators to translate CA principles into actionable practices that foster the meaningful development of interprofessional competencies.

On the other hand, in today's globalized and interconnected landscape, multidisciplinary teams are increasingly composed of professionals from diverse international backgrounds, heightening the importance of technology as a critical facilitator for cross-border collaboration (Goodwin, 2017; Iacono, 2022; Morrison-Smith & Ruiz, 2020). Digital tools -including video conferencing, cloud-based platforms, and virtual workspaces- now play an essential role in enabling professionals to seamlessly integrate their expertise and address complex, shared challenges, regardless of geographical location. Within this context, e-learning environments are uniquely positioned to foster these interprofessional competencies, especially for adult learners who bring prior experiences and require flexible, technology-enhanced approaches to skills development. Through e-learning, adult learners can engage in practical, collaborative experiences that build proficiency in communication, teamwork, adaptability, and intercultural competence, laying a robust

foundation for success in technology-driven, international, multidisciplinary projects (Hermasari et al., 2024; Peeters et al., 2024).

Considering the formation of multidisciplinary teams that increasingly rely on technology for effective cross-border collaboration, it becomes crucial to understand, from a cross-cultural perspective, how core capabilities essential for interprofessional development are being fostered. In light of this need, the present study investigates the potential of the CA framework through the lens of instructors in e-learning environments across four culturally distinct countries: Pakistan, Portugal, Spain, and the United Kingdom. This research pursues two primary objectives: first, to validate the instrument developed by Gómez-Rey et al. (2021) with diverse international samples, assessing its reliability and consistency in identifying key life skills critical for contemporary education. Second, it explores educators' perspectives on integrating these core capabilities into university curricula, providing valuable insights into the perceived effectiveness of current educational practices within different cultural contexts. By bridging the gap between theory and practice, this study contributes to a nuanced understanding of how the CA framework can be leveraged to enhance interprofessional competencies in the context of e-learning across varied cultural settings.

2. Theoretical Framework

The CA, following Martha Nussbaum's perspective, has been described by numerous scholars as an enriching framework that provides a comprehensive perspective for understanding and enhancing the teaching-learning process (Hedge & MacKenzie, 2012; MacKenzie et al., 2022; Walker, 2003; Walker & Unterhalter, 2007). By focusing on individual capabilities, this framework fosters a human-centered education that transcends the mere acquisition of information and technical skills.

Despite this recognition, only one study in the existing literature has, to our knowledge, operationalized Nussbaum's CA within online educational settings (Gómez-Rey et al. (2021)). This foundational work adapts Nussbaum's proposed capabilities to create an instrument to foster the development of life skills in online scenarios. The instrument development process began with the operationalization of Nussbaum's ten capabilities (Nussbaum, 2011). However, due to methodological considerations, the authors opted to use the term 'unidimensional constructs' instead of *capabilities* to define each dimension within the educational context. The central human capabilities, as well as its operationalization for online learning, are outlined below.

LIFE (L): Nussbaum defined this capability as "being able to live to the end of a human life of normal length;

not dying prematurely, or before one's life is so reduced as to be not worth living" (Nussbaum, 2011, p. 33). Gómez-Rey et al., (2021) connect this multidimensional construct to (1) the length of a person's life (L_1), and (2) the quality of that life (L_2). The L_1 dimension pertains to personal and professional growth within the context of learning, while the L_2 dimension is associated with the development of core soft skills within the context of online scenarios (self-study, time management, computer literacy, digital communication, and web searches).

BODY HEALTH (BH): Nussbaum described this capability as "being able to have good health, including reproductive health; to be adequately nourished; to have adequate shelter" (Nussbaum, 2011, p. 33). Gómez-Rey et al., (2021) associated this unidimensional construct with the concept of sedentary behavior, a factor that is especially significant in online learning contexts.

BODY INTEGRITY (BI): Nussbaum outlined this capability as "being able to move freely from place to place; to be secure against violent assault, including sexual assault and domestic violence; having opportunities for sexual satisfaction and for choice in matters of reproduction" (Nussbaum, 2011, p. 33). Gómez-Rey et al., (2021) defined this unidimensional construct within the framework of cybersecurity.

SENSE, IMAGINATION AND THOUGHT (SIT): Nussbaum delineated this capability as:

Being able to use the senses, to imagine, think, and reason—and to do these things in a truly human way, a way informed and cultivated by an adequate education, including, but by no means limited to, literacy and basic mathematical and scientific training. Being able to use imagination and thought in connection with experiencing and producing works and events of one's own choice, religious, literary, musical, and so forth.

Being able to use one's mind in ways protected by guarantees of freedom of expression with respect to both political and artistic speech, and freedom of religious exercise. Being able to have pleasurable experiences and to avoid non-beneficial pain. (Nussbaum, 2011, p. 33)

Gómez-Rey et al. (2021) associated this multidimensional construct with (1) divergent thinking (SIT_1) and convergent thinking (SIT_2), emphasizing the importance of fostering learners' creativity.

EMOTIONS (E): Nussbaum defined this capability as:

Being able to have attachments to things and people outside ourselves; to love those who love and care for us, to grieve at their absence; in general, to love, to grieve, to experience

longing, gratitude, and justified anger. Not having one's emotional development blighted by fear and anxiety. (Supporting this capability means supporting forms of human association that can be shown to be crucial in their development). (Nussbaum, 2011, p. 33-34)

Gómez-Rey et al., (2021) linked this unidimensional construct to the significance of emotion in learning.

PRACTICAL REASON (PR): Nussbaum defined this capability as "being able to form a conception of the good and to engage in critical reflection about the planning of one's life (this entails protection for the liberty of conscience and religious observance)" (Nussbaum, 2011, p. 34). Gómez-Rey et al., (2021) pertain to the right to freedom of thought, conscience, and religion in learning process.

AFFILIATION (A): Nussbaum defined this capability as:

Being able to live with and toward others, to recognize and show concern for other humans, to engage in various forms of social interaction, to be able to imagine the situation of another; and being able to be treated as a dignified being whose worth is equal to that of others (having the social bases of self-respect and non-humiliation). This entails provisions of non-discrimination on the basis of race, sex, sexual orientation, ethnicity, caste, religion, national origin, and species. (Nussbaum, 2011, p. 34)

Gómez-Rey et al., (2021) elucidated this unidimensional construct through the lens of students' social interactions and the creation of a sense of community.

OTHER SPECIES (OS): Nussbaum defined this capability as "being able to live with concern for and in relation to animals, plants, and the world of nature" (Nussbaum, 2011, p. 34). Gómez-Rey et al., (2021) articulated this unidimensional construct as central to fostering learners' environmental awareness.

PLAY (P): Nussbaum defined this capability as "being able to laugh, to play, to enjoy recreational activities" (Nussbaum, 2011, p. 34). Gómez-Rey et al., (2021) explained this unidimensional construct by focusing on balancing academic and recreational time.

CONTROL OVER ONE'S ENVIRONMENTS (COOE): Nussbaum defined this capability as:

Being able to participate effectively in political choices that govern one's life; having the right of political participation, protections of free speech and association; and being able to hold property (both land and movable goods), and having property rights on an equal basis with others; having the right to seek employment on an equal basis with others; having the freedom from unwarranted search and seizure. In work,

being able to work as a human, exercising practical reason and entering into meaningful relationships of mutual recognition with other workers. (Nussbaum, 2011, p. 34).

Gómez-Rey et al., (2021) connect this multidimensional construct to (1) political issues (COOE₁) and (2) material concerns (COOE₂). The COOE₁ dimension is associated with democratic processes, emphasizing the importance of student involvement in shaping their educational experiences and influencing broader societal contexts. In contrast, the COOE₂ dimension addresses accessibility and usability, highlighting the need for educational environments that are both inclusive and user-friendly.

Gómez-Rey et al., (2021) presented this operationalization as a practical example for developing an educational learning theory grounded in the CA framework for online learning environments. They also encouraged other researchers to further explore and expand upon this educational approach. The authors emphasized that their framework is not static but should be adapted to the specific characteristics of each educational context and the aims of the research. Each instructional designer or instructor should arrange and implement these dimensions to best suit the design and objectives of their learning environment. This is why no specific guidelines are provided for this process.

3. Materials and Methods

3.1 Procedures

The procedures employed in this study were systematically designed to ensure a robust and diverse data collection. Some of the authors of this research paper utilized their international network within the academic community to facilitate participant recruitment. This network, encompassing contacts from various online universities worldwide, was fundamental in distributing the formal invitation to participate in the research. The invitation clearly outlined the research objectives, with particular emphasis placed on ensuring that the invitation reached individuals affiliated with universities in different countries to enhance the geographical diversity of the sample.

Upon agreeing to participate, respondents received an email containing a link to the Google Form questionnaire, which also provided details on the allotted time for survey completion and an overview of the types of questions included. The questionnaire consisted of 54 Likert scale items, measured on a 5-point scale, along with demographic questions designed to gather background information. To ensure consistency and comprehension across the diverse international sample, the questionnaire was

administered in English. The primary questions central to this research are available in the dataset file.

3.2 Participants

A total of 138 online instructors from diverse universities participated in this study, with the following distribution: 31 from Pakistan, 30 from Portugal, 41 from Spain, and 36 from the United Kingdom. In terms of gender, men made up the majority, comprising 50.72% of the sample (70 individuals), while women constituted 48.55% (67 individuals). One participant opted not to disclose their gender.

3.3 Data analysis

A quantitative methodology was employed to support this research. This study utilized CFA to assess the instrument developed and validated by Gómez-Rey et al. (2021) using data collected from instructors at open universities across four countries (Pakistan, Portugal, Spain, and the United Kingdom). The analysis concentrated on a series of observed variables, which were systematically grouped into 13 latent dimensions (L₁, L₂, BH, BI, SIT₁, SIT₂, E, PR, A, OS, P, COOE₁, and COOE₂). These latent dimensions were treated as the core constructs, with the observed variables acting as specific indicators reflecting these underlying constructs' characteristics. The primary objective was to validate the proposed factor structure and to examine the relationships between latent and observed variables within the model. MPlus software was employed for the analysis, allowing for a thorough assessment of construct validity and the measurement model using this specific dataset of instructors teaching online scenarios. This approach ensures the robustness and generalizability of the scale in a broader international context (Hoyle, 2000).

Subsequently, hypothesis tests were performed to identify significant differences across the various dimensions under investigation. The researchers evaluated the degree of implementation across 13 latent dimensions: L₁, L₂, BH, BI, SIT₁, SIT₂, E, PR, A, OS, P, COOE₁, and COOE₂. This assessment involved applying the coefficients derived from the confirmatory factor analysis (CFA) to the observed variables associated with each dimension. To ensure a fair comparison among the dimensions, the items were standardized, addressing the differences in the number of observed variables for each dimension. Given that the data were collected on a Likert scale, which does not meet the assumptions of normality, non-parametric tests were employed. Specifically, a non-parametric Nemenyi test was utilized to evaluate significant differences in the implementation levels among the dimensions. This test is well-suited for making comparisons across multiple groups, as it employs critical differences to determine statistical significance, thus highlighting dimensions that demonstrate

substantial variations in their levels of implementation (Liu and Chen, 2012).

4. Results

4.1 Confirmatory factor analysis

The validation process of the instrument proposed by Gómez-Rey et al., (2021) was conducted in two phases to ensure the development of a model with competitive statistical properties. Initially, a model incorporating all questionnaire items was tested. Subsequently, a final model was developed by removing items that did not meet the established minimum statistical thresholds. The robustness of the model for generalization was assessed by calculating estimates for the items associated with the latent variables. The initial model demonstrated strong fit indices, achieving a Comparative Fit Index (CFI) of 0.968, a Tucker-Lewis Index (TLI) of 0.965, and a Root Mean Square Error of Approximation (RMSEA) of 0.068, with a 95% Confidence Interval (CI) ranging from 0.063 to 0.074. Although the results associated with the initial model were promising, challenges were posed by variables I_2 (L_1) and I_{44} (P). Specifically, I_2 (L_1) exhibited a non-significant p -value of 0.068 and a negative coefficient of -0.160, while I_{44} (P) displayed a significant p -value of 0.001 with a coefficient of 1.021. Therefore, the first variable was eliminated due to its non-significant p -value and the negative sign of its coefficient, which did not align with the theoretical interaction expected between the variables. The second variable was also removed because its slope coefficient exceeded 1, which can lead to issues with interpretation and model fit. Consequently, the decision was made to exclude I_2 (L_1) and I_{44} (P) from the initial model, and the analysis was rerun to enhance the model's accuracy. The fit indices for the final model were as follows: CFI of 0.974, TLI of 0.972, and RMSEA of 0.064 (95% CI: [0.058, 0.069]). As observed, the removal of these variables resulted in an improved model. The values obtained for the final model are considered competitive and acceptable within the academic community, as the authors Hu and Bentler (1999) indicate that Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) values greater than 0.90 signify an acceptable model fit, while values exceeding 0.95 indicate a good fit. Furthermore, the study conducted by Schreiber et al. (2006) reinforces this notion by recommending that CFI and TLI values greater than 0.90 reflect a good fit of the model. The revised model, as presented in Table 1, now includes only statistically significant parameters that correspond with the expected theoretical correlations. The elements in the table are arranged in ascending order based on the t -statistic value (Est./S.E.).

Building on the previously presented information, the researchers find it valuable to include details regarding

the correlations between latent variables. While Tables 1 and 2 assess the effectiveness of observed variables in representing conceptual dimensions or latent factors (measurement component). Table 3 emphasizes the structural component by highlighting the causal relationships among these factors. Only significant correlations between latent variables are reported, all of which possess a p -value of less than 0.001. Given that the instrument is holistic and measures the development of life skills, it is reasonable to expect the existence of interactions among these variables. The elements in the table are arranged in ascending order based on the t -statistic value (Est./S.E.).

4.2 Statistical tests

The following describes the implementation of life skills in the open universities under analysis. The scores for each dimension were calculated by applying weights to the instructors' reported performance on the items characterizing each dimension, with the weighting based on the respective factor loadings. Therefore, the score for the i -th dimension and the $n_{(a)}$ -th instructor of the institution indexed in (a) (Pakistan, Portugal, Spain, and United Kingdom), $S_{n_{(a)},(a)}^i$, is obtained as:

$$S_{n_{(a)},(a)}^i = \frac{\sum_j w_j^i x_{n_{(a)},j}^i}{\sum_j w_j^i}, \quad (1)$$

where w_j^i is the j -th factor loading of the i -th dimension, and $x_{n_{(a)},j}^i$ is the output reported by the $n_{(a)}$ -th instructor of the institution indexed in (a) (Spain, Portugal, Pakistan or United Kingdom) in the j -th item of the i -th dimension, with $n_{\text{Pakistan}} = \{1, \dots, 31\}$, $n_{\text{Portugal}} = \{1, \dots, 30\}$, $n_{\text{Spain}} = \{1, \dots, 41\}$, $n_{\text{United Kingdom}} = \{1, \dots, 36\}$; $i = \{1, 2, \dots, 13\}$.

After normalizing the scores, the dimensions were ranked based on performance, with mean rankings calculated accordingly. A ranking of $R=1$ was assigned to the highest-performing dimension, while $R=13$ indicated the lowest-performing dimension. Table 4 gives information about the average results for each dimension across all instructors by country, including both the normalized Average Score (AS) and the Mean Ranking (\bar{R}) for each dimension. The table highlights notable findings regarding implementing the studied life skills (dimensions) in the selected context. It facilitates comparisons between the best effectively implemented dimensions and those with the worst implementation, while also revealing differences across the four selected countries. From a descriptive viewpoint, it can be perceived that each culture prioritizes different life skills. For instance, from instructors' perspectives, the best implemented life skills in online scenarios are the following: in Pakistan

Table 1 - Representation of the observed items within its dimension.

Dimensions	Items	Estimate (Est.)	Standard Error (S.E.)	Est./S.E.	p-value
<i>L</i> ₁	<i>I</i> ₃	0.657	0.051	12.960	p < 0.001
	<i>I</i> ₁	0.711	0.046	15.513	p < 0.001
	<i>I</i> ₄	0.798	0.042	18.890	p < 0.001
	<i>I</i> ₅	0.841	0.034	24.829	p < 0.001
<i>L</i> ₂	<i>I</i> ₁₁	0.897	0.026	34.437	p < 0.001
	<i>I</i> ₇	0.893	0.024	36.922	p < 0.001
	<i>I</i> ₉	0.920	0.021	44.585	p < 0.001
	<i>I</i> ₈	0.921	0.020	46.636	p < 0.001
	<i>I</i> ₆	0.929	0.020	46.826	p < 0.001
	<i>I</i> ₁₀	0.937	0.019	48.573	p < 0.001
BH	<i>I</i> ₁₂	0.911	0.047	19.327	p < 0.001
	<i>I</i> ₁₅	0.853	0.027	32.086	p < 0.001
	<i>I</i> ₁₄	0.922	0.022	41.007	p < 0.001
	<i>I</i> ₁₃	0.934	0.022	42.594	p < 0.001
BI	<i>I</i> ₁₉	0.855	0.031	27.395	p < 0.001
	<i>I</i> ₁₆	0.838	0.029	28.745	p < 0.001
	<i>I</i> ₁₇	0.936	0.019	50.522	p < 0.001
	<i>I</i> ₁₈	0.926	0.018	50.651	p < 0.001
<i>SIT</i> ₁	<i>I</i> ₂₃	0.890	0.024	36.712	p < 0.001
	<i>I</i> ₂₀	0.929	0.020	46.403	p < 0.001
	<i>I</i> ₂₁	0.940	0.018	51.399	p < 0.001
	<i>I</i> ₂₂	0.961	0.017	57.255	p < 0.001
<i>SIT</i> ₂	<i>I</i> ₂₄	0.703	0.048	14.683	p < 0.001
	<i>I</i> ₂₇	0.910	0.045	20.360	p < 0.001
	<i>I</i> ₂₅	0.916	0.043	21.546	p < 0.001
	<i>I</i> ₂₆	0.835	0.037	22.753	p < 0.001
E	<i>I</i> ₂₈	0.947	0.015	62.711	p < 0.001
	<i>I</i> ₂₉	0.938	0.012	76.733	p < 0.001
	<i>I</i> ₃₁	0.958	0.008	113.188	p < 0.001
	<i>I</i> ₃₂	0.982	0.007	141.392	p < 0.001
	<i>I</i> ₃₀	0.979	0.006	150.704	p < 0.001
PR	<i>I</i> ₃₅	0.941	0.019	50.741	p < 0.001
	<i>I</i> ₃₄	0.930	0.016	56.741	p < 0.001
	<i>I</i> ₃₆	0.953	0.015	62.173	p < 0.001
	<i>I</i> ₃₃	0.966	0.013	71.939	p < 0.001
A	<i>I</i> ₃₉	0.872	0.022	39.521	p < 0.001
	<i>I</i> ₃₇	0.924	0.022	42.363	p < 0.001
	<i>I</i> ₃₈	0.923	0.018	51.375	p < 0.001
OS	<i>I</i> ₄₃	0.866	0.028	30.527	p < 0.001
	<i>I</i> ₄₁	0.912	0.025	36.742	p < 0.001
	<i>I</i> ₄₀	0.962	0.022	44.724	p < 0.001
	<i>I</i> ₄₂	0.931	0.017	53.948	p < 0.001
P	<i>I</i> ₄₅	0.908	0.024	37.812	p < 0.001
	<i>I</i> ₄₆	0.955	0.024	39.956	p < 0.001
<i>COOE</i> ₁	<i>I</i> ₄₉	0.834	0.029	28.388	p < 0.001
	<i>I</i> ₅₀	0.913	0.022	40.935	p < 0.001
	<i>I</i> ₄₇	0.963	0.023	42.156	p < 0.001
	<i>I</i> ₄₈	0.910	0.020	44.618	p < 0.001
<i>COOE</i> ₂	<i>I</i> ₅₁	0.813	0.032	25.714	p < 0.001
	<i>I</i> ₅₂	0.875	0.026	33.880	p < 0.001
	<i>I</i> ₅₃	0.896	0.019	46.381	p < 0.001
	<i>I</i> ₅₄	0.937	0.018	50.874	p < 0.001

Table 2 - Linear relationships between latent variables.

Dimensions	Variables	Estimate (Est.)	Standard Error (S.E.)	Est./S.E.	p-value
L_2	L_1	0.912	0.026	35.540	$p < 0.001$
BH	L_1	0.326	0.078	4.158	$p < 0.001$
	L_2	0.316	0.071	4.472	$p < 0.001$
BI	BH	0.483	0.063	7.624	$p < 0.001$
	L_1	0.725	0.045	16.011	$p < 0.001$
	L_2	0.797	0.033	23.980	$p < 0.001$
SIT_1	BH	0.421	0.069	6.065	$p < 0.001$
	BI	0.742	0.042	17.839	$p < 0.001$
	L_1	0.848	0.032	26.394	$p < 0.001$
	L_2	0.876	0.020	43.030	$p < 0.001$
SIT_2	BI	0.310	0.080	3.889	$p < 0.001$
	L_2	0.345	0.080	4.297	$p < 0.001$
	SIT_1	0.439	0.070	6.239	$p < 0.001$
	BH	0.608	0.057	10.606	$p < 0.001$
E	SIT_2	0.332	0.073	4.556	$p < 0.001$
	BH	0.462	0.067	6.939	$p < 0.001$
	L_1	0.751	0.044	16.889	$p < 0.001$
	SIT_1	0.746	0.037	20.304	$p < 0.001$
	L_2	0.795	0.033	23.846	$p < 0.001$
	BI	0.835	0.029	28.847	$p < 0.001$
PR	SIT_2	0.316	0.078	4.052	$p < 0.001$
	BH	0.318	0.076	4.197	$p < 0.001$
	L_1	0.896	0.031	29.044	$p < 0.001$
	BI	0.839	0.029	29.250	$p < 0.001$
	E	0.841	0.027	31.466	$p < 0.001$
	SIT_1	0.844	0.026	32.324	$p < 0.001$
	L_2	0.862	0.024	35.959	$p < 0.001$
A	SIT_2	0.416	0.071	5.832	$p < 0.001$
	BH	0.580	0.056	10.323	$p < 0.001$
	L_1	0.763	0.043	17.899	$p < 0.001$
	SIT_1	0.811	0.37	21.804	$p < 0.001$
	PR	0.777	0.035	22.045	$p < 0.001$
	L_2	0.795	0.034	23.727	$p < 0.001$
	BI	0.855	0.032	26.859	$p < 0.001$
	E	0.851	0.029	29.500	$p < 0.001$

the L_2 dimension ($AS_{L_2}=4.318$ and $\bar{R}_{L_2}=3.645$), in Portugal the BH dimension ($AS_{BH}=3.682$ and $\bar{R}_{BH}=3.633$), in Spain the SIT_2 dimension ($AS_{SIT_2}=3.125$ and $\bar{R}_{SIT_2}=4.109$), and in the United Kingdom the dimension L_1 ($AS_{L_1}=2.007$ and $\bar{R}_{L_1}=4.444$). On the other hand, the worst implemented life skills in online scenarios are the following: in Pakistan the P dimension ($AS_P= 3.260$ and $\bar{R}_P=9.435$), in Portugal and Spain the PR dimension ($AS_{PR}=2.083$ and $\bar{R}_{PR}=9.533 / AS_{PR}=1.755$ and $\bar{R}_{PR}=10.000$, and in the United Kingdom the dimension A ($AS_A=1.626$ and $\bar{R}_A=8.416$).

The significance of the experimental findings was assessed through non-parametric statistical methods, due to the rejection of the normality and equality of variances assumptions based on a prior assessment of the average scores from the dimensions. In particular,

the Friedman and Nemenyi tests were employed for this analysis. The Friedman test is utilized to determine whether significant differences exist within the group of results. In contrast, the Nemenyi test identifies which pairs among the comparisons exhibit significant differences. The Friedman test indicated statistically significant variations in the average rankings among the dimensions, with results reaching a 5% significance level. Specifically, in the case of Pakistan, the confidence interval for the Friedman statistic is $C_0=(0, F_{0.05}= 1.779)$, while the computed F-value is $F^*=5.438$, which lies outside this interval. Consequently, the null hypothesis, which asserts that all dimensions have equal mean rankings, is rejected. The same conclusion applies to the other countries, although the reported results vary. In Portugal, $C_0=(0, F_{0.05}=1.780)$ and F-value is $F^*=9.879$. In Spain, $C_0=(0, F_{0.05}=1.772)$ and F-value is $F^*=14.160$. and, in the United Kingdom, $C_0=(0, F_{0.05}=1.775)$ and F-value is $F^*=3.411$.

Table 3 - Linear relationships between latent variables.

Dimensions	Variables	Estimate (Est.)	Standard Error (S.E.)	Est./S.E.	<i>p</i> -value
OS	<i>SIT</i> ₂	0.507	0.063	8.005	<i>p</i> < 0.001
	<i>L</i> ₁	0.544	0.063	8.844	<i>p</i> < 0.001
	<i>L</i> ₂	0.593	0.053	11.271	<i>p</i> < 0.001
	<i>SIT</i> ₁	0.616	0.055	11.269	<i>p</i> < 0.001
	PR	0.646	0.047	13.851	<i>p</i> < 0.001
	E	0.675	0.045	14.961	<i>p</i> < 0.001
	BH	0.730	0.043	16.983	<i>p</i> < 0.001
	BI	0.743	0.042	17.632	<i>p</i> < 0.001
P	<i>A</i>	0.823	0.033	25.181	<i>p</i> < 0.001
	<i>L</i> ₁	0.205	0.089	2.294	<i>p</i> < 0.001
	<i>L</i> ₂	0.282	0.085	3.297	<i>p</i> < 0.001
	PR	0.299	0.084	3.542	<i>p</i> < 0.001
	<i>SIT</i> ₁	0.334	0.083	4.043	<i>p</i> < 0.001
	BI	0.435	0.075	5.797	<i>p</i> < 0.001
	E	0.427	0.072	5.962	<i>p</i> < 0.001
	<i>SIT</i> ₂	0.571	0.065	8.771	<i>p</i> < 0.001
	<i>A</i>	0.560	0.059	9.443	<i>p</i> < 0.001
	OS	0.701	0.053	13.122	<i>p</i> < 0.001
BH	0.873	0.022	38.877	<i>p</i> < 0.001	
<i>COOE</i> ₁	<i>SIT</i> ₂	0.349	0.072	4.827	<i>p</i> < 0.001
	BH	0.416	0.066	6.357	<i>p</i> < 0.001
	P	0.440	0.069	6.416	<i>p</i> < 0.001
	<i>L</i> ₁	0.650	0.052	12.543	<i>p</i> < 0.001
	OS	0.662	0.046	14.351	<i>p</i> < 0.001
	<i>SIT</i> ₁	0.705	0.043	16.237	<i>p</i> < 0.001
	E	0.727	0.040	18.056	<i>p</i> < 0.001
	BI	0.722	0.040	18.196	<i>p</i> < 0.001
	<i>A</i>	0.754	0.039	19.316	<i>p</i> < 0.001
	PR	0.748	0.037	20.191	<i>p</i> < 0.001
	<i>L</i> ₂	0.782	0.036	22.030	<i>p</i> < 0.001
<i>COOE</i> ₂	<i>SIT</i> ₂	0.401	0.075	5.370	<i>p</i> < 0.001
	BH	0.463	0.063	7.400	<i>p</i> < 0.001
	P	0.497	0.063	7.842	<i>p</i> < 0.001
	<i>L</i> ₁	0.747	0.048	15.712	<i>p</i> < 0.001
	<i>SIT</i> ₁	0.768	0.038	20.043	<i>p</i> < 0.001
	BI	0.785	0.038	20.401	<i>p</i> < 0.001
	OS	0.749	0.035	21.169	<i>p</i> < 0.001
	E	0.792	0.036	21.788	<i>p</i> < 0.001
	<i>L</i> ₂	0.824	0.030	27.737	<i>p</i> < 0.001
	PR	0.835	0.029	28.420	<i>p</i> < 0.001
	<i>A</i>	0.838	0.028	29.703	<i>p</i> < 0.001
	<i>COOE</i> ₁	0.869	0.024	36.919	<i>p</i> < 0.001

Following the previous rejection, the Nemenyi post hoc test was employed to examine significant differences in the rankings of life skills dimensions across each country. This test determines whether a dimension is significantly different based on whether its mean rank varies by at least the Critical Difference (CD). The results of the Nemenyi tests for $\alpha=0.05$ across the four studied countries are illustrated in Figure 1, which includes both the CD and the mean rankings for each dimension. Differences are considered significant when the mean ranks of two dimensions exceed the CD.

In the context of Pakistan, based on the Nemenyi test ($\alpha=0.05$), instructors perceive no significant differences in the level of implementation among the *L*₂, *SIT*₁, PR, E, and OS dimensions, which are ranked the highest. The second-ranked group includes the *SIT*₁, PR, E, OS, BI, *COOE*₂, *A*, *L*₁, *SIT*₂, and *COOE*₁ dimensions. Additionally, a third group comprises the PR, E, OS, BI, *COOE*₂, *A*, *L*₁, *SIT*₂, *COOE*₁, and BH dimensions. Lastly, the fourth group, representing the least effectively implemented dimensions, consists of E, OS, BI, *COOE*₂, *A*, *L*₁, *SIT*₂, *COOE*₁, BH, and P.

Table 4 - Statistical results by dimension based on instructors' perceptions.

Dimensions	Pakistan		Portugal		Spain		United Kingdom	
	AS	\bar{R}	AS	\bar{R}	AS	\bar{R}	AS	\bar{R}
<i>L₁</i>	3.649	7.645	2.408	8.150	2.002	8.500	2.007	4.444
<i>L₂</i>	4.318	3.645	2.087	9.450	1.886	9.182	1.740	6.902
BH	3.448	8.645	3.682	3.633	2.862	4.243	1.785	6.833
BI	3.544	7.161	2.427	6.966	2.083	7.365	1.811	5.236
<i>SIT₁</i>	4.226	5.161	2.249	8.600	2.003	8.585	1.693	8.138
<i>SIT₂</i>	3.763	7.677	3.329	4.566	3.125	4.109	1.788	6.930
E	3.812	6.483	2.299	8.266	2.286	7.524	1.670	8.111
PR	4.112	5.516	2.083	9.533	1.755	10.000	1.708	7.791
A	3.592	7.500	2.664	6.800	2.151	7.829	1.626	8.416
OS	3.628	6.870	2.944	5.683	2.370	6.731	1.721	7.611
P	3.260	9.435	<i>3.413</i>	4.150	<i>2.936</i>	3.731	<i>1.861</i>	6.138
<i>COOE₁</i>	3.484	7.967	2.325	8.083	2.483	5.914	1.726	7.444
<i>COOE₂</i>	3.658	7.290	2.495	7.116	2.224	7.280	1.759	7.000

Bold face indicates best performance. Second best results are in italic.
 AS: Average Score; \bar{R} : Mean Ranking.

In Portugal, results from the Nemenyi test ($\alpha=0.05$) indicate that instructors do not perceive statistically significant differences in implementation levels across the highest-ranked dimensions: BH, P, *SIT₂*, OS, and A. A second grouping, perceived at a slightly lower level of implementation, includes dimensions P, *SIT₂*, OS, A, BI, and *COOE₂*. The third group, positioned lower in implementation, encompasses OS, A, BI, *COOE₂*, *COOE₁*, *L₁*, E, and *SIT₁*. Finally, the fourth group, indicating the least effectively implemented dimensions, comprises A, BI, *COOE₂*, *COOE₁*, *L₁*, E, *SIT₁*, *L₂*, and PR.

For Spain, the Nemenyi test ($\alpha=0.05$) indicates that instructors perceive similar implementation levels for the highest-ranked dimensions, specifically P, *SIT₂*, BH, and *COOE₁*, without significant differences. Following this, the next grouping in implementation levels includes *SIT₂*, BH, *COOE₁*, and OS. At a lower level, a third group emerges, comprising *COOE₁*, OS, *COOE₂*, BI, E, A, *L₁*, and *SIT₁*. An additional set, perceived at an even lower level of implementation, includes OS, *COOE₂*, BI, E, A, *L₁*, *SIT₁*, and *L₂*. Finally, dimensions with the lowest observed levels of implementation are *COOE₂*, BI, E, A, *L₁*, *SIT₁*, *L₂*, and PR.

In the United Kingdom, the Nemenyi test ($\alpha=0.05$) shows that instructors view the implementation of certain dimensions as similarly high, with no significant differences detected among them (*L₁*, BI, P, BH, *L₂*, *SIT₂*, *COOE₂*, and *COOE₁*). A second set of dimensions with slightly lower implementation ratings includes BI, P, BH, *L₂*, *SIT₂*, *COOE₂*, *COOE₁*, OS, PR, E, and *SIT₁*. Finally, dimensions considered to have the lowest levels of implementation are P, BH, *L₂*, *SIT₂*, *COOE₂*, *COOE₁*, OS, PR, E, *SIT₁*, and A.

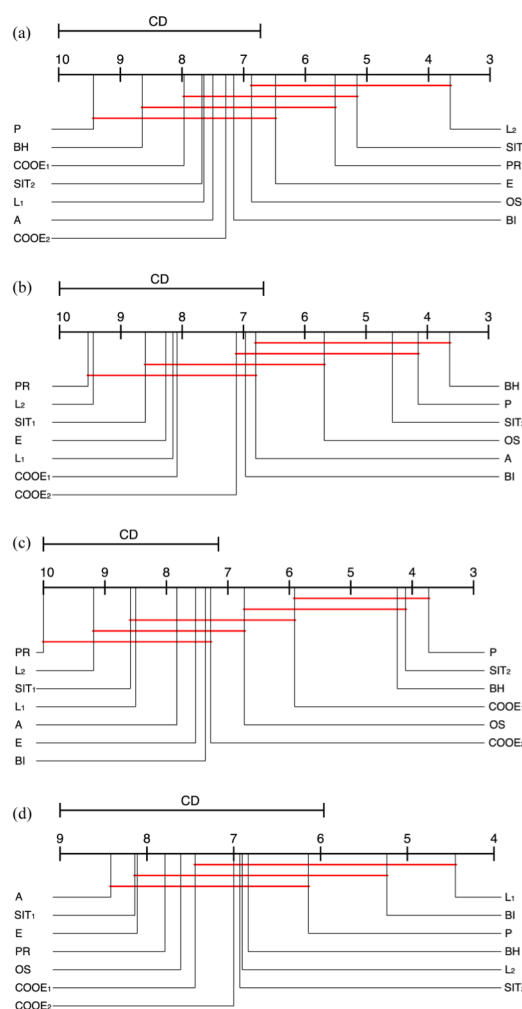


Figure 1 - Educators' perspectives on the implementation of studied dimensions across different countries: (a) Pakistan, (b) Portugal, (c) Spain, and (d) the United Kingdom.

5. Discussion and Conclusions

5.1 Confirmatory factor analysis

In this analysis, the relationships with the highest Est./S.E. values are presented in Table 2. The five most significant relationships are (i) SIT₁ and L₂ (43.030), (ii) P and BH (38.877), (iii) COOE₂ and COOE₁ (36.919), (iv) PR and L₂ (35.959), and (v) L₂ and L₁ (35.540). The relationships selected for further analysis - (i) SIT₁ and L₂, (ii) P and BH, and (iii) PR and L₂ - were chosen because they involve pairs of variables that do not belong to the same higher-order dimension, unlike L₁ and L₂, or COOE₁ and COOE₂. These relationships reveal more meaningful, cross-dimensional connections, offering insights beyond the within-dimension correlations and aligning with the underlying theoretical structure identified through CFA.

The results of this study demonstrate the combined potential of SIT₁ (divergent thinking) and L₂ (development of core soft skills in online environments) to significantly enhance students' learning experiences and outcomes in online education, which is directly relevant to interprofessional development. Divergent thinking enhances problem-solving abilities and critical thinking, while core soft skills provide practical tools for efficient research, communication, and time management. This synergy increases student engagement and motivation, fostering a more dynamic and effective learning process. In this regard, the study by Eccott et al. (2012) incorporates a scenario-based learning perspective to promote innovative problem-solving in authentic interprofessional contexts, embedding activities that strengthen key soft skills such as teamwork and communication.

This study underscores the correlation between the dimensions of P and BH, emphasizing their impact on student well-being and academic performance in online education. The balance between academic and recreational time (P) is essential for mental health and stress reduction, while addressing sedentary behavior (BH) is crucial in screen-intensive learning environments. In this regard, Fadda (2020) emphasizes that the online learning community should incorporate game-based learning strategies. These strategies enhance student engagement, reduce stress, and simulate real-world interprofessional scenarios, fostering student collaboration and teamwork.

The correlation between practical reason (PR) and soft skills (L₂) can be understood through their complementary roles in supporting both individual autonomy and effective social engagement, which is particularly relevant in the context of interprofessional development and e-learning. Practical reason involves the ability to make reasoned, ethical decisions based on critical reflection, particularly in complex or uncertain contexts. In this sense, it is closely intertwined with soft

skills which are necessary for navigating interpersonal interactions. Educators can cultivate more thoughtful, responsible, and collaborative learners, well-prepared for the demands of interprofessional development, by fostering both practical reason and soft skills simultaneously (Pien et al., 2018). These mutually reinforcing skills enable individuals to make informed, ethical decisions and execute them effectively in social and professional contexts, contributing to holistic personal and professional growth within the framework of interprofessional education and e-learning.

5.2 Statistical tests

This subsection analyzes and interprets the findings by comparing them with previous studies in the literature, with particular emphasis on how each of the countries studied is implementing life skills at the university level in online scenarios. The authors analyzed Table 3, focusing specifically on the column containing AS and \bar{R} values. The discussion centers primarily on the best-implemented dimensions, with at least one from the top three AS and \bar{R} values. Conversely, for the least-implemented dimensions, the analysis includes at least one from the bottom three AS and \bar{R} values. To enhance clarity, Figure 2 visually represents the data across all dimensions.

To begin with, Pakistan shows one of its best results regarding life skills implementation in the L₂ dimension. This assertion is supported by quantitative data, mainly through the AS (4.318) and the \bar{R} (3.645), both of which highlight Pakistan's performance in this area. In interprofessional contexts, the ability to manage time effectively and engage in self-directed learning is crucial for professionals from different fields to collaborate efficiently. In this study, L₂ dimension is linked to self-study and time management, among other soft skills in this study. Our findings align with Khan et al. (2018), who demonstrated that Pakistani online instructors carefully design their teaching strategies to foster student autonomy. Specifically, the study emphasized the importance of providing students with resources to assist them when they encounter challenges with new concepts or experience difficulty in understanding. Participants reported that e-learning offered valuable guidance in the professor's absence, fostering self-directed learning and enabling more effective study.

Pakistan has one of the lowest scores for implementing life skills within the P dimension, with an AS of 3.260 and a \bar{R} of 9.435. However, it's important to note that this dimension still has a score above 3 on a 1-5 scale, suggesting that teachers don't consider it poorly implemented, despite rating it lower than others. The P dimension focuses on balancing academic and personal time, which is particularly relevant in the context of interprofessional development. One challenge in this dimension is the unclear boundary between academic and personal time, a critical issue for students and

professionals in interprofessional settings. Studies conducted within the context of Pakistani culture provide insights into these issues. For instance, the pervasive nature of communication in online education exacerbates these challenges, creating additional pressures and blurring the lines between personal and professional life (Abid et al., 2023). The study highlights how personal privacy is affected, as educators often use parts of their homes for recording classes, which intrudes on personal space. In contrast, Shuja et al. (2019) approaches the issue from a more positive perspective, emphasizing mobile learning. This approach enhances flexibility, allowing students to blend leisure and learning more effectively and engage in autonomous learning outside of formal class settings. The widespread use of smartphones fosters interaction and access to diverse information sources.

Similarly to Pakistan, the results from Portugal show consistently high performances overall. However, different from this country, the distribution of the results was more uneven across dimensions, following a pattern very similar to the one found in Spain (Figure 2). In fact, three dimensions stand out from the rest. In two of them (BH and P), the scores are the highest registered in the study. The best performance in Portugal concerns the BH dimension with an AS of 3.682 and a \bar{R} of 3.633. This is not surprising as the importance of designing healthy learning environments has become paramount for online educators in recent years. In the aftermath of the COVID-19 pandemic, attention to mental health issues has been highlighted in the literature worldwide, drawing from the lessons learned in that context (Al-Kumaim et al., 2021). Nuryana et al. (2023) identified as many as 1456 articles published on student stress and mental health topics related to online learning in this period. In Portugal, the concern with student burnout was shared by teachers and parents alike (Seabra et al., 2021). This has led to a shared awareness amongst online learning teachers and designers on the importance of the BH dimension and how it should be fully developed in online learning design.

The second-best result is obtained in the P dimension with an AS of 3.413 and a \bar{R} of 4.150. This is less surprising as it corresponds to a more typical concern in online educational design good practices. As Lasfeto (2020) demonstrates, there is a significant relationship between students' self-directed learning readiness and their social interaction. Therefore, creating social interaction spaces for online learners to meet, network, and share, allowing them to balance academic and recreational time, is a major factor in the successful design of online learning experiences. The third dimension with the highest performance in Portugal is SIT₂. Differently from what was found in Pakistan, Portuguese participants in the study consider convergent thinking to be more implemented in online education practices.

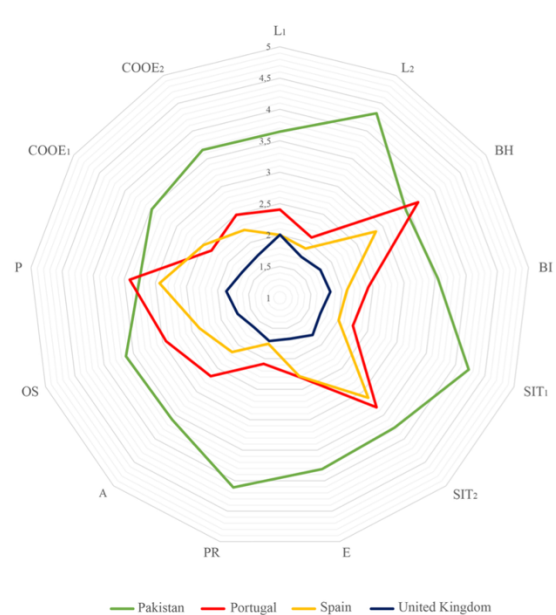


Figure 2 - Implementation of studied dimensions across countries from educators' perspectives.

This results from the combination of two perceptions. One is that online learning is already perceived in Europe as a part of mainstream educational practices. By contrast, in Asian countries, online learning is mostly identified as an innovative and disruptive form of learning. Secondly, resulting from the poor pedagogical practices of Emergency Remote Teaching (ERT) during the COVID-19 pandemic, most of the current practices relate to passive learning methodologies and not to the ones fostering learners' creativity. This finding is supported by the result from the PR dimension, which we address below. It is interesting to note, though, that Portuguese educators are also the participants in the study, which gives the second highest score to SIT₁. However, the difference between the scores given to divergent and convergent thinking (represented respectively by the SIT₁ and SIT₂ dimensions) is quite substantial.

It is also worth mentioning that the score given in Portugal is related to the OS dimension. The potential of online learning to foster learners' environmental awareness, namely by reducing the carbon footprint, has been demonstrated by Otto et al. (2019), Perbandt et al. (2021) and other studies.

On the contrary, the lowest performances in Portugal are found in the L₂ and the PR dimensions. Regarding the first case, the result is the opposite of what has been found in Pakistan but is closer to the situation in Spain. This result confirms the critical importance of developing students' digital skills and competencies for successful online learning. As to what concerns the right to freedom of thought, conscience, and religion in the learning process, the result found in Portugal, like the one found in Spain in this respect, shows a

perception amongst teachers and designers that online learning pedagogy should further explore learner's critical thinking and other higher-order skills.

The results obtained in Spain, particularly in the P dimension, highlight the effective implementation of balancing academic and personal time, which is highly relevant to interprofessional development. Spain's strong performance in this dimension, with the second-highest position in AS (2.936) and the top position in \bar{R} (3.731), indicates that educators in Spain prioritize the integration of academic responsibilities with personal time, a critical factor in fostering well-being and collaboration in interprofessional contexts. However, the flexibility of e-learning, as noted in the scientific literature within the Spanish context does not offer conclusive evidence on this matter. For instance, the study of Xavier and Meneses (2022) suggests that the flexibility of e-learning benefits some students by enabling them to balance personal and academic responsibilities effectively. Conversely, the same study highlights that other students face challenges in establishing clear boundaries, resulting in the encroachment of academic tasks into their personal time. It is important to note that P, which focuses on balancing academic and recreational time, is ranked the lowest in Pakistan and the highest in Spain. This discrepancy may be attributed, in part, to cultural and structural differences in both countries. In Pakistan, the prioritization of academic success and the societal pressure on students to perform may limit opportunities for recreational activities, leading to a reduced emphasis on balancing study with leisure. Conversely, in Spain, the cultural value placed on work-life balance and well-being, along with a more supportive infrastructure for extracurricular activities, likely facilitates a healthier integration of academic and recreational time. These factors may contribute to the relative rankings observed between the two countries.

On the other hand, the PR dimension, which focuses on practical reasoning, is the lowest rated by Spanish educators in terms of implementation (AS=1.755 and \bar{R} =10.000), indicating that this area may require more attention, particularly in interprofessional development and e-learning. Practical reasoning is critical in interprofessional settings, where professionals from different fields must make ethical and informed decisions collaboratively. This finding aligns with other researchers suggesting that Spanish instructors should prioritize enhancing this dimension. For instance, the study of Olcott et al. (2015) presents a code of ethics that outlines several principles for using technologies, emphasizing the importance of respecting the plurality of societal values in digital educational processes. Consistent with the low scores in life skills implementation, the L₂ dimension in Spain also point to a need for improvement in preparing students for interprofessional collaboration (AS=1.886 and \bar{R} =9.182). This dimension pertains to the development

of soft skills. Within the Spanish context, Galindo-Domínguez and Bezanilla (2021) stress the significance of implementing programs designed to enhance higher education students' digital competencies. These programs specifically aim to improve self-management abilities and promote overall well-being. By equipping students with the necessary tools, these initiatives enable them to manage their academic responsibilities more effectively while also fostering a healthy balance in their personal lives. Finally, with an AS of 2.002 and a \bar{R} of 8.500, the L₁ dimension ranks among the lowest in life skills implementation, highlighting the need for greater emphasis on lifelong learning, particularly in the context of interprofessional development and e-learning. This dimension focuses on personal and professional growth in learning contexts. Recommendations should align with literature from the Spanish context, which advocates for continued development due to the observed correlation between lifelong learning and securing employment contracts, as highlighted by Martínez-Cerdá and Torrent-Sellens (2017).

In the United Kingdom, educators identify the L₁ dimension as the most effectively implemented, as evidenced by quantitative results, with an AS of 2.007 and a \bar{R} of 4.444. It should be noted that, despite the privileged position in terms of dimensions ranking, from the educators' point of view, quantitative data does not indicate a highly competitive value. In this study, L₁ is understood as personal and professional growth within the educational context. This subject has garnered attention in educational research within the United Kingdom context. For example, the study of Tuckett (2017) emphasizes that fostering a culture of lifelong and life-wide learning requires supportive measures at the sub-regional level, necessitating government investment. Also, the study of Eynon and Malmberg (2021) suggest that lifelong learning is a crucial tool for addressing social inequalities. However, it must be structured to ensure equitable access for all, not just those with more resources. Additionally, the BI dimension, which relates to cybersecurity issues in this study, is also highlighted as one of the best-implemented life skills. Again, despite its favorable arithmetic average, the AS of 1.811 and the \bar{R} of 5.236 may not indicate substantial or meaningful outcomes. This finding is consistent with the results of studies carried out in the United Kingdom context. Literature suggests that students generally possess only a basic understanding of online privacy and security (Almekhled and Petrie, 2023). Moreover, the same study reveals that only a third are aware of their university's policies on these matters, and a mere 2.5% have yet to receive any training on the subject.

In contrast, the low scores for the A dimension (AS=1.626 and \bar{R} =8.416) in the United Kingdom context highlight challenges in fostering social interactions and a sense of community in online

learning environments, which are critical for interprofessional development and e-learning. In interprofessional settings, collaboration requires strong social bonds and effective communication, which are often hindered when digital interactions fall short of expectations. The study of Xu and Rees (2016) provides valuable insights into this finding within the context of the United Kingdom. They explain that digital interactivity, while facilitated by technology, falls short of the expected quality. This shortcoming is attributed to the absence of opportunities for students to explore ideas with instructors beyond the virtual classroom setting. The study also reveals that the absence of face-to-face interaction allows students with learning difficulties to remain unnoticed by teachers until assessment time. Finally, the E dimension is also identified by educators from the United Kingdom as one of the least effectively implemented areas, as reflected in quantitative measures, with an AS of 1.670 and a \bar{R} of 8.111. This study's dimension is associated with the importance of emotions in the learning process. A possible explanation for this finding aligns with the research of Reid et al. (2016), who suggest that British students often experience negative emotions in online learning due to low-quality teaching materials, adversely affecting their learning outcomes. To enhance interprofessional development, educational strategies should prioritize improving digital interactivity and addressing the emotional needs of learners, ensuring that both social and emotional dimensions are effectively integrated into online environments.

To conclude, this study significantly advances academic research on interprofessional development by exploring how cultural contexts and educational practices influence the development of diverse skill sets in university environments. It further enriches the literature by applying the CA framework to evaluate core interprofessional competencies within culturally diverse e-learning contexts. Finally, based on empirical data from four countries (Pakistan, Portugal, Spain, and the United Kingdom) this research provides strong evidence of the essential role universities play in developing students' interprofessional skills, enabling them to thrive in dynamic and multidisciplinary professional settings.

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Connecting the dots: the role and potential of portfolios in lifelong teacher development in Italy

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Abstract

Lifelong learning is a cornerstone of teacher professionalism, enabling educators to navigate the complexities of a rapidly evolving educational landscape. This paper examines the roles of portfolios, particularly e-portfolios, as tools for fostering reflective practice, professional growth, and the development of competencies across the continuum of teacher education: Initial Teacher Education (ITE), induction, and Continuous Professional Development (CPD). Drawing on established models and recent educational reforms, this position paper examines several critical dimensions that shape the effective implementation of portfolios. Using the Italian education system as a case study, the paper explores how recent reforms and prior experiences can be leveraged to enhance the integration of lifelong portfolios, ensuring continuity and coherence throughout teachers' professional trajectories. Emphasis is placed on the importance of aligning portfolio practices with professional standards, establishing robust training programs, and developing supportive cultural and technological infrastructures. By addressing the opportunities and challenges of embedding portfolios in teacher education, this research contributes to the broader discourse on fostering systemic approaches to professional development and improving the quality of education.

KEYWORDS: Portfolios, Lifelong Learning, Teacher Development, e-Portfolios, Reflective Practice.

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1. Introduction

Lifelong learning has emerged as a cornerstone of teacher professionalism, serving as a critical mechanism for maintaining high-quality education systems and equipping educators to adapt to the complexities and rapid changes of contemporary society. The Council Conclusions on European Teachers and Trainers for the Future (2020/C 193/04) underline the importance of embedding lifelong learning into the career pathways of educators, emphasizing the need for coherent frameworks that seamlessly connect Initial Teacher Education (ITE), induction, and Continuous Professional Development

(CPD). Similarly, OECD studies (Boeskens et al., 2020; OECD, 2024) highlight that achieving such continuity requires addressing systemic challenges, particularly the alignment of multiple stakeholders' interests and policies.

In this context, the concept of the portfolio and more recently the electronic portfolio (e-portfolio or digital portfolio), has gained prominence as a dynamic and versatile tool for fostering professional growth. Initially conceived as a repository for documenting and assessing teacher competencies, portfolios have evolved into comprehensive instruments for reflective practice, self-assessment, and career planning (Zeichner & Wray, 2001). They enable teachers to integrate formal, non-formal, and informal learning experiences, creating a holistic view of their professional journeys. The integration of digital technologies, particularly since the 1990s, has amplified the potential of portfolios, offering platforms for curating teaching artifacts, promoting collaborative practices, and enhancing technological proficiency in the classroom (Harun et al., 2021).

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The Italian education system provides a relevant case study for exploring the implementation of digital portfolios across the continuum of teacher professional development. Italy has made significant strides in institutionalizing the portfolio within all phases of teacher education – ITE, induction, and CPD – positioning it as a core element in recent educational reforms. However, despite these advances, challenges remain in operationalizing portfolios to their full potential and providing coherence and continuity in their use. Achieving coherence across career stages requires addressing cultural, technological, and policy-related factors that influence their adoption and efficacy.

It therefore becomes relevant, at this point, to explore the indications coming from the research in order to collect useful indications aimed at improving the characteristics and use of these tools. Drawing on general models of portfolios established in the literature, we identify critical dimensions that shape their effectiveness. The discussion is further contextualized within the Italian education system, providing insights into the opportunities and challenges of implementing e-portfolios as a systemic tool for professional development.

Global trends, such as the acceleration of technological advancements and the increasing demand for sustainability in education, underscore the relevance of revisiting the portfolio model. As educators navigate a rapidly changing professional landscape, portfolios offer a means to reconcile diverse and evolving experiences, enabling teachers to align their development with broader educational goals. Moreover, the integration of artificial intelligence and advanced digital tools holds the potential to make this process more accessible, efficient, and impactful.

By addressing these themes, this paper contributes to the ongoing dialogue on how portfolios can be leveraged as instruments for lifelong learning, fostering both individual growth and systemic improvements in teacher education.

2. Materials and Methods

This article adopts an argumentative and reflective approach, typical of a commentary or position paper, to examine the role of portfolios in teachers' continuous professional development, with a specific focus on the Italian context. The primary goal is not to provide an exhaustive review of the literature but rather to offer a critical and well-informed perspective, capable of highlighting the challenges, opportunities, and implications associated with using portfolios as a professional development tool with a dedicated focus on the Italian context.

The commentary is an academic genre that allows scholars to stimulate debate through expert analysis and a targeted selection of the most relevant sources. Unlike systematic reviews (Newman & Gough, 2020), which rely on strict criteria for literature selection and synthesis, and narrative reviews (Baumeister & Leary, 1997), which aim to provide a broad and contextualized overview of research, a position paper enables a more focused and interpretative analysis based on an intentional selection of studies, institutional documents, and strategic reports. This approach is particularly well-suited for addressing complex and evolving topics, such as the implementation of portfolios in teacher education, as it allows for the integration of scientific evidence and policy recommendations within a coherent and applicable framework.

The selection of sources was guided by the criterion of conceptual relevance and significance for academic and educational policy debates. We therefore included:

- studies focusing on the application, impact, or evaluation of portfolios in teacher education;
- publications addressing portfolio use in specific professional stages (ITE, Induction, CPD) and their alignment with professional standards;
- research emphasizing portfolio use for reflective practices, professional growth, and assessment mechanisms.

The following sources were included:

- *key academic studies*: studies that have significantly influenced research on portfolios impact in the different stages of teacher education were prioritized. To enrich the perspective, contributions exploring the evolution of portfolio research and emerging challenges, including institutional resistance and difficulties in evaluating the effectiveness of these tools, were integrated.
- *institutional reports and policy documents*: to understand the regulatory framework, strategies adopted and recommendations provided in international education systems, institutional reports from organizations such as OECD (2024) and the European Commission (European Commission/EACEA/Eurydice, 2021) were selected, providing a comparative analysis of teacher education policies across different countries.
- at the Italian level, the *guidelines of the School of Advanced Training of Instruction (SAFI) and ministerial provisions* on the use of portfolios in initial teacher training and the induction period for newly hired teachers were considered.
- *national experiences and portfolio experimentation*: the analysis was enriched by studies and documents describing the implementation of portfolios in teacher education in Italy (Rossi et al., 2017; Pettenati et al., 2024), with particular attention to

their use in the probationary period for newly hired teachers.

These studies allow for an assessment of the extent to which the Italian experience can serve as a reference model for a broader integration of portfolios as a systemic tool for professional development.

Since source selection in a commentary is strategic and targeted, rather than systematic, it is important to clarify that while this is not a systematic review, this contribution integrates key references from academic literature and educational policy reports to provide a solid basis for discussion.

From a theoretical perspective, the construction of the argument involves formulating a central thesis supported by selected evidence, avoiding a descriptive or purely speculative approach.

The analysis revolves around key questions, including:

- what impact portfolios can have in teacher education at different stages of professional development?
- which general model and descriptors can apply to a lifelong teacher portfolio?
- how can the affordances of the Italian teacher education reform and experiences be leveraged to enhance the potential of the integration of lifelong teacher portfolios to ensure continuity and coherence across the professional lifecycle of educators?

Within this framework, the commentary seeks to position itself within the academic and policy debate, seeking to provide an integrative perspective on the potential of teacher portfolios as tools for professional development, while identifying gaps and areas for future research.

3. Results

3.1 Continuity in Teacher Education: an analysis of international policies

Teacher education is a multifaceted field facing several challenges, including disagreements among experts and policymakers, differing priorities regarding pedagogy, subject matter, and student knowledge, as well as a persistent disconnect between theory and practice. Furthermore, there is often a lack of coherence between initial teacher education and continuing professional training. Comprehensive and cohesive policies are essential to address these issues, attract high-quality candidates to the profession, and retain them over time (Musset, 2010). The structure of teacher education programs varies across countries, is influenced by tradition and system-specific characteristics which require careful analysis before implementing reforms. To this end, it is essential to refer to recent international studies, such as those by the European Commission: Directorate-General for Education, Youth, Sport and

Culture (2023), the European Education and Culture Executive Agency: Eurydice (2023), and European Commission/EACEA/Eurydice (2021). These reports provide both comparative insights and country-specific analyses, enhanced by tools like the Teaching Profession section of the Education and Training Monitor Toolbox which allows for effective data visualization and dynamic countries comparison.

In most OECD countries, policy debates and resources tend to concentrate on initial teacher education, emphasizing the skills required at the beginning of teachers' careers and certification pathways, whether through traditional programs or alternative routes. However, continuing professional training has received comparatively little attention (Musset, 2010). Teacher education should instead be conceptualized as a continuum, with intrinsic connections across its stages – initial teacher education, induction, and continuing professional development (CPD). For this to be realized, Musset (2010) identifies a set of policy recommendations, among which it's worth citing the following:

- connect initial education, induction, and continuing training to create coherence and synergy.
- build continuing training on the foundation of initial education to adapt to changes in the teaching environment.
- focus on output-based criteria (skills and competencies) rather than input-based (coursework).
- design programs that address specific school needs and encourage collaboration among teachers.
- use systematic feedback mechanisms to improve teaching quality.
- ensure complementarity between theoretical knowledge and practical experience.
- promote shared responsibility between schools and training institutions to address the theory-practice gap.

The call for the development of educational policies that establish career trajectories for teachers and support lifelong professional development has been reiterated recently in the United Nations Secretary-General's High-Level Panel on the Teaching Profession (2024). This report provides several significant recommendations, including the following (p. 8):

Recommendation 29: Governments should develop policies that outline clear career pathways and allocate resources and personnel dedicated to teacher professional development and lifelong learning within well-defined vertical and horizontal career trajectories.

Recommendation 30: Governments should implement accountability measures and robust

evaluation systems for teaching. These systems should employ methods for assessing teacher performance that take into account the complexity of teachers' roles in diverse educational settings. The ultimate aim should be to enhance the quality of teaching and its impact on learning through formative support and continuous improvement.

3.2 Reflexivity as a core competency of lifelong learning

The OECD document *Policies to support teachers continuing professional learning: A conceptual framework and mapping of OECD data* (Boeskens et al., 2020) highlights reflection as a core competency for teachers, central to effective professional learning and continuous improvement. Reflective practice is characterized as a process that allows teachers to critically examine their methods, evaluate their impact on student learning, and adapt to meet the diverse and evolving needs of their classrooms. The document underscores the importance of fostering teachers as reflective practitioners who engage in systematic inquiry into their teaching practices, thus enhancing their professional autonomy and capacity for innovation. Reflection is presented not only as an individual process but also as a collective endeavor. Teachers are encouraged to collaborate with peers, share experiences, and engage in joint problem-solving to deepen their understanding of effective pedagogical approaches. The document also emphasizes that reflective practice is most effective when embedded in context-based professional learning, which aligns teacher inquiry with the specific goals and challenges of their school environment.

3.3 Portfolio's potential in teacher education

At international level, research on teacher portfolios, particularly in Initial Teacher Education (ITE), has expanded significantly since the 1990s, emphasizing their potential to provide a holistic view of student growth and the development of professional qualities essential for effective teaching (Darling, 2001). Portfolios are recognized for their role in supporting reflection, fostering professional growth, and serving as tools for assessment (Babin et al., 2002). This shift aligns with broader educational paradigms, moving from instructional delivery to creating active, reflective learning environments. Despite their advantages, challenges such as resistance among educators ("portfolio paranoia") and implementation difficulties, including unclear guidelines and perceptions of portfolios as bureaucratic burdens, have hindered their widespread acceptance (Wolverton, 1996; Babin et al., 2002; Shepherd & Skrabut, 2011).

Formative portfolios focusing on teacher development are shown to be more effective in supporting

professional outcomes compared to summative portfolios aimed at accountability (Beck, Livne & Bear, 2005). The need for systematic research to examine the quality of reflection and assessment enabled by portfolios is critical, as argued by Zeichner and Wray (2001). Granberg (2010) highlights e-portfolios as tools for archival purposes, summative assessment, and learning, while also noting barriers such as inconsistent educator understanding and prioritization of summative evaluation. Similarly, Imhof and Picard (2009) stress that portfolios are most effective when supported by clear communication, robust mentorship, and integration into a cohesive training framework.

E-portfolios, as highlighted by Harun, Hanif, and Choo (2021), have transformative potential, fostering reflective, metacognitive, and technological skills while promoting collaboration and professional identity development. However, challenges like insufficient technological support, time constraints, and privacy concerns require comprehensive strategies for their effective integration into teacher education programs.

More recently, Feder and Cramer (2023) emphasized the need for robust quantitative data to assess portfolio effectiveness. Their review of 246 studies reveals that most research focuses on user perceptions rather than measurable outcomes such as professional competencies or reflective writing quality. They thus advocate for further investigation into the direct and indirect effects of portfolios, leveraging innovative methods like computer-based text analysis to address the gap between policy-driven adoption and science-based evidence.

Overall, these studies underscore portfolios' potential to bridge theoretical and practical elements in teacher education, supporting professional development and reflective practices. However, their success depends on clear objectives, institutional and technical support, effective mentorship, and a systematic approach to addressing barriers such as variability in readiness and resource limitations.

The transition from pre-service teacher education to professional teaching contexts highlights the evolving role of ePortfolios. Boulton (2014) emphasizes their value in fostering professional identity, reflective practice, and self-regulation during pre-service training, while also aiding in aligning teaching practices with professional standards. However, their use diminishes during the Newly Qualified Teacher (NQT) phase, shifting focus to personal and professional development. A key challenge lies in the limited adoption of e-portfolios within school systems, reducing their effectiveness during the induction phase. The study underscores the importance of integrating e-portfolios into teacher education and professional development systems, bridging the gap between university training and ongoing professional growth. Further research is recommended by the author to

explore their long-term relevance across diverse educational contexts.

Mokone and Setlalentoa (2023) extend this focus by examining the role of e-portfolios, supported by mentor teachers, in enhancing beginner teachers' self-efficacy. Their findings highlight the effectiveness of e-portfolios in reflecting on teaching practices, personal growth, and professional development. Mentor support is critical, offering feedback and guidance that fosters confidence and professional identity. The study concludes that e-portfolios, combined with sustained mentorship, significantly enhance beginner teachers' efficacy. Again, institutional adoption of e-portfolios as part of induction and professional development programs is recommended, along with further research to assess their long-term impact and potential to create coherence within teacher education systems.

Eventually, studies on the use of portfolios in Continuous Professional Development (CPD) are less frequent and often involve smaller sample sizes and qualitative methodologies.

Hamilton (2018) highlights the role of teaching portfolios in facilitating the transition from classroom teacher to teacher educator. Her self-study emphasizes portfolios' effectiveness in fostering critical reflection, professional identity formation, and scholarship in teaching. Portfolios also bridge gaps between teaching and teacher education, supporting evidence-based reflection and collaborative feedback to drive personal and professional growth. The study underscores the importance of supportive environments for novice teacher educators to navigate institutional barriers and align practices with evolving philosophies.

Chou (2012) examines e-portfolios' impact on technological and vocational schoolteachers in Taiwan, finding significant links between e-portfolio acceptance, computer self-efficacy, and teacher evaluation effectiveness. E-portfolios enhance instructional design and professional growth, particularly for formative evaluations aimed at improving teaching practices. However, robust technology training and support are indicated as essential for effective integration.

Kabeta et al. (2013) explore teaching portfolios in Ethiopian primary schools, noting their perceived benefits for self-reflection, professional development, and student progress tracking. However, barriers such as time constraints, insufficient training, and attitudinal resistance are pointed out as they hinder effective implementation. Recommendations include better mentor training, clear standards, and the integration of self and peer assessments.

Aras (2021) examines portfolios' impact on in-service early childhood educators, emphasizing their role in reflective practice, needs assessment, and professional growth. Portfolios, particularly those including multimedia evidence like video recordings, provide

valuable insights into classroom practices and foster goal-oriented development. They also serve as archival records of professional journeys, motivating teachers by documenting progress.

Espinoza and Medina (2021) study e-portfolios among in-service English teachers, highlighting their role in enhancing technological skills, reflective practices, and collaborative learning. Teachers valued e-portfolios for promoting innovative teaching strategies and showcasing professional growth. Again, challenges include the time-intensive nature of e-portfolio creation and limited technological resources. Overall, e-portfolios are recognized as effective tools for professional development, with the potential to improve teaching strategies and engagement with digital tools.

The adoption and study of teacher portfolios have gained traction in Europe, including Italy, following advancements in the Anglo-Saxon context (Imhof & Picard, 2009). Early Italian research, such as Rossi (2005) and Rossi & Giannandrea (2006), introduced a systemic approach, proposing a general model applied to three portfolio types: student, teacher, and institutional. This innovative perspective highlighted the potential synergies between these portfolios, structured around portfolio construction phases such as collection, selection, reflection, connection, direction, and public presentation. Italian portfolio early applications focused mainly on initial teacher education (ITE) for early childhood and primary teachers.

Giannandrea (2016) built on the multiple experiences to propose a holistic framework for e-portfolio use in lifelong education, emphasizing personalization, flexibility, external scaffolding, and alignment with educational goals. E-portfolios were presented as dynamic tools fostering reflective learning and professional skill development. These principles informed the large-scale implementation of digital portfolios in Italy, particularly for Newly Qualified Teachers, starting with a pilot in 2014/15 (Rossi et al., 2015; Mangione et al., 2016), formalized in 2015/16 (Rossi et al., 2017; Pettenati et al., 2022), and revised in 2023/24 (Di Stasio et al., 2021; Pettenati et al., in press). Over ten years, more than 350,000 teachers have used a digital portfolio during their probation year. This large scale experimentation provided valuable insights into their perceived value and lifelong potential (Pettenati et al., 2024).

Giannandrea (2017) emphasized the role of e-portfolios in fostering a culture of trust in teacher training, highlighting their versatility in documenting experiences, enabling reflection, and supporting professional growth. Challenges such as balancing reflective and evaluative purposes were addressed through strategies like open badges to enhance authenticity. Fanni (2023) conducted a systematic review of Italian literature, analyzing 24 studies from 2001 to 2021. Results confirmed e-portfolios'

effectiveness in promoting reflection, self-assessment, and Continuous Professional Development, but noted their limited use outside the probation year due to technical and resource constraints. Further research was recommended to explore new applications and overcome challenges, reaffirming the pedagogical value of e-portfolios in fostering transformative learning and critical thinking.

3.4 A general teachers portfolio model

In 2005, Pier Giuseppe Rossi (2005) synthesized existing international portfolio models and proposed a new general model (ivi, pp. 69-78) structured into five phases of the portfolio construction process: Collection-Selection-Reflection/Connection-Direction-Public Presentation. This model served as the foundation for large-scale teacher portfolio implementations tested in subsequent years for Newly Qualified Teachers (Rossi et al., 2017). The outcomes of this multi-year research experience informed the redefinition of a new general model, which is centered around Teacher Standards to facilitate self-assessment and the evaluation of competencies essential for professional practice (Di Stasio et al., 2021).

The updated model is organized around four core functions: Documentation, which entails the curated collection of materials evidencing professional development; Reflection and Narrative, where teachers connect selected materials to articulate their competencies and growth; Projection, enabling teachers to assess their skills against a professional competence profile and set future goals; and Publication, which facilitates the sharing of aspects of their professional journey with peers and other stakeholders.

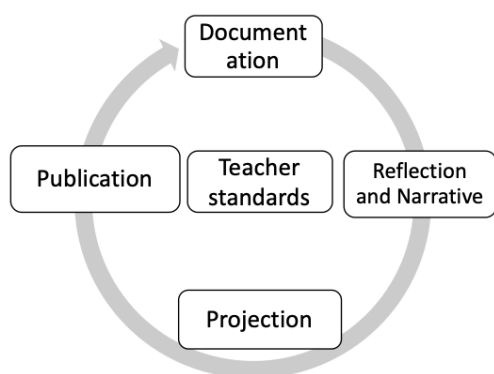


Figure 1 - Teacher's portfolio model (Di Stasio et al., 2021).

This portfolio model is designed to support teachers across all stages of their professional journey, from initial teacher education to in-service training, aligning with a lifelong learning perspective (Pettenati et al., 2025).

At its core, Teacher Standards are central to the portfolio's design, serving a dual purpose: facilitating

the evaluation of teacher performance against established benchmarks and promoting professional self-assessment and planning for future growth. These professional standards act as a cornerstone for defining the competencies, knowledge, and practices expected of teachers throughout their careers (Pettenati et al., 2024). They ensure consistency across various stages of teacher development, providing clear and actionable benchmarks for what educators should know and be able to do. Additionally, they foster a shared understanding among stakeholders – teachers, policymakers, and educational institutions – regarding the quality and expectations of the teaching profession.

The practical application of this general theoretical model requires customization to address the specific needs of teachers at different stages of their professional careers, ensuring the portfolio remains relevant and responsive to their evolving development needs.

Using the elements specified by Rossi (2005, p. 19) as an initial reference, it is possible to develop an enriched taxonomy of the components (Table 1) that should be accounted for to clearly define a teacher portfolio.

At this stage, it is therefore possible to summarize the general and ideal characteristics of the teacher portfolio in relation to the potential and specific needs of the three stages of professional development (Table 2).

3.5 The Portfolio in the Italian teacher education system

Teachers in Italy must complete higher education programs to qualify for teaching positions (Samoilă, et al., 2024). For pre-primary and primary levels, a five-year degree in Primary Education Sciences (LM-85bis) is required, which includes qualifying traineeships. For secondary school teachers, candidates must acquire at least 60 ECTS (CFU) in a structured qualifying training program covering pedagogical, disciplinary, and technological competences. Legislative changes introduced by Law No. 79/2022 revised these requirements, increasing the credits needed for teacher qualification and allowing adaptations for those with prior credits or teaching experience.

The qualification pathway for secondary school teachers involves:

1. obtaining a master's degree (or bachelor's for technical-practical teachers).
2. completing the qualifying training program with 60 CFU or adjusted credits (30/36 CFU) for those with prior experience or credits.
3. passing a national public competition involving written and oral tests and evaluation of qualifications.
4. completing a one-year probationary period (induction), with a final evaluation, to secure tenure. The induction year is regulated by a model defined in Ministry Decree 226/22.

Table 1 - Elements Defining the Teacher Portfolio.

Element	Description
<i>Function</i>	What is the purpose of the portfolio? To evaluate, guide, document, showcase, etc.
<i>Purpose / types of portfolio</i>	E.g. To define and highlight professional competencies; foster critical reflection and continuous growth; showcase achievements and milestones; support personalized learning. Types include professional portfolio, showcase portfolio, learning portfolio, course portfolio, or portfolios for specific areas or disciplines
<i>Artifacts</i>	Teaching documents (lesson plans, evaluations), teaching videos, feedback received, personal reflections, etc.
<i>Selection criteria</i>	E.g. Artifacts selected based on their relevance to learning objectives, competencies to be demonstrated, experiences to be showcased, etc.
<i>Who designs it</i>	E.g. Institutions for initial teacher education, continuous training organizations, research institutions, professional networks, etc.
<i>Who compiles and implements it</i>	Compiled by the individual using it (pre-service or in-service teacher) and implemented with or without institutional support (e.g., a tutor)
<i>Who consults or reviews it</i>	E.g. The person compiling it, mentors, tutors, school leaders, evaluation committees, etc.
<i>Implementation period</i>	Implemented during specific training or professional development periods or continuously
<i>Consultation period</i>	Consulted during evaluation phases, such as career transitions, returning from leave, or mobility processes, etc.

Table 2 - General/ideal characteristics of the teacher portfolio across the three stages of teacher development.

Element	Initial Teacher Education	Induction	In-Service Training
<i>Function</i>	Document and reflect on learning; support the evaluation of emerging competencies	Evaluate professional standards; support the construction of teacher identity	Monitor Continuous Professional Development; promote collaboration and sharing; support career transitions
<i>Purpose / types of portfolios</i>	Learning portfolio, subject-specific portfolio	Professional portfolio, self-assessment portfolio	Showcase portfolio, personalized professional growth portfolio
<i>Artifacts</i>	Lesson plans, internship reports, academic feedback, personal reflections	Actual lesson plans, classroom observations, mentor feedback, evidence of teaching practice, development or reflections on induction experiences	Certifications, educational projects, critical reflections on professional practical experiences
<i>Selection criteria</i>	Artifacts chosen to demonstrate progress in pedagogical and subject-specific competencies	Artifacts chosen to reflect on significant experiences and required standard competencies	Artifacts chosen to demonstrate ongoing improvement in teaching practices and/or the achievement of specific competencies (e.g., roles within the institution)
<i>Who designs it</i>	Universities and academic trainers	Training organizations for newly hired teachers	Continuous training organizations, professional networks, universities, research institutions
<i>Who compiles and implements it</i>	Compiled by student teachers; implemented with support from academic tutors	Compiled by newly hired teachers; implemented with support from mentors or school tutors	Compiled by in-service teachers; implemented through digital platforms and targeted training
<i>Who consults or reviews it</i>	Academic tutors, university professors	Mentors, school leaders, evaluation committees	Colleagues, school leaders, professional accreditation bodies
<i>Implementation and consultation period</i>	Implemented during academic training; consulted at the end of each module/ course, internship, and study program	Implemented during the probation year; consulted for interim and final evaluations	Continuously throughout the career; consulted for promotions professional accreditations

Teachers are employed under private-law contracts, either temporary or permanent, and governed by national collective agreements.

Professional development for teachers in Italy is compulsory, as mandated by Law 107/2015. CPD activities are organized at the school level, often in collaboration with regional networks, and must align with national priorities set by the Ministry of Education. Teachers are entitled to five days off per year for training activities.

As part of the M4C1R2.2 Reform of the National Recovery and Resilience Plan (PNRR), funded by the European Union through the Next Generation EU program, the “School of Advanced Training of Instruction” (Scuola di Alta Formazione dell’Istruzione, SAFI) was established. SAFI is a qualified body created to direct and coordinate the training of all school personnel, promoting uniform and high-quality standards across the national territory. SAFI oversees the planning of training activities for teachers, school leaders, administrative service managers (DSGA), and technical and auxiliary school staff (ATA), ensuring alignment with initial training and respect for educational autonomy. Among its main functions is the promotion of Continuous Professional Development, guaranteeing continuity between initial training and in-service training for tenured teachers, with a focus on high standards and incentivized training.

SAFI also develops guidelines for initial teacher training in collaboration with the National Institute for the Evaluation of Universities and Research (ANVUR) and university training centers, updating training programs and monitoring their effectiveness. It implements a system for monitoring and evaluation to verify the achievement of training objectives, conducting periodic accreditation checks of initial training programs through on-site visits and analysis of licensure exam results. Another SAFI key area is fostering cooperation with schools, promoting collaborative relationships to encourage teachers’ participation in training and educational research through co-design and active engagement. Finally, it collects and analyzes data on the outcomes of teacher qualification exams and probationary periods, transmitting this information to ANVUR for periodic accreditation of training programs.

On December 27, 2023, The Advanced Training School adopted the Three-Year Strategic Guidelines for the Training of School Personnel 2023–2025 (Act No. 3), introducing for the first time the portfolio as a systemic and strategic element in this teacher education segment as well.

3.6 A Comparative analysis of portfolio functions in teacher training in Italy

Based on the top-level documents defined by the Italian Ministry of Education for the three teacher training segments – ITE, Induction, and CPD – the key aspects characterizing the use and purpose of the portfolio can be summarized in Table 3.

4. Discussion and Conclusions

To address the complexity and diversity of teaching as a profession – shaped by formal, informal, and non-formal contributions throughout various career stages – the teaching portfolio emerges as a dynamic and versatile tool. It supports professional growth by fostering critical reflection and documenting significant experiences tied to expected competencies. Additionally, the portfolio functions as an evaluative and developmental instrument, tailored to the specific context and career stage of the educator.

The reviewed studies consistently emphasize the transformative potential of portfolios in fostering professional growth, reflective practices, and teaching competencies. To realize this potential, the following recommendations must be prioritized:

1. Develop clear frameworks and guidance; effective portfolios require explicit objectives, structured frameworks, and alignment with professional standards. Clear definitions of purpose and expected outcomes are essential for consistency and usability.
2. Invest in comprehensive training; teachers, mentors, and supervisors must receive targeted training on critical reflection, self-assessment, and the curation of meaningful artifacts. Training should also focus on equipping mentors – of the different teacher education programs – with skills to provide constructive feedback that enhances portfolio utility.
3. Overcome technological and logistical barriers; robust technological support is vital for e-portfolios, including reliable platforms, privacy safeguards, and equitable access to resources. Institutions must also allocate sufficient time for portfolio creation and review to reduce the burden on educators.
4. Foster collaborative and reflective practices; portfolios thrive in environments that encourage collaboration among educators, mentors, and peers. Establishing structured opportunities for feedback and shared reflection, such as Professional Learning Communities (PLCs), enhances portfolio content and supports professional development. Digital tools, possibly AI-enhanced, could further facilitate reflective documentation and collaboration.

5. Promote acceptance and value; resistance to portfolio adoption can undermine its effectiveness. Institutions must build trust and demonstrate the value of portfolios as meaningful professional development tools rather than bureaucratic tasks. Sharing successful case studies can aid in fostering a positive perception.

The integration of Teacher Standards into portfolio frameworks has the potential to transform them into systemic instruments for lifelong learning. By standardizing different portfolio structures across career stages, they can support a seamless transition from initial education to professional development. Portfolios should enable teachers to document their growth, align their practices with institutional goals, and plan personalized learning paths.

In Italy, significant progress has been made in institutionalizing the portfolio across different stages of a teacher's career.

Recent educational reforms and the collaborative efforts spearheaded by the School of Advanced Training of Instruction demonstrate an alignment with international policy recommendations as for promoting a lifelong learning and reflexivity culture in teachers. However, while the portfolio is utilized in initial teacher education, induction, and CPD phases, its application remains heterogeneous and under-integrated into a coherent professional lifecycle. A more systemic approach is essential to fully leverage its formative and evaluative potential even if its use during the induction phase has already involved over 350,000 newly qualified teachers over the last ten years. This extensive experience has contributed to creating a "habit" of using the tool, gradually overcoming resistance toward this type of practice.

Table 3 - Summary table of the key aspects of the portfolio according to Italian regulations (ITE, Induction, CPD).

Aspect	Initial Teacher Education (ITE - Early Childhood and Primary Education, DM 249/2010)	ITE - Secondary Education (DPCM August 4, 2023)	Induction (Probation Year, DM 226/22)	Continuous Professional Development (CPD, SAFI Act 3/2023)
<i>Portfolio indication</i>	(Not explicitly stated) During the internship a reflective "final report" is indicated (Art. 10, para. 6)	Explicitly indicated during direct and indirect internship (Art. 7, para. 3)	Explicitly indicated to document all the annual probationary period (Art. 11, para. 1)	Explicitly indicated as playing a "systemic" role in documenting continuous professional growth
<i>Definition</i>	An original document integrating theoretical and practical skills acquired (Art. 10, para. 6)	A digital tool for documenting competencies and reflecting on case studies (Art. 7, para. 3)	A formative tool for documenting, reflecting on, and planning future training objectives (Art. 11, para. 2)	A digital platform for compiling certifications and self-assessments
<i>Training purpose</i>	Consolidate and rework acquired skills (Art. 10, para. 6)	Foster critical reflection and active learning (Art. 7, para. 3)	Promote ongoing professional growth and support personalized training planning (Art. 11, para. 2)	Encourage autonomous reflection on professional development
<i>Assessment purpose</i>	Component of the licensure examination (Art. 10, para. 8)	Evaluate competencies acquired during training (Art. 9, paras. 1-2)	Validate skills acquisition for the final interview (Art. 13, para. 2)	Assess the impact and outcomes of professional development programs, career progression
<i>Components</i>	Activities performed, skills acquired, integration of theory and practice	Documentation, reflective analyses, case studies, and an internship journal	Training Curriculum, self-assessments of teachers' standards acquisition, teaching activity records and reflections	Certificates, professional qualifications, skill evidence, self-assessments
<i>Completed by</i>	Interns, under the supervision of tutors and instructors (Art. 10, para. 6)	Interns, with guidance from academic tutors (Art. 7, para. 3)	Probationary teachers, with support from assigned mentors (Art. 11, para. 1)	In service teachers, within structured professional development frameworks
<i>Reviewed by</i>	Examination boards and school-based tutors (Art. 10, para. 9)	Academic and school-based tutors (Art. 10, para. 3b)	Evaluation committees (Art. 13, para. 2)	SAFI and school institutions for feedback and monitoring
<i>Usage period</i>	Applied during internships and the licensure examination	Used throughout direct and indirect internships; consulted for evaluations	Used during all the probationary year and final evaluations	Continuously updated for monitoring, professional growth, and analysis

The widespread exposure to the portfolio has laid a foundation for leveraging this familiarity to accelerate its adoption for continuing professional development (CPD), since teachers are more inclined to embrace a tool they already know and have experienced as effective.

One key factor in the effectiveness of the portfolio lies in the collaborative elements it facilitates, particularly peer discussions and mentor support. These interactions not only enhance the quality of reflection but also provide critical guidance in aligning personal practices with professional standards. However, scaling the use of the portfolio as a generalized tool for all teachers in CPD requires careful consideration of several challenges.

A significant challenge is designing an organizational model that promotes the identification and deployment of internal mentors within schools. While the portfolio has been effectively utilized in universities and schools for small cohorts during the ITE and induction phase, scaling this approach to include the entire teaching community demands a more complex and resource-intensive structure.

The design of the portfolio must strike a balance between completeness and simplicity. Overly complex tools can discourage usage, while incomplete or superficial ones risk being perceived as ineffective. A key aspect of this balance involves the documentation required within the portfolio. It must serve its intended functions without becoming burdensome, ensuring it remains an accessible and practical tool for teachers.

To ensure coherence in teachers' professional journeys, portfolios used in different contexts—initial training, induction, and CPD—should align with the same or analogous Teachers Standards. This consistency prevents confusion and disorientation among teachers who encounter the portfolio at various stages of their careers. Maintaining alignment with professional standards fosters a sense of continuity and supports teachers in understanding how their practices evolve over time.

The experiences gained in Italy provide a valuable basis for extending the use of the portfolio to CPD on a larger scale. However, successful implementation requires addressing the challenges identified above. Policies and practices must focus on creating sustainable organizational structures, designing user-friendly yet comprehensive tools, and ensuring coherence across career phases.

Ultimately, the portfolio's potential as a transformative tool in teacher education lies in its ability to adapt to diverse contexts while maintaining a unified framework grounded in professional standards. By addressing these challenges, the education system can foster a culture of ongoing professional development that supports teachers in achieving excellence throughout their careers.

Further research is needed to explore long-term impacts, scalable models, innovative strategies and AI integration experimentation for portfolio implementation across diverse contexts. By ensuring thoughtful design and robust support, portfolios can fulfill their potential as instruments of excellence in teaching, bridging theory and practice while fostering continuous professional growth. This vision aligns with the idea of the portfolio as

“an unfolding of teachers' understandings about their development as professionals” (Aras, 2021)”

marking a critical step in advancing the quality of teacher education.

Authors' contribution

The authors fully share the conceptual framework, arguments, and conclusions of the paper. However, for the purposes of academic attribution, the sections were drafted as follows: Pettenati wrote sections 1, 3.1, 3.2, 3.4, 3.5, 3.6, and 3.7; Martinelli contributed to section 3.3; Tancredi was responsible for section 2; and all authors jointly wrote section 4.

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Is ChatGPT better than me? Analyzing the applicability of Large Language Models to the syllabus of a university course

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Abstract

This paper investigates and compares the use of three Large Language Models (LLMs), i.e., ChatGPT4, Google Gemini, and Claude 3.5, as decision support systems to plan the syllabus of a university course. The experiment was conducted in the context of the bachelor's degree in Music Informatics of the University of Milan. The course under the exam focuses on the MIDI protocol, a very technical subject in the field of sound and music computing. The responses provided by LLMs have been evaluated by the author, a domain expert who has been teaching the subject for more than 10 years. From here emerges the provocative question in the title: can an AI-based chatbot prove to be more effective than an experienced teacher in defining educational objectives, materials, and the lesson plan for a university course? The results of the experimentation show that all three LLMs enable the formulation of a fairly comprehensive syllabus, allowing for the structuring of a university course. Their responses present interesting points of convergence in terms of both structure and content, while also highlighting some specificities. At present, biases and limitations still exist that make chatbots excellent co-pilots but do not replace the role of the teacher. Finally, a generalization is proposed to outline potential benefits and risks in the applicability of LLMs to the planning of educational activities.

KEYWORDS: Large Language Models, Syllabus, University Course, Educational Activities.

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1. Introduction

Language models (LMs) are computational models that can understand and generate human language. They have the transformative ability to predict the likelihood of word sequences or generate new text based on a given input (Chang et al., 2024). The most common types of LM are N-gram models, which estimate word probabilities based on the context (Brown et al., 1992). Large Language Models (LLMs) are sophisticated models with vast parameter counts and exceptional learning capabilities. At the heart of many LLMs, such as GPT-3 and GPT-4, is the self-attention mechanism

within the Transformer architecture, which serves as the essential component for language modeling. Transformers have impacted the field of Natural Language Processing (NLP) by efficiently handling sequential data, enabling parallel processing, and capturing long-range dependencies in text (Vaswani et al., 2017).

A noticeable feature of LLMs is *In-Context Learning* (ICL), where the models generate text based on a provided context or prompt, leading to more coherent and contextually appropriate responses, making them well-suited for conversational and interactive tasks (Brown et al., 2020). ICL refers to the ability of a language model to generate output based on given instructions or task demonstrations without requiring additional training or gradient updates. In other words, instead of needing extra training, LLMs can learn just by seeing examples and getting instructions.

Another aspect that plays a vital role in refining LLMs is *Reinforcement Learning from Human Feedback* (RLHF). This technique fine-tunes the model by using human-generated feedback as a reward, helping the model improve through iterative learning and

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enhancing its overall performance (Christiano et al., 2017).

Even if the foundational moment for LLMs can be traced back to the introduction of the Transformer architecture in 2017, the years 2021-2023 witnessed the proliferation of LLMs. Companies like *OpenAI*, *Google*, and *Meta* began to invest heavily in creating and deploying their LLMs. With models like *BERT*, *T5*, and more advanced versions of *GPT*, these companies made LLM technology more accessible through APIs, leading to widespread adoption in various applications. This period saw the rapid growth of AI startups and a competitive race to develop even larger and more capable models, such as *GPT-4*, *PaLM*, and *LLaMA*.

ChatGPT by *OpenAI* (chatgpt.com), *Google Gemini* (gemini.google.com), and *Claude* (claude.ai) by *Anthropic* are well-known examples of natural language processing tools driven by AI technology and trained to interact in a conversational way. In a dialogue with a human user, these chatbots are reportedly able to answer follow-up questions, admit their own mistakes, challenge incorrect premises, and reject inappropriate requests.

LLMs are proving to be highly versatile, finding practical applications across various specialized fields. For example, in healthcare, they assist with medical diagnoses, treatment plans, and research by summarizing medical records and literature. In education, LLMs personalize learning by helping students understand complex topics and even grading assignments. In law, they automate tasks such as legal research, contract drafting, and case law analysis, providing valuable support to legal professionals. Finance benefits from LLMs' ability to analyze markets, generate insights, and automate reporting. Scientific research is another area where LLMs streamline the process, aiding in literature reviews, data analysis, and research paper drafting. Beyond these fields, LLMs can enhance customer service with sophisticated chatbots, assist journalism with content creation and fact-checking, and improve human resources by automating recruitment and employee support processes. This wide range of use cases highlights their potential to address specialized domains through efficiency and innovation.

Moreover, by revolutionizing fields traditionally connected to creativity, LLMs are putting at risk the jobs dealing with textual information gathering, translation, original writing, etc. For this reason, the scientific community is divided between those who see enormous potential and those who focus on the dangers associated with indiscriminate use.

Moving from an agnostic point of view, this work aims to explore a specific scenario, namely the applicability and effectiveness of LLMs as decision support systems to plan the syllabus of a university course. In detail, AI-based chatbots will be asked to plan a 24-hour module on MIDI in the context of a bachelor's degree in Sound

and Music Computing. After a cross-comparison between the answers provided by different LLMs, we will present a subjective evaluation based on expert supervision. In fact, the paper's author has been teaching this technical subject for over 10 years and is a member of the MIDI Association.

The initial, and deliberately provocative, question in the title is whether LLMs, used as decision-support systems, are better than an experienced instructor at determining the syllabus of a university course. However, this concern raises more specific research questions:

- [RQ1] Can the suggestions made by LLMs help an instructor (or a student) without prior experience in planning an effective teaching/learning program on a well-focused subject?
- [RQ2] Are the suggestions made by LLMs valid from a didactic and pedagogical standpoint, in the eyes of an expert?
- [RQ3] Are the findings from this experiment generalizable to different educational contexts, e.g. other subjects or educational grades?

This paper extends a talk presented at the ATEE 2023 Annual Conference – “Teacher Education on the Move”, August 27-30, 2023, Budapest, Hungary.

2. Interactions with Large Language Models

All prompts were launched at the beginning of October 2024. Today's LLMs are designed to follow instructions and are trained on huge datasets. This large-scale training enables them to perform certain tasks in a “zero-shot” manner. In *zero-shot prompting*, the prompt given to the model contains no examples or demonstrations; instead, the prompt simply directs the model to perform a task without any additional guidance (Wei et al., 2022). We decided to adopt such an approach, even creating new accounts so as not to influence the answers based on previous conversations. Other approaches would be possible, such as *few-shot prompting* (a technique to enable in-context learning where we provide demonstrations in the prompt to steer the model to better performance), *chain-of-thought prompting* (where complex reasoning capabilities are enabled through intermediate reasoning steps), *meta prompting* (an advanced technique that focuses on the structural and syntactical aspects of tasks and problems rather than specific content details), etc. The methodology will be better clarified in Section 2.1.

The LLMs under examination were *ChatGPT-4* (see Section 2.3), *Google Gemini* (see Section 2.4), and *Claude 3.5 Sonnet* (see Section 2.5). The prompt, identical for all LLMs, is reported in Section 2.2.

Answers are copied and pasted to maintain the original layout of titles, paragraphs, and bulleted and numbered lists. Some adjustments were made, in particular

boldface, only to make the text more readable after adopting the journal template.

Please note that Sections 2.3 to 2.5 contain only and exclusively the responses provided by the LLMs; the author's comments will be reported in a later section.

2.1 Methodology

To evaluate the applicability of Large Language Models (LLMs) in designing a university syllabus, a structured experiment was conducted. The study focused on a 24-hour module on the MIDI protocol within the bachelor's degree in Music Informatics at the University of Milan.

The methodology involved the following steps:

1. *selection of LLMs*: three widely used LLMs (ChatGPT-4, Google Gemini, and Claude 3.5 Sonnet) were chosen based on their accessibility and advanced text-generation capabilities;
2. *prompt design*: a zero-shot prompting approach was adopted, providing each model with the same standardized prompt (see Section 2.2). This prompt was intentionally broad to assess the LLMs' ability to autonomously generate a structured response;
3. *data collection*: each model's syllabus proposal was extracted without modification, preserving its original structure, terminology, and level of detail. Minor formatting adjustments were made for readability.
4. *comparative analysis*: the generated syllabi were analyzed across three dimensions: 1. structural similarities (organization, weekly breakdown, and assessment methods), 2. content alignment (coverage of fundamental MIDI concepts, technical aspects, and advanced topics), 3. pedagogical suitability (practicality, coherence, and alignment with established educational standards).
5. *expert evaluation*: the syllabi were compared to the actual course syllabus, designed by the author, a domain expert with over 10 years of teaching experience, and a member of the MIDI Association. This qualitative assessment identified gaps, strengths, and cultural biases in the AI-generated proposals.

2.2 The Prompt

"In the context of a bachelor's degree program in Sound and Music Computing, I have to teach a 24-hour module focused on MIDI. Please prepare a teaching syllabus".

2.3 ChatGPT-4

Here's a proposed syllabus for a 24-hour module focused on MIDI (Musical Instrument Digital Interface) within a Bachelor's Degree in Sound and Music Computing. The course will cover both the

foundational and advanced aspects of MIDI technology, with practical and theoretical components.

Module Title: MIDI: Foundations and Applications

Module Hours: 24 hours (12 sessions, 2 hours each)

Pre-requisites: Basic knowledge of digital audio, basic music theory, and computer literacy.

Course Objectives:

- Understand the fundamental concepts and architecture of the MIDI protocol.
- Explore the technical aspects of MIDI message types, including Note, Control Change, Program Change, and System Messages.
- Develop proficiency in using MIDI hardware and software for sound synthesis, composition, and production.
- Learn how to integrate MIDI with DAWs (Digital Audio Workstations), sequencers, and other music software.
- Experiment with advanced MIDI techniques, such as automation, synchronization, and MIDI-based performance systems.
- Gain hands-on experience with MIDI controllers, synths, and virtual instruments.

Course Outline:

Week 1: Introduction to MIDI (2 hours)

- Overview of MIDI: History and evolution of MIDI.
- Basic Concepts: What is MIDI? The purpose and advantages of MIDI in music production.
- MIDI Devices and Components: Synthesizers, controllers, sequencers, and MIDI interfaces.
- Practical: Setting up a simple MIDI environment using a MIDI controller and software synth.

Week 2: MIDI Protocol and Message Structure (2 hours)

- MIDI Architecture: Explanation of MIDI data flow.
- Types of MIDI Messages: Note On/Off, Control Change (CC), Program Change, Pitch Bend, Aftertouch.
- Channel Messages vs. System Messages: Understanding the distinction.
- Practical: Analyzing MIDI data in a DAW (using a MIDI monitor).

Week 3: Working with MIDI in DAWs (2 hours)

- Integrating MIDI with DAWs: Logic Pro, Ableton Live, Cubase, FL Studio, etc.
- MIDI Tracks and Routing: How to set up MIDI tracks and route MIDI signals.
- Quantization and MIDI Editing: Basic manipulation of MIDI note data.
- Practical: Create a basic musical sequence using MIDI tracks.

Week 4: MIDI Controllers and Instruments (2 hours)

- MIDI Controllers: Keyboard controllers, pad controllers, wind controllers.

- Virtual Instruments and Plugins: Using VST/AU instruments.
 - Practical: Configuring and using various MIDI controllers with virtual instruments in a DAW.
- Week 5: Sound Design with MIDI (2 hours)
- MIDI and Sound Synthesis: Connecting MIDI with hardware and software synthesizers.
 - Automation and Modulation: Using MIDI CCs for sound manipulation.
 - Practical: Design a custom sound using MIDI and a software synthesizer.
- Week 6: Advanced MIDI Techniques (2 hours)
- MIDI Automation: Automating parameters in real-time with MIDI CC messages.
 - MIDI Mapping and Customization: Assigning hardware controls to software parameters.
 - Practical: Create a project with extensive use of MIDI automation.
- Week 7: MIDI Synchronization and Clock (2 hours)
- MIDI Clock and Timing: Synchronizing MIDI devices and DAWs.
 - MIDI Time Code (MTC) and SMPTE: Understanding synchronization protocols.
 - Practical: Sync multiple MIDI devices and software to a central clock.
- Week 8: MIDI and Live Performance (2 hours)
- MIDI in Live Settings: Using MIDI for live performance control.
 - MIDI Foot Controllers and Live Automation: Creating real-time controls for stage performances.
 - Practical: Set up a basic live performance rig using MIDI controllers.
- Week 9: Creative MIDI Applications (2 hours)
- MIDI for Generative Music: Algorithmic composition with MIDI.
 - MIDI in Interactive Systems: Using MIDI in installations and multimedia.
 - Practical: Experiment with MIDI for generative music and interactive sound design.
- Week 10: MIDI 2.0 and the Future of MIDI (2 hours)
- Overview of MIDI 2.0: Key differences between MIDI 1.0 and MIDI 2.0.
 - New Capabilities: Enhanced resolution, per-note control, backward compatibility.
 - Practical: Explore a modern DAW setup with MIDI 2.0 compatible hardware/software.
- Week 11: MIDI Troubleshooting and Workflow Optimization (2 hours)
- MIDI Troubleshooting: Common problems with MIDI devices and connections.
 - Optimizing MIDI Workflows: Best practices for efficient MIDI use in studio and live settings.
 - Practical: Solve a real-world MIDI troubleshooting scenario and optimize a MIDI-based workflow.

Week 12: Final Project Presentation (2 hours)

- Project Submission: Students present a project that showcases their use of MIDI (composition, performance setup, sound design, or interactive system).
- Feedback and Evaluation: Peer and instructor review of the projects.

Assessment:

- Class Participation and Practical Exercises: 30%
- Mid-Term Assignment: MIDI-based composition or sound design project (20%)
- Final Project: Full MIDI-based production or performance setup (50%)

Recommended Tools and Software:

- MIDI Controllers: Novation Launchkey, Akai MPK, Native Instruments Komplete Kontrol, etc.
- DAWs: Ableton Live, Logic Pro, Cubase, FL Studio.
- Software Synths: Serum, Massive, Arturia V Collection, Kontakt.
- MIDI Monitoring Tools: MIDI-OX, Protokol.

Suggested Readings:

- “The MIDI Manual: A Practical Guide to MIDI in the Project Studio” by David Miles Huber.
- “MIDI Power! The Comprehensive Guide” by Robert Guerin.
- “Music Technology from Scratch” by Mortimer Rhind-Tutt.

This syllabus provides a blend of theoretical understanding and hands-on practice with MIDI technology, aiming to build proficiency in both technical skills and creative applications. Let me know if you'd like any adjustments!

2.4 Google Gemini

Syllabus: MIDI Fundamentals and Applications

Module Overview

This module aims to provide students with a comprehensive understanding of MIDI (Musical Instrument Digital Interface), its protocols, and applications in sound and music computing. Students will learn about the basics of MIDI, its data structure, and how to use MIDI devices and software to create, manipulate, and control musical sequences.

Learning Objectives

By the end of this module, students will be able to:

- Understand the fundamental concepts of MIDI and its history.
- Analyze MIDI messages and their structure.
- Use MIDI devices and software to create, edit, and control musical sequences.
- Integrate MIDI into music production and performance workflows.
- Explore advanced MIDI techniques and applications.

Course Outline

Week 1: Introduction to MIDI

- Introduction to MIDI: history, purpose, and basic concepts
- MIDI messages: types, structure, and functions
- MIDI devices: keyboards, controllers, sequencers, and sound modules

Week 2: MIDI Data Structures and Protocols

- MIDI data structures: events, channels, and messages
- MIDI protocols: UART, USB, and Ethernet
- MIDI system messages: exclusive, real-time, and system common

Week 3: MIDI Software and Hardware

- MIDI software: sequencers, editors, and virtual instruments
- MIDI hardware: interfaces, cables, and controllers
- MIDI system configuration and troubleshooting

Week 4: MIDI Applications and Techniques

- MIDI in music production and performance
- Advanced MIDI techniques: automation, synchronization, and control
- MIDI and other audio formats: integration and conversion

Teaching Methods

- Lectures and presentations
- Practical exercises and assignments
- Hands-on workshops and demonstrations
- Group discussions and Q&A sessions
- Guest lectures from industry professionals

Assessment

- Mid-term exam (theoretical knowledge)
- Final project (practical application of MIDI concepts)
- Class participation and assignments

Recommended Resources

Books:

- The MIDI Manual by David Benn
- MIDI: A Complete Guide by Paul Davies

Online resources:

- MIDI Association website
- Online tutorials and forums
- MIDI device and software manuals

Note: The specific content and emphasis of the module can be adjusted based on the students' background knowledge and the course's overall focus. Consider incorporating examples and case studies from various musical genres and applications to make the learning experience more engaging.

2.5 Claude 3.5 Sonnet

I'd be happy to help you create a teaching syllabus for a 24-hour module on MIDI as part of a Bachelor's Degree program in Sound and Music Computing. Let

me outline a comprehensive syllabus that covers the key aspects of MIDI.

MIDI Module Syllabus (24 Hours)

Course Description

This module provides a comprehensive introduction to MIDI (Musical Instrument Digital Interface) technology, its applications in music production, and its role in sound and music computing. Students will gain both theoretical knowledge and practical skills in working with MIDI.

Learning Objectives

By the end of this module, students will be able to:

1. Explain the fundamentals of MIDI technology and its historical context
2. Understand MIDI messages, channels, and protocols
3. Set up and configure MIDI systems
4. Use MIDI for music composition and production
5. Implement basic MIDI programming
6. Analyze and troubleshoot MIDI systems

Course Outline

Week 1 (8 hours)

Day 1 (4 hours)

1. Introduction to MIDI (2 hours)
 - Definition and historical context
 - MIDI 1.0 vs. MIDI 2.0
 - Role of MIDI in modern music production
2. MIDI Fundamentals (2 hours)
 - MIDI messages and events
 - Channels and polyphony
 - Note on/off, velocity, aftertouch

Day 2 (4 hours)

3. MIDI Hardware (2 hours)
 - MIDI controllers and interfaces
 - Synthesizers and sound modules
 - MIDI ports and connections
4. MIDI Software (2 hours)
 - Digital Audio Workstations (DAWs) and MIDI
 - Virtual instruments and plug-ins
 - MIDI editors and sequencers

Week 2 (8 hours)

Day 3 (4 hours)

5. Advanced MIDI Concepts (2 hours)
 - Control Change (CC) messages
 - Program changes
 - System Exclusive (SysEx) messages
6. MIDI Clock and Synchronization (2 hours)
 - MIDI Time Code (MTC)
 - MIDI Clock and tempo mapping
 - Synchronizing multiple devices

Day 4 (4 hours)

7. MIDI Programming Basics (2 hours)
 - Introduction to MIDI programming
 - MIDI libraries and APIs

- Simple MIDI input/output programming
8. MIDI for Composition and Arrangement (2 hours)
- Using MIDI for musical notation
 - Quantization and humanization
 - MIDI orchestration techniques
- Week 3 (8 hours)
- Day 5 (4 hours)
9. MIDI and Audio Integration (2 hours)
- Combining MIDI and audio in productions
 - MIDI-to-audio conversion
 - ReWire and inter-application MIDI routing
10. MIDI Troubleshooting and Best Practices (2 hours)
- Common MIDI issues and their solutions
 - Optimizing MIDI performance
 - MIDI system management
- Day 6 (4 hours)
11. Future of MIDI and Emerging Technologies (2 hours)
- MIDI 2.0 in-depth
 - OSC (Open Sound Control) and alternatives
 - MIDI in mobile and web applications
12. Final Project Workshop and Presentation (2 hours)
- Students present their MIDI projects
 - Q&A and peer feedback session

Assessment

1. Practical assignments (40%): Weekly hands-on tasks demonstrating MIDI skills
2. Final project (40%): Create a musical piece or interactive system utilizing advanced MIDI techniques
3. Written exam (20%): Covering theoretical aspects of MIDI technology

Required Resources

- MIDI-capable keyboard or controller
- Digital Audio Workstation (e.g., Ableton Live, Logic Pro, or Reaper)
- MIDI programming environment (e.g., Max/MSP, Pure Data, or a programming language with MIDI library)

Recommended Reading

- The MIDI Manual: A Practical Guide to MIDI in the Project Studio by David Miles Huber
- MIDI Power!: The Comprehensive Guide by Robert Guérin
- Electronic and Experimental Music: Technology, Music, and Culture by Thom Holmes

I've created a comprehensive syllabus for a 24-hour MIDI module as part of a Bachelor's Degree program in Sound and Music Computing. This syllabus is designed to cover the essential aspects of MIDI technology, from its fundamentals to advanced concepts and practical applications.

The module is structured over three weeks, with two 4-hour sessions per week, totaling 24 hours of instruction. Here's a brief overview of the content:

1. Week 1 focuses on introducing MIDI, its fundamentals, and the hardware and software associated with it.
2. Week 2 delves into more advanced MIDI concepts, synchronization, basic programming, and composition techniques.
3. Week 3 covers the integration of MIDI with audio, troubleshooting, emerging technologies, and includes a final project presentation.

The syllabus also includes learning objectives, assessment methods, and recommended resources to support the students' learning.

Would you like me to elaborate on any specific part of the syllabus or make any adjustments to better fit your program's needs?

3. Analysis

3.1 Structure of the Answers

The three LLMs under examination provided responses sharing a very similar structure, that can be roughly split into three parts: 1. title and overview, 2. detailed course outline, and 3. final suggestions.

In the first part of the answers, all models proposed a title for the module and presented the general objectives of the course. *ChatGPT* was the only model that listed module prerequisites. It was also the only chatbot that did not expand the request into a more detailed description, whereas *Gemini* provided a "module overview" and, similarly, *Claude* proposed a "course description".

The second part of the answers, focusing on a more detailed course description, was articulated in weeks, days (only by *Claude*), and, finally, hours. This aspect is interesting since the prompt did not mention the concept of "week". Evidently, the various models have been trained on syllabi primarily organized into weeks, as it commonly happens in the U.S., U.K., Australia, New Zealand, and some European universities (specifically, those adhering to the Bologna Process). *ChatGPT* proposed 2 hours of lessons per week, which is coherent with the typical timetable of a semester-based system, such as the one in use at the Department of Computer Science, University of Milan. *Gemini* fitted the content into 4 weeks, suggesting that each week consists of 6 hours of lessons; this approach is consistent with the transition to a quarterly structure, which is curiously under discussion in this period at the Department of Computer Science, University of Milan. Finally, *Claude* indicated a structure made of 3 weeks, 2 days per week, 4 hours per day, which could be considered an intensive course.

In the last part of their answers, all LLMs agreed to propose forms of assessment that, once again, had not been explicitly requested and turned out to be aligned. Once again, it is plausible that LLM training took place

in educational systems quite similar to each other and, conversely, rather different from the Italian university system. Even if Italian university professors sometimes require the preparation of a final project and, more rarely, assign tasks to be completed during the course, this is not the rule. The emphasis placed on practical assignments and the final project seems overestimated for the Italian system, especially in the case of *Claude*, which allocated 80% of the overall grade to these activities. Finally, all LLMs recommended several software and hardware resources and provided a minimal bibliography.

3.2 Suggested Content

This section mainly aims to cross-compare the content of the answers, thus highlighting similarities and differences between LLMs. A critical analysis of the answers against the current version of the MIDI module, designed in a “traditional” way, will be reported in Section 3.3.

Concerning the module title, *ChatGPT* and *Gemini* made similar proposals: “MIDI: Foundations and Applications” and “MIDI Fundamentals and Applications”, respectively. Conversely, *Claude* did not provide a title. In both cases, an unexpected emphasis was placed on applications. Please note that practical aspects are difficult to reconcile with the idea of academic teaching in Italy. The consequences of this vision were also evident in the lesson plan, as better detailed below.

Concerning the course objectives, all LLMs agreed to start with the fundamental concepts and architecture of the MIDI protocol, then explore the technical details of MIDI messages, foster proficiency in using MIDI hardware and software (addressing sound synthesis, composition, and production), and gain experience with advanced MIDI techniques. No answer explicitly mentioned Standard MIDI Files, General MIDI and its evolutions, or the new MIDI 2.0 protocol extension, even if these subjects could be implicitly covered by other definitions. Only *Claude* cited basic MIDI programming, a subject that, interestingly, belonged to the syllabus of a previous edition of the course, taught when the module lasted 48 instead of 24 hours. It is worth underlining that, even if the students in the degree program have in-depth skills in general-purpose coding, it would be hard to introduce MIDI-oriented programming activities within a 24-hour module.

As a final remark, we noticed heterogeneity in the level of detail in the responses. The description provided by *Gemini* was much more concise and did not include specific references to the durations of the various teaching units. Needless to say, by adopting a technique different from zero-shot prompting, it would have been possible to elicit more detailed responses through additional interactions.

3.3 Comparison with Actual Module Content

After comparing the responses provided by the LLMs under examination, the next step involved comparing their suggestions with the current course structure, planned and structured in a traditional way based on years of experience and constant refinements. The results, graphically summarized in Figure 1, show some interesting similarities and several notable differences.

As a premise, it was not always possible to fully grab the topic of the various teaching units from the brief descriptions provided by the LLMs. For example, General MIDI, one of the key extensions made to the original protocol, was never mentioned; still, we cannot rule out the possibility that *ChatGPT* planned to cover it under the topics for Week 3 or *Gemini* under those for Week 4. The consequence in Figure 1 is that the column of General MIDI is present only in the actual edition of the course.

In a complementary way, the columns for “other” topics are present as LLM suggestions only, which is rather obvious if we consider that the current edition is the reference for defining what *other* content is. It is plausible that such a category, in addition to capturing concepts that do not fit within the current structure of the university course (e.g., MIDI troubleshooting), may also include topics whose placement is not entirely clear; if described with more specific terms, such content could be classified in the remaining categories.

The part of the course dedicated to the introduction and history of the protocol is quite similar in all proposals.

The fundamentals are much more prominent in *Gemini*’s syllabus, but this could be due to the poorly detailed response provided by this model.

One of the main differences between LLMs and the current course structure lies in the time dedicated to the description of specific MIDI messages, which is much greater in the current course edition.

Hardware and software aspects are not specifically addressed in the current syllabus, where these topics are distributed across several lessons. For example, the category of software tools known as MIDI monitors is mentioned during the discussion of MIDI messages, as monitors are useful to fully comprehend the bit-by-bit structure of messages. Similarly, sequencers and DAWs are introduced together with Standard MIDI Files. Conversely, the current syllabus does not cover MIDI hardware, except for some introductory concepts (e.g., how a MIDI cable is constructed) and trivial examples needed to describe basic scenarios (e.g., what are and how to connect controllers and synthesizers).

The topic of synchronization is interestingly covered in two hours in all proposals, both those from AI chatbots and the current edition.

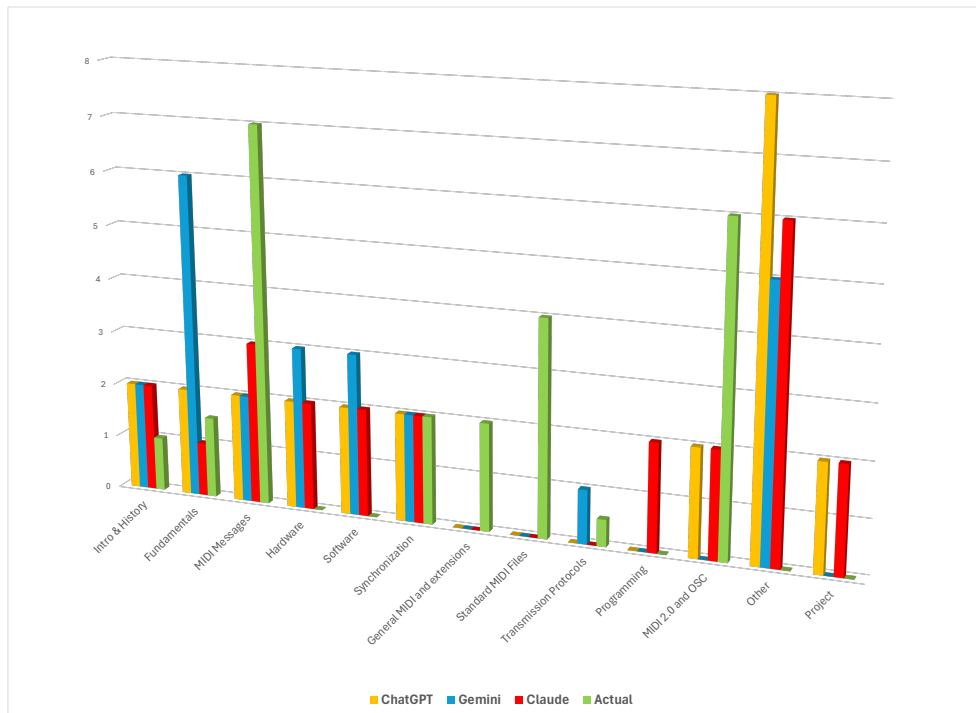


Figure 1 - Comparison of the number of hours dedicated to each lesson topic.

General MIDI, its extension, and Standard MIDI Files apparently characterize only the current syllabus, but these might be topics that LLMs do not mention explicitly, hiding them under other terms.

Transmission protocols, discussed only by *Gemini* among LLMs, are quickly covered also by the current syllabus.

As mentioned before, *Claude* is the only chatbot that proposes also a programming unit.

MIDI 2.0 and OSC are treated in a rather superficial way by LLMs, while teaching experience shows that they are rather complex topics and their understanding requires much more than 2 hours of lessons. In fact, in the current syllabus, MIDI 2.0 and OSC are covered in 6 hours, and students often complain that the subjects are very compressed.

Finally, LLMs propose practical activities and reserve some time to present the final project, have a Q&A session, and obtain peer feedback. Even if discussion is encouraged during lessons, the current course structure does not allocate a time slot for the mentioned activities, especially since the course does not include a lab or a final project.

Figure 2 provides an alternative graphical representation of the proposals made by chatbots with respect to the current course structure. Some blocks have comparable dimensions (e.g., the orange bars for introductory and historical aspects), some blocks appear only in chatbot proposals (e.g., the red bars referring to software aspects), some blocks are chatbot-specific (e.g., the light green bar for programming in

Claude), and, finally, some blocks highlight the different weights assigned to common topics (e.g., the olive bars for MIDI messages).

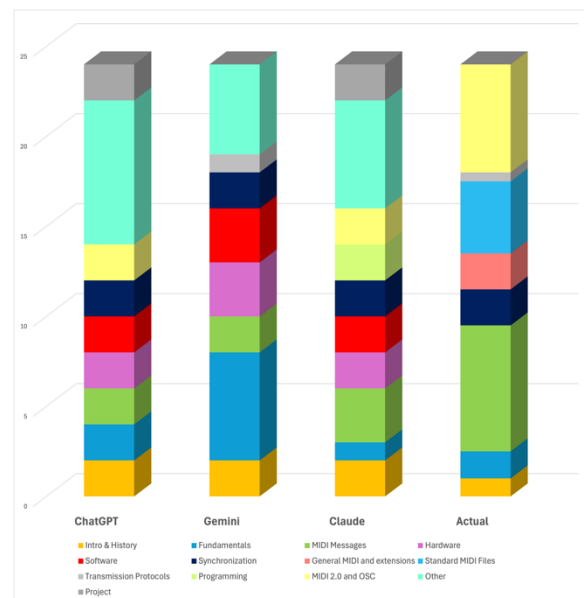


Figure 2 - The course structures, topic by topic, according to the various proposals.

4. Discussion and Conclusions

The final considerations start from the original question – “Is ChatGPT (and are other LLMs) better than me?”

– and decline such an inquiry into the three research questions listed at the end of Section 1. Most of the comments reported below are based on the experience gained by the author in more than a decade of teaching, so they have a strong foundation, but they are profoundly subjective, too.

[RQ1] “Can the suggestions made by LLMs help an instructor (or a student) without prior experience in planning an effective teaching/learning program on a well-focused subject?” The answer is yes. The LLMs, questioned with a rather generic prompt and in a zero-shot manner, were able to structure a rich and effective educational proposal, according to the knowledge accumulated by the author over years of teaching. Some aspects are barely sketched and some important keywords are missing, but, in general, the answers cover a wide range of topics. Under this perspective, the adoption of LLMs can work as a source of inspiration for those who want to approach a topic, even a very technical one, from scratch. Furthermore, LLMs can help a non-domain expert to structure an educational path in an organic way. Finally, it is worth underlining that this paper is based on very limited interactions with LLMs. When answers are considered unsatisfactory, incomplete, or too generic, new prompts can be launched, thus adopting strategies such as few-shot or chain-of-thought prompting.

[RQ2] “Are the suggestions made by LLMs valid from a didactic and pedagogical standpoint, in the eyes of an expert?” Here the answer becomes more complex. First, the expert must be open-minded towards the suggestions provided by LLMs. If the expert believes she is the best in her field, the experiment can be considered a failure from the start. From an agnostic point of view, some gaps found in the syllabus are serious. For example, the fact that no LLM mentions the topic of Standard MIDI Files is a critical issue: a domain expert could easily detect such a gap, but a non-expert would simply skip the topic, unaware of its existence and importance. Similarly, the weight given to some teaching subjects seems unlikely: covering MIDI programming (using what a paradigm and language?) or MIDI 2.0 extension in a few hours means keeping the presentation at an extremely superficial level, probably incomprehensible to the expected audience.

In general, the structure of the course proposed by LLMs shows a cultural bias, probably due to the training conducted on US and UK university systems. In fact, assignments are a regular part of the educational process in American and English universities. Differently from Italian academic standards, students are often given weekly or bi-weekly assignments in the form of essays, problem sets, projects, or reading tasks, and assignments contribute significantly to a student’s final grade. Many programs, particularly in STEM (science, technology, engineering, and math) fields, incorporate hands-on activities like lab work, projects,

internships, and practical applications. Especially in applied disciplines, project-based learning is emphasized, with students working in teams to develop solutions to real-world problems or creating innovative prototypes. Examples can be easily found in web-available syllabi of computer-related courses, such as those administered by Stanford University or MIT. [See <https://web.stanford.edu/class/cs107/syllabus/> or <https://ocw.mit.edu/courses/6-0001-introduction-to-computer-science-and-programming-in-python-fall-2016/pages/syllabus/> (visited on February 27, 2025)].

As a result of this “biased” training, some parts of the syllabi proposed by LLMs are more technical than theoretical, with plenty of practical topics (for example, MIDI routing and troubleshooting) and hands-on activities. However, it is worth noting that the introduction of lab and practical skills can be a good suggestion, also for the Italian system, to make lessons clearer and more engaging.

[RQ3] “Are the findings from this experiment generalizable to different educational contexts, e.g. other subjects or educational grades?” LLMs are certainly capable of providing answers on a wide range of topics. Of course, the prompts must be properly constructed to provide essential information about the students’ background and the target educational level.

An instructor is expected to be an expert in what she is teaching, not someone completely unfamiliar with the subject. This means that the function of LLMs is that of a co-pilot rather than a full replacement of the instructor. For example, a domain expert can easily detect and fill in the gaps in a course program. Similarly, she can recognize hallucinations, namely situations where the model generates information that is factually incorrect, misleading, or entirely fabricated, even though presented confidently (Perković G. et al., 2024).

Finally, the experience accumulated over years of teaching, the face-to-face interaction with students in a classroom environment, and the ability to build an empathetic relationship between teacher and learner go beyond the capabilities of an LLM.

In conclusion, “Is ChatGPT better than me?” Currently, it is not, and it is highly improbable that new versions of LLMs will be able to fully replace the role of an educator. However, AI-based chatbots can be helpful companions in revising consolidated syllabi, proposing new content, and pushing teachers to critically reflect on their choices. In this sense, analyzing the advantages and limitations of LLMs can play a fundamental role in being able to profitably use them.

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PRODACT, a tool to analyse digital products created by students, against Digital Educational Poverty

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Abstract

The construct of ‘digital educational poverty’ was introduced in 2021 by CREMIT and Save the Children, expanding on the concept of the ‘digital divide’. The article presents how this framework is the outcome of the hybridisation of two perspectives through which digital competence can be understood: that of ‘rights’ and that of ‘New Literacies’. At the heart of the article is the description of the PRODACT tool (PROMote Digital Analysis and Competences in Transmedia), developed in 2023 by the authors and applied between 2021 and 2024 to products created by 6,598 minors (most of them 12 or 13 years old) within the framework of a project involving 99 secondary schools throughout Italy. PRODACT was designed to support teachers in evaluating the digital artefacts produced by students, emphasising the centrality of practices in a dialectical relationship between theory and application, between consumption and production, and between criticism and creativity. It is structured around five dimensions and eight indicators, which were adapted and refined into seven specific versions tailored to each format type (Wikipedia, online petition, podcast investigation interview, podcast review, visual storytelling, video storytelling, and social marketing). The article analyses 350 products through PRODACT, demonstrating how digital competence must be considered dynamic rather than static (not something obtained ‘once and for all’) and how, in this perspective, PRODACT enables an integrated and comparative evaluation of the richness and complexity of the aspects that define these products, promoting their use in curricular teaching practices.

KEYWORDS: PRODACT, Digital Educational Poverty, Onlife Citizenship, Digital Competences, Postdigital.

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1. Introduction

The teaching profession today is rooted in a society that is increasingly postdigital and in a parallel evolution of what is meant by ‘digital school’. A few years ago, after an initial phase characterised by the technical option of the concept (Pasta, 2021a), scholars theorised (Rivoltella, 2018) that technology, initially seen as a tool for specific tasks, has expanded to become the normal environment for school practices, a process that transfers technology from the extra-ordinary computer

labs, or computer classrooms, to something ordinary in everyday classroom life. This ‘normalisation’, which today goes by the name of ‘postdigital’ (the end of the extra-ordinariness of the digital; cf. Jandrić, MacKenzie & Knox, 2023), is facilitated by technological devices that have become light and portable, flexible and multifunctional, usable, intuitive and immediate, and always connected.

The postdigital society is also characterised by the continuous hybridisation between the online and offline dimensions of the informational and relational ecosystem, indicated by Luciano Floridi (2014) with the neologism of ‘onlife’. In this context, one of the areas with which the ‘digital school’ was declined, that of ‘digital education’, evolves into the paradigm of ‘Onlife Citizenship’, since, in the postdigital era, citizenship education is no longer thought of as a transition to ‘life on the screen’ (Turkle, 1996), nor should it be understood as ‘one’ of the citizenships, but as an internal dimension of the single citizenship of which the subjects are bearers, which requires new alphabets (Rivoltella, 2020) and new tasks for schools

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in this regard (Pasta & Rivoltella, 2022a). From the perspective of Onlife Citizenship, it is precisely the focus not only on tools (whether or not to use mobile phones), but on alphabets and culture, that underlies the construct of digital educational poverty.

The article presents the PRODACT tool (PROmote Digital Analysis and Competences in Transmedia), developed in 2023 by Michele Marangi and Stefano Pasta of the Research Center on Media Education, Innovation and Technology Education (CREMIT) of the Catholic University of Milan. This tool was created to support for secondary school teachers to assess the digital artefacts produced by students as part of Save the Children Italy's Digital Connections project. It will be presented here as a tool that, even beyond the project, offers evaluation criteria for teachers in guiding students through digital product creation processes.

This contribution is part of the studies on digital educational poverty; in other forums so far the measurability of the phenomenon has been discussed (Pasta, Marangi & Rivoltella, 2021), its definition (Pasta & Rivoltella, 2022b; Pasta, 2022; 2023), on the data collected through the DEPEND (Digital Educational Poverty in Educational Networking and Development) tool (Pasta & Rivoltella, 2022), with a focus on children in whom digital educational poverty and educational poverty did not coincide (Marangi, Pasta & Rivoltella, 2023), and on the points of overlap between intercultural and digital competences in the children of mixed couples (Marangi & Pasta, 2023; Pasta & Marangi, 2025), on the methodology proposed in the creation of digital artefacts in order to combat digital educational poverty (Pasta & Marangi, 2023; 2024; Marangi & Pasta, 2025).

2. Digital Educational Poverty

2.1 The new construct

The construct of 'digital educational poverty' was introduced in 2021 by CREMIT and Save the Children, expanding on the concept of the 'digital divide'. It is not understood solely as deprivation of devices and access to the Net, nor as denial of participation in distance learning or integrated digital education during the Covid-19 emergence.

It should be remembered that the construct of 'educational poverty' was intended to broaden the measurement of inequality from just economic poverty, although this is very important. The Index of Educational Poverty (IPE) is calculated on the basis of 12 percentage indicators: children between 0 and 2 years old without access to public educational services for early childhood; primary school classes without full-time education; secondary school classes without full-time education; pupils who do not use the canteen service; school drop-outs; minors between 6 and 17

years old who have not gone to the theatre; who have not visited museums or exhibitions; who have not gone to concerts; who have not visited monuments or archaeological sites; who do not play sports on a continuous basis; who have not read books; who do not use the internet (Cerbara & Caruso, 2020).

The Educational Poverty Index is based on the concept of the 'educational opportunities' offered by an area (Mazziotta & Pareto, 2013). Similarly - but not surveyed on a territorial basis - 'digital educational poverty' refers to the lack of acquisition of digital skills, understood as new alphabets (Rivoltella, 2020) necessary to analyse the production and fruition of the various digital contents by 'viewers' (Pasta, 2021b) and, therefore, a sort of 'pedagogical endowment' to access the opportunities offered by the social web. Quoting Save the Children's definition (2021, p. 15),

“digital educational poverty thus refers to the deprivation of opportunities to learn, but also to experience, develop and allow skills, talents and aspirations to flourish freely, through the responsible, critical and creative use of digital tools” (translation by the authors).

It does not, with a utopian and cyber-enthusiastic outlook, equate the Internet only with positive aspects, but associates it, consistently with classical media-educational frameworks, with an 'extension of reality' characterised by risks and opportunities.

This heterogeneity in surveying and measuring digital competences is also reflected in the ambiguity with respect to the 'digital divide', a term which, as a systematic literature review by Scheerder, van Deursen and van Dijk (2017) has shown, is used to define very different concepts, both for the type of digital divide addressed (skills, uses and outcomes), and for the determinants. Since the 1990s, when personal computers and the Internet became widespread, the digital divide has been at the centre of the debate (Eastin, Cicchirillo & Mabry, 2015). At that time, it was defined as inequalities in access to and use of Information and Communication Technologies (ICTs), mostly the Internet (Castells, 2002). Access to the Internet led to a binary distinction between those connected to the Internet and those who were not ('first-level digital divide'). In 2002 Hargittai stated that a distinction should be made between an Internet access divide and a skills divide, the latter indicating differences between groups of people in terms of skills necessary to effectively use the Internet ('second-level digital divide'). This is the first step in overcoming a deterministic approach according to which the mere presence of technology would automatically give access to all the benefits of technology. Consequently, the focus of the digital divide discourse shifted to digital skills, which also encompasses differences in use, referred to as the 'usage gap' (Van Dijk, 2005).

Finally, with the ‘third-level digital divide’, researchers (Van Deursen & Helsper, 2015; Wei & Hindman, 2011) propose that digital inequalities can be observed in the consequences of Internet use (Fuchs, 2009), where inequality exists when the possession of digital skills and Internet use do not lead to beneficial outcomes. Indeed, in some cases, promoting access and skills without attention to outcomes may perpetuate or exacerbate social inequality (Van Deursen & van Dijk, 2014; Pasta, 2021c). Other more recent studies, such as *Geographies of Digital Exclusion: Data and Inequality* by Graham and Dittus (2022), reflect on how the prominence of data and algorithms still changes the key contours of information inequality, and who, what and where gets left out.

The notion of digital educational poverty is the outcome of the hybridisation of two perspectives with which digital competence can be declined: that of ‘rights’ and that of ‘New Literacies’.

The first paradigm is based on the rights perspective, it is inspired by the *European Digital Competence Framework for Citizens (DigComp) 2.1* (Carretero Gomez, Vuorikari & Punie, 2017) and the additions of 2.2 (Vuorikari, Kluzer & Punie, 2022), also considering documents such as the European Union Strategy on the Rights of the Child (2021) and the General Comment to the United Nations Convention on the Rights of the Child regarding children’s rights in relation to the digital environment (2021); this perspective is reflected in the concept of ‘digital competence’ of Europe’s Digital Decade 2030 (2021) and in previous European digital competence surveys such as ICILS (2018) and DESI (2019).

Despite the European framework of heterogeneity referred to, more than half of the educational systems (including Italy) make explicit reference to DigComp in their attempts to define digital competences. The five areas of the DigComp - Information and Data Competences, Communication and Collaboration, Digital Content Creation, Security, Problem Solving - constitute the conceptual framework for the construction of functional operational tools most present in educational systems (Ranieri, 2022), even though they are sometimes formulated differently and sometimes include additional areas. However, some declinations of DigComp show a limitation in the static nature with which they think about digital competences, mistakenly basing assessments on certifications, patents, and checklists (Rivoltella, 2020).

To try to overcome this limitation, the construct of digital educational poverty also refers to a second paradigm, that of New Literacies, which focuses on the dynamism and transdisciplinarity of competences (Buckingham, 2019) and to the concept of Dynamic Literacies (Potter & McDougall, 2017), underlining how a segmented approach betrays the ‘citizenship vocation’ of digital competence (Pasta, 2021b). Digital competences, in fact, are not static, but dynamic: this

means that they unfold on a performance continuum and are co-determined by other subjective and contextual variables. Moreover, they are subject to continuous change over time. This creates a strong risk that a competence appears to be possessed today and is undetectable a few days later. At an international level, this approach can be found in the works of the Stanford History Education Group, such as *Students’ Civic Online Reasoning* (2019) and *Evaluating Information: The Cornerstone of Civic Online Reasoning* (2016); at an Italian level, this approach is present in the Digital Civic Education Curriculum, drawn up for Italian schools (from Infancy to Upper Secondary) by the Ministry of Education in 2018.

This dual approach is present in the different tools proposed by CREMIT for Digital Connections, for example in the twelve indicators that make up the Digital Competence Score (PCD) and at the basis of the DEPEND test to detect digital educational poverty. The 12 indicators of the PCD are: technical knowledge of digital formats and environments; knowledge of the rules of publishing and copyright; ability to filter data and contextualise information in digital content; knowing how to recognise and activate digital creativity; possessing and using narrative skills; knowing strategies for protecting one’s digital identity; knowledge of netiquette and awareness of cyberstupidity; competence in the logic of how algorithms work; recognition of the collaborative dimension of digital knowledge; using digital from a perspective of conscious and active citizenship; ability to share content; ability to verify and situate information (Marangi & Pasta, 2023).

In the PRODACT tool, which is the focus of this article, the dual perspective is integrated in more classical items - such as respect for copyright - alongside more innovative components, such as assessing the ability to inspire others or groups to produce additional media materials on the theme of the digital artefact produced by the group of young people.

2.2 Classes of ‘performers’ producing digital artefacts

PRODACT was submitted to 6,598 minors (most of them 12 or 13 years old) from 410 classes in 99 secondary schools throughout Italy during the school years 2021-22, 2022-23, and 2023-24. It should be noted that the sample is not statistically representative but consists of schools whose directors responded to the call issued by Save the Children and the Ministry of Education. These schools are often located in areas with significant levels of educational poverty, as Save the Children prioritized this criterion in selecting candidates, alongside geographical diversity and a mix of urban and rural areas.

In the Digital Connections (2021-24) project, implemented by Save the Children together with

CREMIT and the Edi Onlus cooperative, classes participated in cross-media creation workshops, delivered over a two-year course of 48 school hours as part of civic education classes. The pupils, working in small groups, were asked to create digital artefacts in four newsrooms: Online Writing (creation or integration of a Wikipedia entry and/or drafting an online petition), Podcast (review of a media product or a territory-related enquiry), Digital Storytelling (e.g., memes, visual/ video/data storytelling), and Social Marketing (content dissemination to promote conscious and responsible lifestyles on social or static web platforms).

Priority is given to topics that reflect the pupils' media consumption, focus on the local territories of the schools (but outside the school walls), connect with subjects taught in other disciplines to practice the interdisciplinary nature of civic education, or relate to sustainable development and a culture of rights. The didactic proposal promotes, at the same time, critical thinking in media consumption, from recognizing algorithmic logic to identifying fake news, and responsibility in media production, from respecting copyright to amplifying diverse perspectives. It therefore reflects a conception of digital competence according to a metacognitive and strategic vision of activities related to digital environments, which is based on technical, intellectual, citizenship, and participative-relational skills. This approach develops New Media Literacy by interweaving the dimensions of criticism (semantics, meanings, social and cultural meaning), ethics (values, responsibilities, citizenship), and aesthetics (codes, languages, narratives).

The PRODACT tool was designed to support teachers in evaluating the digital artefacts produced by students in the newsrooms, emphasizing the centrality of practices in a dialectical relationship between theory and practice, between consumption and production, and between criticism and creativity. This tension highlights the dynamic nature of digital competence: practice is not merely a way to illustrate or apply theory but serves as a means to develop and even challenge it.

In the following sections of the article, we will show how this perspective on digital competence underpins PRODACT as a tool for analysing digital products.

3. Methods of analysis: PRODACT, an original tool for analysing digital products

Evaluative research in the field of Media Literacy Education has long shown that digital competences have a high degree of pragmatic specificity (Bonaiuti et al., 2017), meaning their possession can only be assessed when applied to real-world problems in practical contexts (Pasta, Marangi & Rivoltella, 2021; Ranieri, 2022). This poses a clear challenge to abstract certification approaches, which often rely on

information gathered in formal and hierarchical settings, such as school classrooms, that fail to reflect or meaningfully represent people's actual lifestyles and consumption habits.

In recent years, scholars have increasingly emphasized that digital competences should be understood dynamically and adaptively rather than statically. These competences exist on a performance continuum and are shaped by subjective variables and their relationship to social and cultural contexts. Moreover, they are constantly evolving, making it likely that a competence evident today may become undetectable in just a few days.

The spread of digital technologies as a connective rather than merely productive medium (Rivoltella, 2017) has also transformed the meaning of media products within an intrinsically postmedial perspective (Eugeni, 2015). Krauss (2005) defines the aesthetic medium as a complex device, integrating conventions, tools, and its materiality. In this light, the creative process transcends the tools and materials involved. This perspective applies especially to today's platform- and data-driven media, where media elements blend seamlessly into a larger ecosystem (Rivoltella, 2024).

In line with this perspective, an assessment tool was developed to analyze media products through various indicators, measuring digital competences in literacy, communication, collaboration, content creation, safety, well-being, problem solving, and 'Onlife Citizenship' competences (Pasta & Rivoltella, 2022a). These competences are applied in contexts designed to be as authentic and relevant to students' lives as possible.

The media products were analyzed based on the aesthetic, critical, and ethical dimensions of digital competence as outlined in New Literacy (Rivoltella, 2022), alongside the guidelines of DigComp 2.2 (Vuorikari et al., 2022) and the four areas of Digital Educational Poverty (Save the Children, 2021).

From this perspective, it appears evident that in contemporary pedagogical research, the development of digital competence requires frameworks that transcend purely technical skills, fostering instead a critical, cultural, and creative engagement with media. Within this perspective, the analysis of digital media formats acquires a central role, as outlined below.

The analysis of digital media formats is rooted in the most current theoretical paradigm of Media Education (Buckingham, 2020), which moves beyond conceiving digital technologies as mere instruments and products as isolated objects or simple "tasks" to be performed. Rather, it seeks to uncover the underlying logics that shape the design, dissemination, and usage of digital artefacts (Jenkins, 2009).

In this context, the structure of PRODACT is founded on a holistic understanding of digital competence, articulated through three interconnected dimensions.

First dimension is interpretative, grounded in systematic strategies of textual analysis and informed

by a model of “extended semiosis,” this dimension embraces not only cognitive processes but also the affective, projective, and ritualistic elements embedded in media practices.

The second dimension is cultural, adopting a macro-analytical lens, examining media within their broader social, economic, and ideological frameworks, and exploring the networks of relationships they sustain with institutions, groups, and individuals.

Last dimension is creative, situated within a contextual perspective, it integrates critical-interpretative approaches with the proactive, participatory practices that emerge through the production of artefacts, emphasizing and enhancing the personal and collective experiences of individuals engaged in the creation and use of diverse media formats.

This framework underpins PRODACT (PROMote Digital Analysis and Competences in Transmedia - www.cremi.it/product/), the tool developed by Marangi and Pasta in 2023 to evaluate various types of digital products created in classrooms. Table 1 summarizes its key elements, highlighting the convergence of diverse classification methods and criteria (Marangi & Pasta, 2025).

This is a communicative product evaluation form, structured around 5 dimensions and 8 indicators, which has been adapted and refined into 7 specific versions tailored to each format type (Wikipedia, online petition, podcast enquiry interview, podcast review, visual storytelling, video storytelling, and social marketing). The adaptations are based on the characteristics of the product and the indicators of DigComp 2.2, the Digital Competence Score-PCD (encompassing all 12 indicators), and the three dimensions of New Literacy, which include 2 critical, 3 aesthetic, and 3 ethical components.

These three assessment dimensions were combined with the 4 areas of Digital Educational Poverty, each represented by 2 indicators, to develop and validate the Digital Competence assessment and weighting system. Each form includes a final column with basic guidelines, offering concrete considerations tailored to each communication format.

The PRODACT framework is designed to detect the various aspects characterising the creation of a digital communicative artefact, to identify criteria consistent with the existing literature, and to enable an assessment that considers all procedural elements involved in product creation. From this perspective, PRODACT

Table 1 - PROMote Digital Analysis and Competences in Transmedia - PRODACT.

	Evaluation Dimensions and Indicators of communicative products	Area of Digital Educational Poverty (DEP)	Digital Competence Score (PCD)	Dimensions New Literacy	DigComp 2.2
<i>A. Technical and structural issues</i>					
1	Ability to use applications and digital content while respecting copyright	Understanding	Knowledge of rules of publishing and copyright	Critical	Copyright and licences; solving technical problems
<i>B. Thematic issues</i>					
2	Care in the choice of sources	Understanding	Ability to filter data and contextualise information in digital content	Critical	Managing data, information and digital content
3	Ability to identify the essential aspects of the topics covered and to be coherent with the project approach	Being	Possessing and using narrative skills	Aesthetic	Integrating and re-elaborating digital content
<i>C. Stylistic and narrative issues</i>					
4	Ability to use the expressive potential of the format used through an effective narrative and stylistic register	Being	Knowing how to recognise and activate digital creativity	Aesthetic	Developing digital content
5	Ability to engage the reader, listener or viewer	Autonomous and active living	Ability to share content	Aesthetic	Creatively using digital technology
<i>D. Socio-cultural issues</i>					
6	Ability to contribute to a constructive debate, expressing a recognisable point of view	Autonomous and active living	Using digital from a perspective of conscious and active citizenship	Ethical	Interacting through digital technologies; protecting health and well-being
7	Ability to offer a pluralist and open, non-self-referential vision	Living together	Knowledge of netiquette and awareness of cyberstupidity	Ethical	Netiquette; protecting personal data and privacy
<i>E. Generativity</i>					
8	Potential for development to stimulate other people or groups to create further media materials or communicative situations or to stimulate direct or indirect spill-over effects on the territory	Living together	Recognition of the collaborative dimension of digital knowledge	Ethical	Sharing through digital technologies; engaging citizenship through digital technologies

serves as a key tool for determining competence levels, but it should be applied in a nuanced and qualitative manner, rather than mechanically or solely quantitatively.

Every communicative and narrative product involves different levels of analysis and interpretation, which are not solely related to the presumed objectivity of the technological, aesthetic, and thematic elements constituting the product, but also to the observer’s subjective interpretation and the social and cultural variables of the production context (Eugeni, 2023).

4. Product analysis

Here, we propose an analysis of the elements identified through the PRODACT tool, conducted on 350 products developed as part of the Digital Connections project. We randomly selected 25 productions per format for each two-year period (second and third grade classes), resulting in a total of 50 productions for each format. The analysis of the digital products was conducted by the authors of this article, in collaboration with a team of three other university researchers specializing in Media Education at CREMIT. Evaluation scores were assigned using a 1-to-10 scale. These scores should not be interpreted as percentages, but rather as values distributed along a progressive linear continuum, as will be further clarified in the following section.

As outlined in the project, scores are assigned based on four levels (Table 2): the initial level (1 to 5.5), the basic level (5.51 to 7), the intermediate level (7.01 to 8.5), and the advanced level (8.51 to 10).

Table 2 - PRODACT scores.

Minimal traces of the observed aspect	1-5,5	Initial
Elements of the observed aspect, but not articulated and deepened	5,51-7	Basic
The observed aspect emerges and recurs, but needs to be articulated and structured further	7,01-8,5	Intermediate
The observed aspect appears constant and well managed, in an original and conscious manner	8,51-10	Advanced

The averages for each newsroom (Figure 1) show higher values for products in the second two-year period compared to the first, likely due to teachers becoming more familiar with the tools and the project. The difference is more pronounced for podcasts and less so for digital storytelling.

With reference to the values achieved in the newsrooms, the best overall result is achieved in digital

storytelling (8.57), similar by podcasting (8.53), placing both newsrooms in the advanced level, the highest category. If we consider the Standard Deviation (Figure 2), in the podcast there is a greater variation between the scores in the first biennium (SD 1.13), while in Digital Storytelling the score difference is more marked in the second biennium (SD 0.92). From this further indicator, the difference in the results of the podcasts in the first two years expresses a lesser widespread competence with respect to this format, while the greater difference for Digital Storytelling in the second two years indicates the difference that progressively develops between more standardized products and more original products, which better incorporate the training path developed. The lowest score is recorded in the digital writing newsroom (7.87), while social marketing performs better with 8.22. However, both of these newsrooms fall within the intermediate level, demonstrating that, on average, results across all areas of production align with the two highest levels.

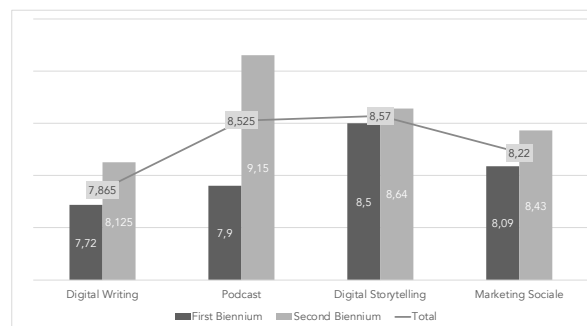


Figure 1 - Average by Newsroom.

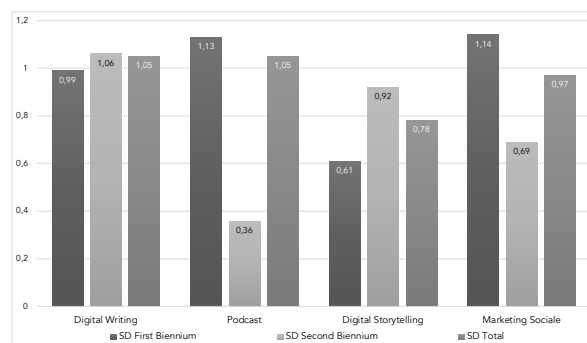


Figure 2 - Standard Deviation by Newsroom.

One possible explanation for these results is that writing is the first activity tackled, making it more challenging to engage with project activities during both two-year periods. Conversely, social marketing, being the final activity, often faced shorter timeframes or, in many cases, saw its products somewhat confused with those of digital storytelling, indicating a limited understanding of the purpose of creating communication campaigns.

Once again, based on the recorded results, digital storytelling stands out as the most popular and highest-quality format - together with podcasting in particular in the second year - reflecting the strong overall competence and familiarity with expressive modes and technical aspects that students often practice outside school.

Conversely, the lower rating of the newsroom related to digital writing could be attributed to two factors: first, the lesser habit of students to write in an articulate and in-depth manner outside the school environment; second, the consideration of age, as mastery of style and writing is not always fully developed at this stage.

In this context, while no objective trends can be definitively established, it is noteworthy that this generation of pre-adolescents demonstrates greater skill and effectiveness in communicating through mixed codes and formats, typical of digital storytelling, rather than through canonical writing codes, which remain the primary medium used in traditional school teaching.

An in-depth analysis of the specific formats within the individual newsrooms (Figure 3) highlights some significant findings. The product with the best overall results is the review, while the petition ranks the lowest.

In addition to the review, visual and video storytelling also fall within the advanced level, with scores exceeding 8.5. The other products are classified within the intermediate level, scoring between 7.01 and 8.5: the wiki entry, the survey, and social marketing all achieve scores above 8, while the petition remains the only product below this threshold.

In the case of digital writing, Wikipedia entries score approximately 0.3 points higher than petitions. Based on the products analyzed, it appears that petitions posed greater challenges, not so much in terms of writing quality, but in aligning the content with a specific cause and structuring the narratives to make them more engaging for readers. Conversely, Wikipedia entries, even when less effective, tend to maintain writing standards more consistent with everyday school activities. In the podcast newsroom, the superior performance of reviews in both two-year periods stands out, with an overall score approximately 0.4 points higher than that of inquiry. This difference allows reviews to fall within the advanced level, while inquiry remain in the intermediate level

Beyond the median value, between the first and second two-year periods, however, there is a significant increase in scores in the inquiry (+1.32), in the review (+1.18) and in the petition (+0.95), while the other formats remain stable, with the only case of decrease for the Wikipedia entry (-0.14).

If the Standard Deviation (Figure 4) is also used for these data, in the second two-year period both the inquiry (0.35) and the review (0.27) have low discrepancy values, indicating an upward leveling compared to the results of the first two-year period,

confirming the previous data. The highest variations in the SD, in this case, concern Video Storytelling (1.27) and the Wiki entry (1.21), confirming what previously emerged for the Digital Storytelling newsroom and the discrepancy that characterized the wiki format.

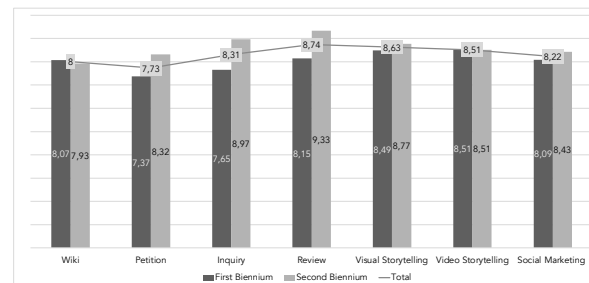


Figure 3 - Average by Format (1-to-10 scale).

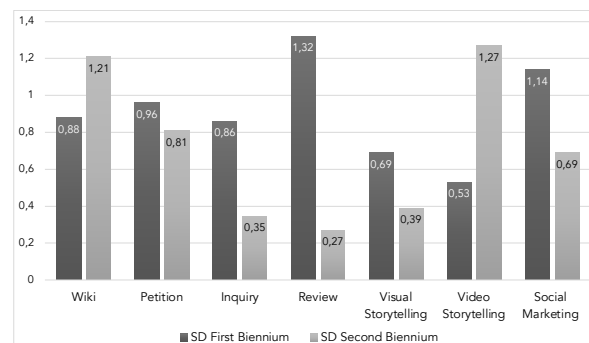


Figure 4 - Standard Deviation by Format.

From the qualitative analysis of the products, it often appeared that the reviews are experienced by students as more personal opportunities to address and recount issues they feel are closer to them, ranging from cultural consumption to social activities, or the perception of the territorial contexts they experience, in a more engaging way. This is not to say that the inquiries are less effective, but in the analyzed products, a more pronounced direction from adults often emerged in shaping the topics to be addressed and the people to be involved. Moreover, the investigation seemed more complex than the not always respected need to construct and conduct interviews, integrating them with a journalistic narrative. From this perspective, the reviews seem to benefit from a style and approach that, in many cases, may appear more colloquial, without losing any of their communicative effectiveness. This dynamic of greater familiarity is confirmed in the digital storytelling newsroom, where both visual and video formats are placed at an advanced level.

The fact that visual formats have excellent performances in both bienniums seems to confirm the students' familiarity with using this type of format, particularly highlighted by the large number of memes produced, which were often very effective and consistent with the project's context. This seems to

further demonstrate that the possibility of incorporating informal skills and everyday consumption into a formal learning and in-depth reflection environment, such as school, enables an unprecedented yet effective convergence between the acquisition of new digital skills and the reinforcement of familiar communication practices.

The performance of video storytelling, which scores identically in both two-year periods, indicates great familiarity with this format on the part of the students. The excellent performance of both formats in the digital storytelling newsroom is significant, considering that they account for 44% of the total products produced over the three years of the project.

When analyzing the individual indicators that make up PRODACT, additional data emerges regarding the performance of digital competence in each communication format (Figure 5).

The highest values for all indicators are consistently found in the review format, while the lowest values appear in the petition format. From a purely mathematical perspective, both constants align with what we observed earlier: the review format achieved by far the best ratings, while the petition format received the lowest. This remarkable consistency, considering a sample of 350 products and three years of work in very heterogeneous schools, confirms some elements we have already seen and seems to attest to the great popularity of the review format and the challenges involved in constructing and structuring a petition.

In our opinion, the key element appreciated in the review format, which allowed for the highest values in each indicator, is the opportunity to express one's own perspective on very diverse topics and aspects, often connected to daily life, consumption, and the preferences that characterize male and female students. Furthermore, the review format seems to encourage an unprecedented sense of agency, allowing students to direct the creation of original and personal artifacts, even within the formalized context of school.

On the contrary, the petition likely involves a particularly complex set of elements that students are not very accustomed to, ranging from preliminary documentation to the ability to identify key components, not only to describe but also to engage people in taking concrete actions to finalize what is proposed. Moreover, it is quite evident that in many petitions, the choice of theme and the proposed objectives cannot be entirely attributed to the agency and preferences of male and female students.

If we consider the Standard Deviation (Figure 6) for the five evaluative dimensions in each production format over both two-year periods, it emerges that the stylistic and narrative dimension records the greatest differences for the Wikipedia entries (1.46), for the Petition (1.26), for the Video Storytelling (1.34) and for

the Social Marketing (1.22), while generativity is more diverse in the Inquiry (1.18), the Technical and Structural Issues differs more in the Review (1.48) and the Socio-Cultural Issues are more heterogeneous in the Visual Storytelling (0.98).

If, on the other hand, the greatest homogeneity is maintained between the various dimensions in the formats, the Technical and Structural Issues record lower values in the Inquiry (0.78), in the Wikipedia entries (0.85), in the Petition (0.95), while the Thematic Issues have fewer divergences in the Visual Storytelling (0.4), in the Video Storytelling (0.91), in the Special Marketing (0.95) and in the Review (1.05).

From these data, a greater stylistic and narrative heterogeneity emerges for the digital and visual writing formats, which seem to polarize more between more obvious or very original narrative modes, a fact confirmed by the qualitative analysis of the products of these categories.

Conversely, the thematic dimension records fewer differences in all visual and more social formats, an aspect confirmed by the recurrence of themes typical not only of the age group, but also of the school context, which cause products of this type to emerge on topics such as bullying and cyberbullying, healthy lifestyles, peer relationships and the relationship with school.

5. Digital productions as experiential didactics, in the logic of 'third spaces'

During the course of the project, 2,700 media productions were created by the classes. With reference to the breakdown by product type (Figure 7), a clear predominance of third-year formats emerges, particularly digital storytelling.

The types of products proposed in the second year are much closer to the modes of consumption and production that boys and girls presumably engage in during their daily lives outside of school.

In the first newsroom dedicated to digital writing, there was a greater production (+3%) of petitions than of Wikipedia entries, reflecting a higher level of involvement and interest on the part of the classes in creating a communicative format seen as more incisive and impactful for proposing changes or engaging people externally regarding a cause or topic deemed important.

In the second newsroom, concerning podcasts, reviews, and investigations with interviews, the number of productions was equally divided, with both formats being well-received by the classes that produced them. It can be assumed that the gradual introduction of a more performative technology, as required by the podcast, piqued students' interest, whether in the creation of an interview for the investigation or in the production of a review.

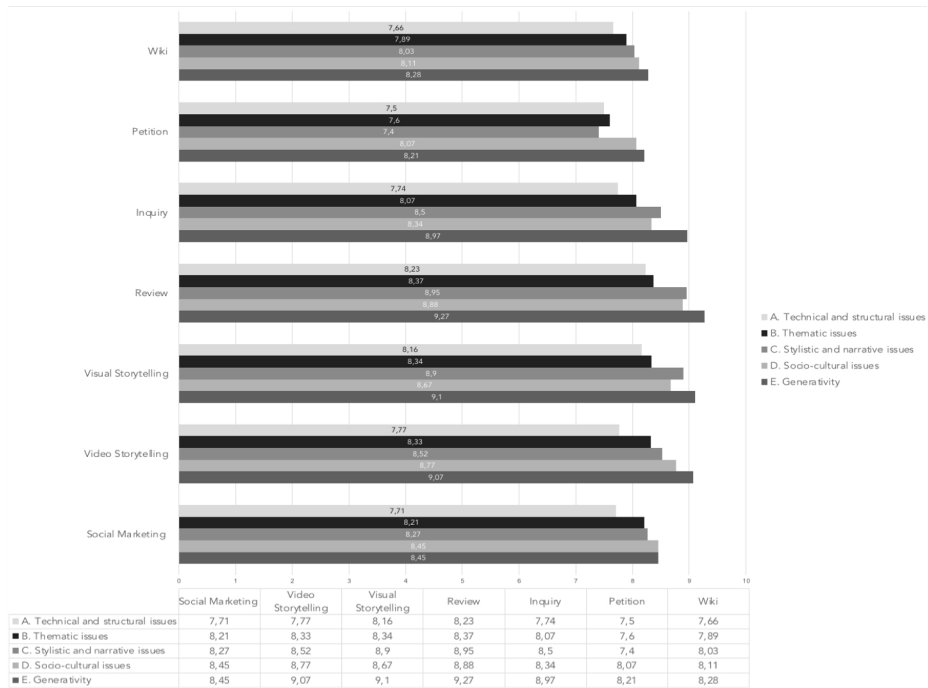


Figure 5 - Scores by Format and Dimensions (1-to-10 scale).

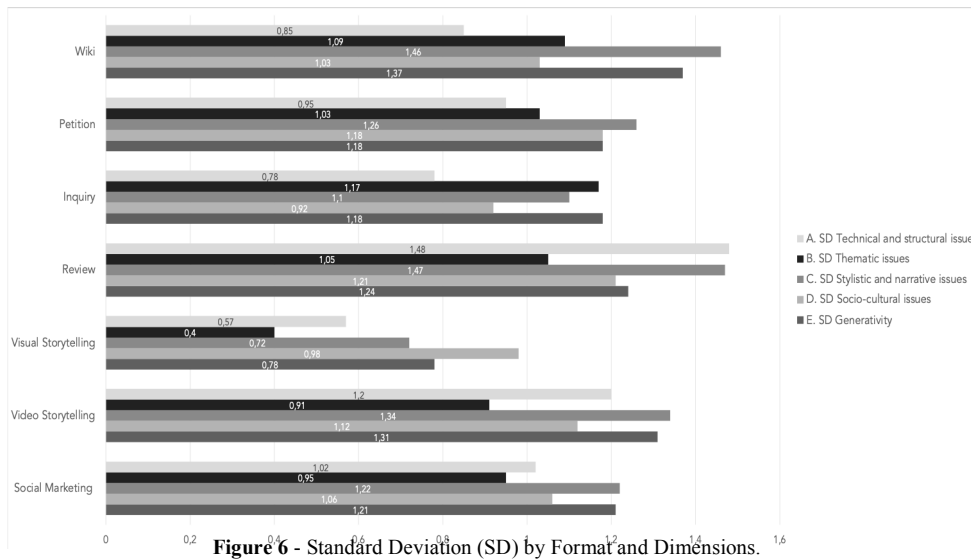


Figure 6 - Standard Deviation (SD) by Format and Dimensions.

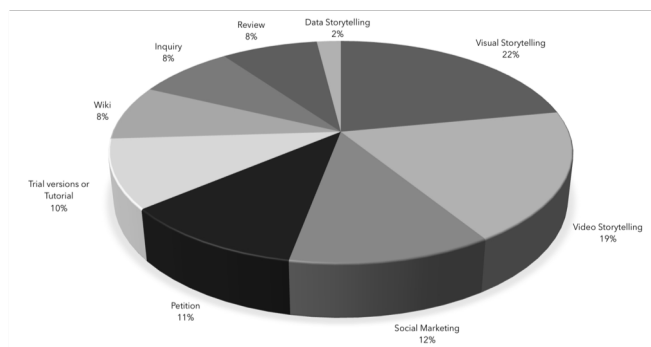


Figure 7 - Product Format.

In the third newsroom, the most productive one, it is not surprising that visual storytelling emerged as the most frequently produced format, although it was closely followed by video storytelling. While one might initially think that visual storytelling requires complex graphic design and structuring, seemingly aimed only at those with some prior experience, the project effectively demonstrated that visual storytelling today can also encompass memes.

It is no coincidence that memes are the most popular format for visual storytelling, although presentations using tools like Canva and PowerPoint, as well as posters, are also common.

This type of format seems perfectly suited to teaching requirements, both in terms of the time needed, which may not be excessively long, and in terms of the opportunity to work in small groups, without devaluing or trivializing the contribution of individual students.

The products analyzed highlight the potential of male and female students in using communication tools to become aware of their abilities, not only in technological and digital skills but also in narrative and stylistic capacities. In this context, they were able to fully utilize the opportunity offered by the project to communicate their own point of view, both individual and collective, in an original way—one capable of conveying a unique perspective and, often, being very mindful of the impact these products can have within the communication circuit.

Regarding the different newsrooms, the Wikipedia entry format and the investigative podcast format seem more coherent and practiced within a school setting. The petition format, on the other hand, is much more aligned with the third socio-cultural space, not only in relation to the quantitative data but also in terms of the topics addressed, which, although approached from a didactic perspective, tackle broader themes and situations more closely related to citizenship, particularly in relation to the local territory. The second-year newsrooms, digital storytelling and social marketing, on the other hand, appear to be more transversal in relation to these perspectives.

The reviews demonstrate a clear quantitative majority related to personal space, focusing on social and cultural media consumption typical of the target age group, such as viewing, listening, and reading. However, it is interesting to note how the school has successfully integrated curriculum-related learning into the review format, for example, through reviews of historical figures, cultural events, or places of historical or cultural significance in the local area.

What emerges is the importance of developing the didactic ability to propose diverse formats during the planning stage, allowing for experimentation with various dimensions of work, ranging from the more institutional and formal to the more personal and informal. This approach recognizes and promotes

social and cultural awareness, even prior to digital literacy.

This underscores the need for teachers not to remain confined to rigid categories, as it is not solely the format that determines the outcome of the communicative product. In many cases, the boys and girls demonstrated the ability and potential to combine different perspectives of analysis and development. For instance, reviews are not limited to specific school reports but also address much broader issues, ranging from ongoing wars around the world to gender equality, from the challenges of growing up to the meaning of being a superhero in contemporary times. Similarly, investigations are not confined to interviews with celebrities or reportage on news events; instead, they reveal a strong social and cultural orientation, with recurring themes such as respect for the environment or the significance of engaging in sports in a balanced way, rather than solely focusing on competition.

To foster these dynamics, the analyzed experience effectively demonstrates the potential of didactic work framed by the principles of the ‘third space’ (Potter, McDougall, 2017), understood as a dimension of co-construction and negotiation of meanings. This space can be physical or online, as long as it is characterized by free aggregation dynamics based on individuals’ interests, in line with the principles of non-formal learning (Pasta & Marangi, 2024). Additionally, it can manifest as a processual dynamic, not solely a productive one, situated within a formalized setting such as school, to promote dialogue and the exchange of skills between teachers and students, without creating disruptions in formal roles. Instead, it leverages typical dimensions of digital society, including situated learning (Rivoltella, 2013), Media Education as a participatory practice (Jenkins, 2009), and affinity groups as communities of practice (Gee, 2007) - that is, physical or virtual relational contexts where processes of appropriation among peers are identified, activated, and nurtured, based on firsthand experiences. Here, peers are considered as individuals engaged in shared contexts and interests, rather than reductively as mere clusters of registrants. Three important socio-pedagogical dimensions emerge in the structuring of educational ‘third spaces,’ which are captured in the digital products analyzed here with PRODACT.

Firstly, the collective and situated dimension of learning, where spaces proximal to learners’ living environments are central, allowing people to learn through collective rather than solely individual dynamics.

Secondly, the operational dimension of knowledge practices, which should encompass both the concrete and conscious appropriation of daily media and cultural tools and content, as well as the production of expressive and narrative artifacts that are integral to communicative and relational flows.

Lastly, attention to the dimension of socio-materiality - i.e., the significance of social and cultural consumption, including media consumption, in people's present lives. This must be understood as an essential starting point for articulating an effective process of reflection and learning about the logics that characterize such consumption. It should not be limited to activating critical thinking but should instead foster the development of socio-cultural awareness and widespread competence, enabling the stimulation of further creative capacities and design skills.

6. Development perspectives

From the different analyses conducted with PRODACT on digital communication products, the phenomenon that Bolter refers to as 'digital plenitude' is clearly evident. This refers to the richness and variety of topics, styles, and approaches that decisively break down the concept of high and low culture, uniting seemingly distinct and incoherent fragments into dimensions that offer a broader and more recognizable meaning. In this context, for schoolwork and teaching practice, it seems strategic to use digital storytelling as the format that boys and girls engage with, rework, produce, and distribute daily through their social networks and smartphones. Whether or not they are aware that it is called digital storytelling seems secondary; the high prevalence of production in this area is emblematic of the project's importance in fostering greater critical awareness and creative competence—not only technical skills—in refining and functionalizing the communication formats that are often unconsciously used in everyday life.

Based on this, some possible elements for operational development and future research are proposed below, which could be valuable moving forward.

Digital competence should increasingly be viewed not just as a standalone subject or as a certification confined to a purely technological dimension, but rather as a transversal element within the school curriculum. It should be integrated into the logic of the Civic Education curriculum, which focuses on the development and reinforcement of competencies to prevent and address Digital Educational Poverty. The design and production of digital communicative artifacts provides fertile ground for schools to strengthen and further develop the intersection of formal, informal, and non-formal learning. This approach encourages teaching practices that effectively integrate school language, in line with the National Guidelines for the first cycle curriculum, the Civic Education Guidelines, and the Orientation Guidelines.

The variety of products created, beyond the specific format categories and the newsrooms themselves, demonstrates the considerable expressive and communicative potential present in the students. This

potential is often underestimated by both adults and the students themselves, but school practice can help bring it to the surface, discipline it, and guide it. This approach fosters not only the development of technical or narrative skills but also greater awareness and self-esteem regarding students' own modes of thought and expression.

Finally, the complexity and richness of the productions - both thematically, socially, and culturally, as well as in terms of expressiveness, aesthetics, and narrative - underscores the need to avoid reducing this type of activity and project to a static, one-size-fits-all model. Instead, it is essential to promote adaptability to the diverse needs of school contexts, whether territorial, social, or cultural. This approach ensures that each school has the opportunity to bring out and certify digital competencies in a way that is both deeply rooted in students' life practices and aligned with a systemic, rigorous, and coherent perspective in line with national and international guidelines and developments in the concept of digital competence.

The PRODACT tool was designed and developed precisely with this dual approach in mind. Its goal is not only to analyze digital products but also to enable an integrated and comparative evaluation of the richness and complexity of the aspects that define these products, promoting their use in curricular teaching practices.

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Investigating the mediating effects of motivation on academic performance in a synchronous EFL online learning

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Abstract

The issue of motivation in synchronous online teaching and learning is still an area of continued research and development. This research seeks to determine the roles played by cognitive presence, teaching presence and social presence concerning external and internal motivational factors and the students' academic performance with a particular focus on the effect of the two motivational factors on the English performances of EFL learners learning online in a parallel mode. Questionnaires were administered to 233 EFL students at a private university in the Mekong Delta in Vietnam. The effects of the research variables under consideration were analyzed by Partial Least Squares Structural Equation Modeling (PLS-SEM). The findings indicate that cognitive presence significantly influences both external and internal motivation. Teaching presence positively impacts external motivation, but not internal motivation or academic performance. Whereas social presence does not significantly affect motivation or academic performance. External motivation was found to positively influence academic performance, while internal motivation showed no significant effect. These results suggest that enhancing cognitive and teaching presences can effectively enhance students' external motivation, which in turn improves academic performance in synchronous online EFL learning. The study highlights the need for well-designed instructional strategies and active facilitation to engage students. The study's limitations include employing cross-sectional research design, and participants engaging in one institution only, a recommendation for future research, that is, the use of longitudinal research designs and large samples. These findings are crucial for educators and policymakers who aim to optimize online educational strategies to enhance students' academic motivation and success.

KEYWORDS: EFL, Synchronous Online Teaching and Learning, Motivation, CoI, University.

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1. Introduction

Motivational factors have been well researched in language learning in the field of education (e.g., Łockiewicz, 2019; Riyanti, 2019; Badali et al., 2022; Yung, 2023) and how they affect students' learning processes in online platforms (e.g., Badali et al., 2022). Previous studies highlighted that motivation is not only a predictor of academic success but also a

vital component that affects students' satisfaction and engagement in virtual settings (Giesbers et al., 2014; Elshareif & Mohamed, 2021). The COVID-19 outbreak disrupted conventional educational systems worldwide in unprecedented ways and accelerated a shift to online learning. This shift posed numerous challenges and opportunities for educators and students alike. Digital tools and e-learning systems became indispensable, providing continuity in education amidst global lockdowns (Bokolo et al., 2020; Yan et al., 2022). The pandemic highlighted significant gaps in the preparedness and adaptability of educational institutions to fully leverage online learning's potential (Bilal et al., 2022). The transition from traditional learning to online learning to continue education, especially during and after the COVID-19 pandemic, has also posed the question of the role of student motivation in this educational setting, especially in language learning where learning

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environments play significant impact on the learning process (e.g., Sociocultural theory, Social Cognitive theory, Interactionist theory).

The Community of Inquiry (CoI) framework, developed by Garrison, Anderson, and Archer, provides a holistic approach toward online learning. It emphasizes the important roles of cognitive presence, social presence, and teaching presence in fostering a meaningful learning environment (Garrison et al., 2000; Garrison & Arbaugh, 2007). Cognitive presence plays a crucial role in fostering critical thinking and sustained learning, which are heavily influenced by students' motivation (Fiock, 2020; Al Mamun & Lawrie, 2023). Social presence, the capacity of learners to present themselves as social entities within a learning community, facilitates active participation and interpersonal interactions, contributing to an increase in learning outcomes (Lim, 2023). However, the existing literature shows mixed findings of this relationship (e.g., Kreijns et al., 2022; Dinh, 2023). Teaching presence, comprising of the organization, facilitation, and coordination of cognitive and social processes, has a direct impact on students' motivation and learning performances (Li & Wang, 2024).

Despite widespread recognition of motivation's importance in education, its specific impact on EFL success in synchronous online environments is not fully understood. Prior studies, such as one by Vansteenkiste, Lens, and Deci (2006), and Jang, Reeve, and Deci (2010) highlighted the quality of academic motivation as a pivotal factor, yet the correlation of different types of motivation and academic performance remains inconsistent (e.g., Meng & Hu, 2022; Zhu et al., 2022). However, there is a scarcity of research indicating the impingement of different types of motivation, particularly intrinsic and extrinsic ones, on learners' English learning in synchronous online modes, which paves the way for this study. Moreover, this research also investigates the impact of synchronous online modes on students' performance in English.

By addressing these objectives, we aspire to contribute to the development of e-Learning by providing actionable insights into the optimization of online educational practices to foster enhanced academic motivation and performances.

2. Literature review

2.1. Interplay Between Cognitive Presence and Motivation in Academic Performance

Cognitive presence, the ability of learners to construct and validate meaning through continuous reflection and discourse within a community of inquiry (Garrison et al., 2001, p.11), is akin to a collaborative problem-solving process that unfolds in four stages:

1. Identifying the Problem: Students recognize a problem or question requiring exploration.
2. Exploring the Problem: Students engage in critical thinking individually and with peers to analyze the issue.
3. Making Sense of the Problem: Students gain deeper insights into the problem but still require guidance from the instructor.
4. Applying the Knowledge: Students utilize their newfound understanding to solve problems or generate new ideas.

Cognitive presence is an essential component of the CoI framework, which is designed to foster effective online learning environments (Garrison, 2011). It promotes collaborative knowledge creation and peer learning.

Research indicates that cognitive presence can positively influence both intrinsic and extrinsic motivation, as well as academic performance. Intrinsic motivation, driven by personal interest, and extrinsic motivation, influenced by external rewards or pressures, can both benefit from cognitive engagement (Tokan & Imakulata, 2019; Widiatmaka, 2021). While cognitive presence enhances motivation by engaging learners in collaborative problem-solving, intrinsic motivation can simultaneously support cognitive processes by driving a deeper interest in understanding concepts. Tokan and Imakulata (2019) found that intrinsic motivation directly enhances cognitive processes in traditional learning environments, meaning that students' eagerness to comprehend a concept boosts their understanding. Although Widiatmaka (2021) suggested that cognitive presence did not directly affect motivation, it facilitated the link between motivation and academic performance. Other research in blended learning environments has revealed an inverse relationship between motivation and cognitive presence, though it failed to establish a direct causal link (Law, Geng & Li, 2019). This finding highlights the intricate and context-dependent nature of this relationship, suggesting that cognitive presence may exert an indirect rather than direct influence on motivation. This underscores the complex relationship between motivation and cognitive presence in shaping learning outcomes. Exploring these nuances could guide the development of tailored instructional strategies that optimize the interplay of cognitive presence and motivation in various learning environments.

Cognitive presence interacts with other key elements in the CoI framework, including social and teaching presence. Gutiérrez-Santiuste et al. (2015) demonstrated that social and teaching presence significantly enhance cognitive presence, highlighting that a supportive environment improves cognitive engagement and academic outcomes. Thus, it is crucial to cultivate all three presences to optimize the online learning experience.

In online learning settings, cognitive presence is linked to deeper learning and greater engagement. A study by Galikyan & Admiraal (2019) showed that while cognitive presence is vital, it does not always directly correlate with higher grades. Instead, cognitive presence may indirectly contribute to academic success by fostering active participation, which increases a student's prominence in online discussions, thereby improving learning outcomes. Similarly, Doo et al. (2023) emphasized the role of cognitive presence in enhancing learning outcomes, especially during the COVID-19 pandemic.

Based on these findings, the following hypotheses were formulated:

- H1a: Cognitive presence positively influences students' external motivation in synchronous online general English learning.
- H1b: Cognitive presence positively influences students' internal motivation in synchronous online general English learning.
- H2: Cognitive presence positively influences students' academic performance in synchronous online general English learning.

2.2 Effect of Teaching presence on Motivation and Academic performances

Teaching presence refers to the actions and efforts aimed at designing, facilitating, and integrating cognitive and social processes within learning communities to create valuable and meaningful educational experiences (Garrison, 2011). Research into teaching presence continues to generate substantial interest among scholars and educators.

Teaching presence is crucial for motivating students across diverse learning contexts. For instance, Shi et al. (2021) found that teaching presence, particularly in terms of pedagogical support, positively impacts both intrinsic and extrinsic motivation in blended synchronous learning environments. Similarly, Werang et al. (2022) demonstrated that teachers' performance in motivating students significantly enhances academic achievements in Indonesian language classes at the junior high school level. This suggests that teachers not only improve academic performance by supporting students but also foster intrinsic motivation. Widiatmaka (2021) emphasized that teaching presence directly influences student academic performance by guiding learners through their educational journey.

Furthermore, teaching presence plays a pivotal role in shaping students' motivational growth over time. Lee and Lim (2023) found that teaching presence influences students' motivational beliefs, expectations, and task values, which improve throughout a course. In blended learning environments, teaching presence enhances both social and cognitive presence, which in turn boosts motivation and indirectly improves performance (Law et al., 2019). In addition, teaching

presence mediates the relationship between intrinsic motivation and course satisfaction, highlighting the impact of student-teacher interactions (Trolan et al., 2018).

Teaching presence is also essential for academic success. In blended learning courses, students report that high levels of teaching presence, characterized by effective content delivery and facilitation, are strong predictors of performance (Almasi & Zhu, 2019). Aspects such as course design, facilitation of discussions, assessment, and technological support influence learning engagement, which is closely tied to performance. For example, assessment and technological support are linked to behavioural engagement, while direct instruction is linked to emotional engagement (Wang, 2022). Studies on video-mediated learning also show that teacher presence in videos significantly enhances academic achievements, especially when the teacher's presence is intermittent rather than continuous (Yu, 2022).

These findings underscore the significance of teaching presence in promoting students' motivation and enhancing academic outcomes. Based on this, the following hypotheses were proposed:

- H3a: Teaching presence positively influences students' external motivation in synchronous online general English learning.
- H3b: Teaching presence positively influences students' internal motivation in synchronous online general English learning.
- H4: Teaching presence positively influences students' academic performance in synchronous online general English learning.

2.3 Effect of Social presence on Motivation and Academic performances

Social presence, according to Garrison and colleagues (2000), refers to a learner's capacity to express his or her personality and emotions while interacting with other learners in an online class setting. Kehrwald (2008) expands on this concept, viewing social presence as the capacity of an individual to demonstrate active participation in a virtual environment. This active participation signals their receptiveness to interpersonal interactions and fosters a sense of "being there" with others in the online learning space. Kehrwald (2008) further emphasized the performative nature of social presence, positing a developmental process. This process entails the initial establishment of social presence, followed by its ongoing maintenance through visible learner activity. According to Tan (2021), social presence reflects how students connect, collaborate, and interact with classmates and coursework. This sense of community is believed to foster belonging and encourage open expression (Law et al., 2019). Social presence has been identified as a significant factor influencing student engagement and motivation in online

classrooms and open online courses (MOOCs) (Poquet et al., 2018; Widjaja & Chen, 2017; Mitchell et al., 2021). As online learning inherently functions as a social process, perceiving other participants as genuine individuals becomes crucial for stimulating productive interaction and collaborative learning (Lowenthal & Moore, 2020). Therefore, learners exhibiting high social presence are less likely to experience feelings of isolation or disconnection, as their peers perceive them as authentic (Widjaja & Chen, 2017; Miao & Ma, 2022). In this way, heightened levels of social presence may positively influence students' motivation (Mitchell et al., 2021).

Social presence has recently gained recognition as a crucial factor influencing academic achievement in virtual learning modes (Dijkers et al., 2017). A growing body of research suggests a positive and significant association between social presence and students' success in these settings (Rodriguez, 2015; Tan, 2021). For instance, Lowenthal and Moore (2020) investigated the interconnectedness of social presence, student satisfaction, and academic achievement in online courses. Their study, involving 104 students from asynchronous classes, revealed a positive correlation. The study found a positive correlation, suggesting that higher social presence leads to better academic achievement in these online courses. Tan (2021) also reported that students perceived a pronounced sense of social presence during their online courses, which they attributed to improved motivation and higher academic performance. However, while some studies suggest a positive link between learning outcomes and social presence, the findings are still inconclusive (Choy & Quek, 2016; Rodriguez, 2015). Kožuh et al. (2015) investigated the connections between social interaction, academic achievement, and social presence in a study of 62 engineering undergraduates. While their findings indicated a link between social interaction and student success, social presence showed no significant association with academic achievements. In contrast, Akyol and Garrison (2008) found that while social presence is essential in online learning, its impact on student-perceived learning is most effective when integrated with cognitive and teaching presence.

Based on the above analyses, we proposed the following hypotheses:

- H5a: Social presence positively influences students' external motivation in a synchronous online learning of English.
- H5b: Social presence positively influences students' internal motivation in a synchronous online learning of English.
- H6: Social presence positively influences students' academic performances in a synchronous online learning of English.

2.4. Effects of motivation on academic performance

Student motivation emerges as a critical factor influencing academic achievement (Hakan & Munire, 2014; Clayton et al., 2010). Previous research suggests a distinction between extrinsic and intrinsic motivation in learning outcomes (Young, 2005). Extrinsic motivation is driven by external rewards or punishments (Ryan & Deci, 2000) and may initially promote participation in learning activities. In contrast, intrinsic motivation, arising from genuine interest and personal satisfaction (Young, 2005), fosters deeper learning through increased persistence. This ultimately translates to enhanced academic performance. This positive association is believed to stem from the direct influence of motivation on student effort. Highly motivated students exhibit increased effort due to their interest in the subject and a belief in its value (Wang et al., 2023). Conversely, low motivation can lead to a lack of drive and hinder academic achievement. Empirical studies consistently demonstrate a significant positive correlation between student motivation and academic success across various disciplines (Ariani, 2016). For instance, Berdida and Grande's (2023) research revealed a positive impact of motivation on the academic achievement of nursing students. This aligns with Afzal and Crawford's (2022) research, which demonstrated a positive relationship between academic performance and self-motivation within online learning environments.

Research also suggests the mediating role of motivation in online learning environments. However, the precise nature of this influence remains under debate (Tucker et al., 2002). Some scholars advocate for a direct effect of motivation on performance, while others posit an indirect influence through factors impacting motivation itself. Ariani (2016) found a link between higher academic motivation and stronger self-regulation, which in turn, resulted in students' better academic performance. In this vein, Ma et al. (2020) and Wang et al. (2022) suggested that motivation mediates the positive effects of teacher-learner relationships on students' academic performance in virtual environments. Existing research further supports this connection between teacher engagement and motivation in the EFL context (e.g., Carreira, 2012). Additionally, a burgeoning body of research demonstrates a positive relationship between autonomous motivation, learning behaviors, and achievement (Alamer & Lee, 2019). In this sense, Self-determined motivation can increase students' perceived importance of online learning and encourage the application of cognitive strategies, ultimately leading to improved foreign language learning outcomes (Fang, 2015).

Based on the above analyses, the following hypotheses were put forward:

- H7a: Students’ external motivation positively influences their academic performances in a synchronous online learning of English.
- H7b: Students’ internal motivation positively influences their academic performances in a synchronous online learning of English.

The research model and hypotheses presented were depicted in Figure 1 below.

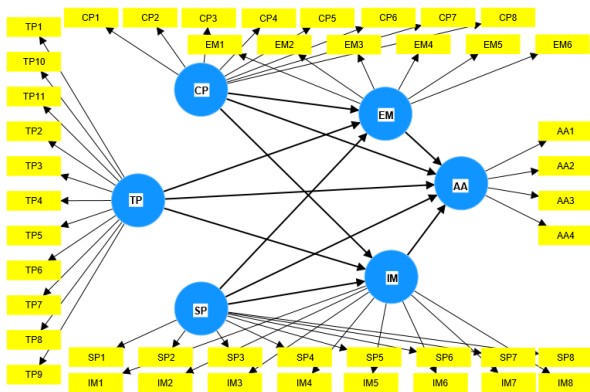


Figure 1 - The proposed research model.

3. Methods

3.1 Participants

The research participants were 265 EFL students from a non-public university in the Mekong Delta, Vietnam from March 26 to May 10, 2024, who have studied general English in synchronously online platforms via Microsoft Teams during the academic year 2023-2024 as required by the university. They come from various provinces in the Mekong Delta, majoring in diverse disciplines, ageing 18-19. To call for their voluntary participation in the study, survey questionnaire and a consent form were shared with these participants via a link.

The official participants of the study were 233 out of 265 after the data filtration. Kock and Hadaya (2018) indicate that to conduct a PLS-SEM analysis with a significance level of 5% and a minimum path coefficient of 0.2, a sample size of at least 155 is required. Therefore, the sample size employed in this study meets the necessary criteria for subsequent data analysis. Detailed demographic information of the participants is provided in Table 1 below.

Table 1 - Participant demographics.

		N	Percentage (%)
Gender	Male	133	57.08
	Female	100	42.92
Age	18-19	233	-
Majors	English	82	35.19
	Business	90	38.63
	IT	61	26.18
Academic year	1 st	75	41.2

3.2 Research instrument

The survey questionnaire comprised four sections containing 45 modified items adapted from prior research. Specifically, the first section featured 27 items measured on a 5-point Likert scale, with responses coded from 1 (Strongly disagree) to 5 (Strongly agree). Within this section, 8 items pertained to cognitive presence, 11 to teaching presence, and 8 to social presence, all adapted from Wertz (2022). The second section involved 14 5-point Likert scale items, starting from “strongly disagree” to “strongly agree”, which explored students' perceived effects of Motivation on their online English performances. Specifically, these items related to extrinsic and intrinsic motivation were adapted from Utvær and Haugan (2016), those related to academic performances were adapted from Ejubović and Puška (2019). For example, Cognitive presence, adapted from Wertz (2022), measures reflective engagement, such as, “I engage in discussions with peers to clarify my understanding of complex concepts”. Teaching presence evaluates the instructor’s facilitation, including, “The instructor provides clear instructions on how to complete assignments”. Social presence gauges students' sense of community, as in, “I feel comfortable sharing my ideas with classmates during online sessions”. Intrinsic motivation, adapted from Utvær and Haugan (2016), includes, “I enjoy learning English because it is personally fulfilling”, while extrinsic motivation focuses on, “I work hard in this course because good grades are important for my future”. Lastly, academic performance, adapted from Ejubović and Puška (2019), examines outcomes such as, “I feel confident that I can achieve good grades in this course”.

The last section was the participants’ demographics. The survey questionnaire was translated into Vietnamese to facilitate respondents’ understanding.

3.3 Data analysis

Survey questionnaires, including the Consent Form to show the participants’ willingness to participate in the study, were administered to participants via Google Forms. Prior to the main study, a pilot questionnaire was conducted with forty students from the researcher's class to ensure its reliability. The results showed that all variables were above 0.7, ranging from 0.88 to 0.94, indicating that the variables exhibited good internal consistency and reliability. In other words, the instrument was reliable and suitable for further analysis.

For the primary data collection phase, Smart-PLS 4.0 was deployed to assess the relationships and impacts of independent variables on dependent variables. PLS-SEM was selected due to its appropriateness for explaining causal-predictive relationships between variables, particularly in complex models and when dealing with small sample sizes (Hair Jr et al., 2017).

4. Results

5.1 Instrument Reliability and Validity

All exogenous and endogenous variables should ensure the indicator reliability (factor loadings should be greater than .70), intrinsic consistency reliability (Cronbach’s Alpha score should be larger than .70), and the convergent validity, variance inflation factor (VIF) values, and discriminant validity - HTMT correlations < 0.9 (Henseler et al., 2015). These values are demonstrated as follows in Table 2.

Table 2 indicated all constructs met the instrument reliability and validity since each construct met the indicator reliability (>0.7), only one variable TP3 is slightly below 0.7 which was retained since it contributed to the composite reliability and overall validity of the construct (Haji-Othman & Yusuff, 2022), internal reliability (Cronbach’s Alpha > 0.7, CR > 0.7), and the convergent validity (AVE > 0.5) (Hair Jr, et al., 2021).

The discriminant validity of scale was measured to ensure that the model variables differ from another. The HTMT of each item should be lower than 0.9 (Henseler et al., 2015). After the initial analysis, Items EM5, EM6, IM6, IM7, TP11, AA1, and SP1 were deleted since they resulted in construct collinearity. After the second analysis, all constructs met discriminant validity criteria.

Table 3 shows that all values are less than 0.9, indicating good discriminant validity.

Collinearity analysis

The variance inflation factor (VIF) should be lower than 3 (Hair Jr. et al. 2021) to ensure that the collinearity issues did not arise.

Table 4 indicated that many bivariate correlations are greater than 3 (CP-AA, IM-AA, SP-AA, SP-AA, SP-EM, SP-IM, TP-AA, TP-EM, TP-IM). Nonetheless, “if all VIFs resulting from a full collinearity test are equal to or smaller than 3.3, the model can be considered free of common method bias” (Kock, 2015, p.7). The full collinearity test results are presented in Table 5.

5.2 Structural model analysis and hypothesis testing

In order to evaluate the structural model, the coefficient of determination R² (0.25 < R² < 0.9) and the path coefficients should be examined (Hair et al., 2019).

Table 6 shows that the R² values of EM, IM and AA were 0.56, 0.58, and 0.28 respectively. This means that the proposed variables of the structural model were fairly satisfactory (Hair et al., 2019).

Table 2 - The reliability and validity of the instrument.

Dimensions	Items	Factor loadings	Cronbach’s α	CR	AVE
Cognitive presence (CP)	CP1	0.827	.937	.937	.693
	CP2	0.834			
	CP3	0.840			
	CP4	0.856			
	CP5	0.802			
	CP6	0.855			
	CP7	0.836			
	CP8	0.809			
Teaching presence (TP)	TP1	0.774	0.937	.939	0.615
	TP2	0.803			
	TP3	0.644			
	TP4	0.814			
	TP5	0.802			
	TP6	0.820			
	TP7	0.780			
	TP8	0.814			
	TP9	0.836			
	TP10	0.785			
	TP11	0.735			
Social presence (SP)	SP1	0.816	.931	.935	.675
	SP2	0.792			
	SP3	0.779			
	SP4	0.876			
	SP5	0.787			
	SP6	0.878			
	SP7	0.793			
	SP8	0.841			
Extrinsic motivation (EM)	EM1	0.809	0.888	.894	0.642
	EM2	0.819			
	EM3	0.789			
	EM4	0.871			
	EM5	0.771			
	EM6	0.741			
Intrinsic motivation (IM)	IM1	0.873	0.950	.951	0.741
	IM2	0.885			
	IM3	0.887			
	IM4	0.877			
	IM6	0.864			
	IM7	0.840			
	IM8	0.860			
	Academic performance (AA)	AA1			
AA2		0.917			
AA3		0.901			
AA4		0.891			

Table 3 - Discriminant validity.

	CP	EM	IM	SP	TP
AA					
CP	0.506				
EM	0.538	0.806			
IM	0.431	0.810	0.835		
SP	0.519	0.762	0.646	0.559	
TP	0.521	0.833	0.754	0.660	0.866

Table 4 - Evaluating Collinearity of Scale and Model Fit.

	AA	CP	EM	IM	SP	TP
Academic Achievement (AA)						
Cognitive presence (CP)	4.033		2.666	2.666		
External motivation (EM)	2.909					
Internal Motivation (IM)	3.038					
Social presence (SP)	3.099		3.072	3.072		
Teaching presence (TP)	4.095		3.873	3.873		

Table 5 - A Full Collinearity Test.

	Random
Academic Achievement (AA)	1.291
Cognitive presence (CP)	2.765
External motivation (EM)	1.241
Internal Motivation (IM)	2.252
Social presence (SP)	
Teaching presence (TP)	1.440

The VIFs of all items are smaller than 3, ensuring no collinearity issue.

Table 6 - R² Values.

Dimensions	R ²	R ² Adjusted
External motivation (EM)	0.57	0.56
Internal Motivation (IM)	0.58	0.58
Academic Achievement (AA)	0.30	0.28

Hypotheses Testing

Tables 7 and 8, and Figure 2 show the path coefficients and p-values for each hypothesis. In other words, the tables indicated the direct, indirect, and total effects of the exogenous variables on the endogenous variables. In particular, as regards cognitive presence, Table 7 reveals that it had direct positive effects on both external and internal motivations ($\beta=0.508$, $P=0.000<0.05$ and $\beta=0.731$, $P=0.000<0.05$ respectively); hence H1a and H1b were confirmed. However, no correlation between cognitive presence and students' English performances was found ($p = 0.611 > 0.05$). In contrast, H2 proposing a link between CP and AA, was rejected with a non-significant p-value of 0.611.

Regarding Teaching presence, Hypotheses H3a and H3b proposed the effects of TP on EM and IM, respectively. H3a was supported with a path

coefficient of 0.310 and a significant p-value of 0.000, indicating a positive relationship. However, H3b was rejected ($P=0.163>0.05$). Similarly, Hypothesis H4 examining the effect of TP on AA was rejected due to an insignificant p-value of 0.444.

Regarding Social presence, Hypotheses H5a and H5b, which suggested the impact of SP on EM and IM, were both rejected with p-values of 0.702 and 0.221 respectively. Hypothesis H6 proposing the impact of SP on AA was also rejected ($P=0.068>0.05$).

Hypothesis H7a proposing the impact of external motivation on academic achievement, was supported ($\beta=0.258$, $P=0.019<0.05$). In contrast, hypothesis H7b, suggesting a positive effect of internal motivation on academic achievement, was rejected ($P=0.876>0.05$).

The study also aimed to examine the mediating role of external and internal motivations on students' academic achievements, hence indirect path coefficients were performed, only two positively significant effects were found. The results were illustrated in Table 8.

Overall, the study highlights the significant role of cognitive and teaching presence in enhancing external motivation, while also emphasizing the critical impact of external motivation on academic achievement in synchronous online EFL learning environments. However, the anticipated positive effects of social presence and internal motivation on academic outcomes were not supported by the findings.

5. Discussion and Conclusions

This study aimed to investigate how the elements of the Community of Inquiry affect external and internal motivation, as well as academic achievements, among EFL students in synchronous online learning. Additionally, the study explored the mediating role of motivational factors in academic achievement. The results indicated that cognitive presence significantly enhances both external and internal motivation (H1a and H1b), aligning with findings by Tokan & Imakulata (2019), who observed that intrinsic motivation directly influences cognitive processes. However, cognitive presence did not have a direct impact on academic performance (H2), which was consistent with existing studies (e.g., Doo et al., 2023; Galikyan & Admiraal, 2019), confirming that cognitive presence does not have a straightforward relationship with academic success. Echoing Widiatmaka (2021), who identified cognitive presence as a mediator between motivation and performance, our study also found a significant indirect influence of cognitive presence on academic performance (H2).

The study also revealed that teaching presence significantly impacted external motivation (H3a) but had no significant effect on internal motivation (H3b) or academic performance (H4).

Table 7 - Hypotheses Testing Results.

Hypothesis	Paths	Path Coefficients	p-value	Results
H1a	CP->EM	0.508	0.000	Supported
H1b	CP->IM	0.731	0.000	Supported
H2	CP->AA	0.067	0.611	Rejected
H3a	TP->EM	0.310	0.000	Supported
H3b	TP->IM	0.132	0.163	Rejected
H4	TP->AA	0.104	0.444	Rejected
H5a	SP->EM	-0.029	0.702	Rejected
H5b	SP->IM	-0.103	0.221	Rejected
H6	SP->AA	0.203	0.068	Rejected
H7a	EM->AA	0.258	0.019	Supported
H7b	IM->AA	-0.018	0.876	Rejected

Table 8 - Indirect path coefficients.

Indirect paths	Path Coefficients	p-value	Results
TP -> EM -> AA	0.080	0.043	Supported
CP -> EM -> AA	0.131	0.023	Supported

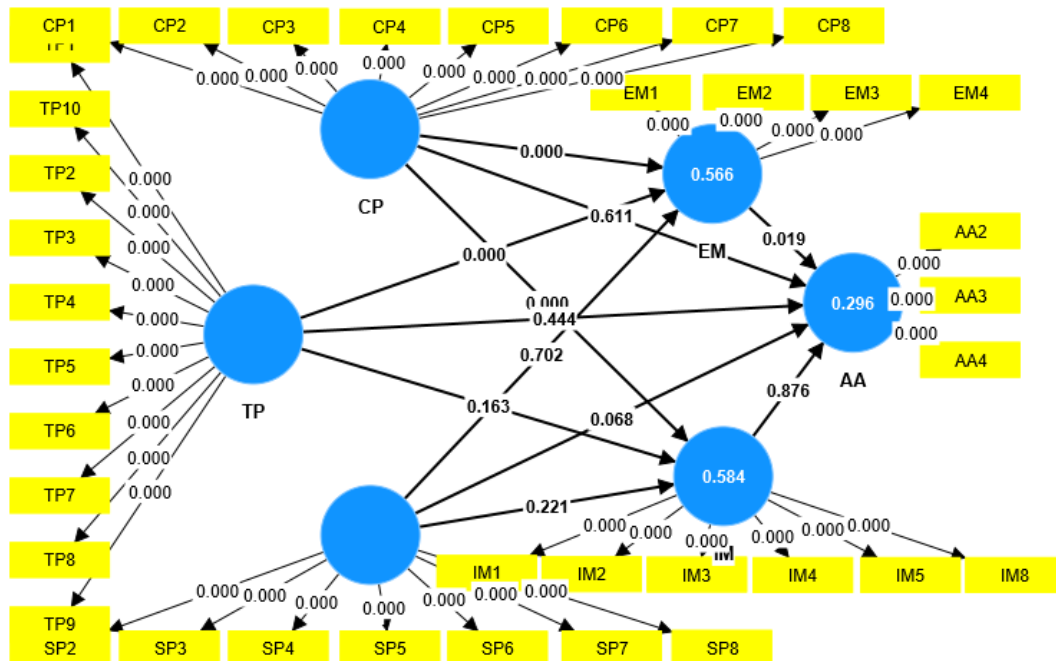


Figure 2 - Structural model analysis.

This suggests that the instructor's role in guiding and facilitating learning activities boosts motivation driven by external rewards or career incentives, but it does not necessarily enhance intrinsic motivation, such as personal enjoyment or satisfaction, nor does it directly improve academic achievement. This finding supports prior research, such as that by Lee & Lim (2023), Shi et al. (2021), and Werang et al. (2022), who showed that teaching presence positively affects external motivation (H3a). However, our findings are not fully aligned with those of Law et al. (2019), who found that teaching presence influenced motivation indirectly by first enhancing social presence, which in turn boosted cognitive presence and learning performance.

In contrast, no significant relationships between social presence and motivation or academic performance were found (H5a, H5b, and H6). This contradicts several studies that have highlighted the positive influence of social presence on student engagement and motivation in online learning. For example, research by Poquet et al. (2018), Widjaja & Chen (2017), and Mitchell et al. (2021) emphasized the role of social presence in fostering a sense of community and open communication, which can enhance motivation and engagement. Nevertheless, the literature on the correlations between social presence, motivation, and academic performance is mixed, as seen in studies by Kreijns et al. (2022) and Dinh (2023).

The inconsistency in our findings may be attributed to several methodological factors. Firstly, this study focused specifically on synchronous online learning in the context of EFL, which may differ from other online learning environments in the role social presence plays. Secondly, the study's participants were EFL students from a private university in the Mekong Delta region of Vietnam, aged 18-19. Cultural, age-related, and academic factors specific to this group could have shaped their perception of social presence. Thirdly, the study utilized a modified version of a questionnaire from Wertz (2022) to measure social presence, and the design of the questionnaire could have influenced the results. Lastly, because the study concentrated on synchronous online learning, the dynamics of social presence may vary from asynchronous learning, where the immediacy of interaction might differ.

Additionally, the study found that academic performance is positively influenced by external motivation (H7a), but internal motivation did not show a significant correlation with academic performance (H7b). This finding aligns with previous studies that have underscored the importance of motivation in enhancing academic performance in online learning settings. For example, Wang et al. (2023) found that learning motivation positively affected online accomplishments, in which academic self-efficacy and experiences acted as mediators. The lack of a significant impact from internal motivation may reflect the unique nature of synchronous online EFL learning, where external incentives, such as grades or recognition, may play a more prominent role in motivating students compared to intrinsic satisfaction.

In summary, this research underscores the significant role of cognitive and teaching presences in motivating students in online EFL learning environments. While these factors did not directly impact academic performance, they played a crucial role in driving external motivation. The findings also emphasize the importance of external motivation in academic success in synchronous online learning, suggesting that strategies to boost external motivation could improve student outcomes. However, the anticipated effects of social presence on motivation and performance were not observed, indicating that the impact of social interaction and community feeling may not be as influential as previously believed.

6. Limitations and Future Research

The study acknowledges some limitations. First, although the participants' background information was described clearly, this research only recruited EFL students from a university in the Mekong Delta of Vietnam, which may impose certain generalization restraints. Second, the methodology used in the

current study is cross-sectional; thus, it makes it impossible to determine change over time and therefore causes exogenous and endogenous variables. The reliance on self-reported data may also incur biases related to inaccurate self-assessment.

Therefore, future research should incorporate longitudinal designs to gain deeper insights into the causal relationships and long-term impacts of cognitive and teaching presences on academic performance, as well as the mediating role of external motivation between teaching and cognitive presences and students' English achievement. Additionally, expanding the sample to diverse students of educational backgrounds and academic years could enhance the generalizability of the findings. Last but not far from the least, qualitative studies could provide deeper insights into the nuances of how these presences affect motivation and performance in synchronous online learning environments.

7. Implications

The findings of this study provide several implications for educators and policymakers. Given the significant impact of cognitive and teaching presence on external motivation, educators should focus on enhancing these aspects through well-designed instructional strategies and active facilitation in students' cognitive thinking. For example, teachers may give more tasks that require students to make use of prior knowledge to provide innovative solutions to problems, or tasks related to the goals or objectives of the course, which can motivate them to engage more in the learning process. More importantly, tasks that require cognitive thinking should be prioritized in the synchronous online modes ($\beta=0.508$ vs. $\beta=0.310$). As such, institutions should provide training and teaching resources to help instructors create more engaging and motivating online learning experiences. Moreover, the strong link between external motivation and academic performance suggests that reward systems could be effective in boosting students' performance in online settings. Finally, the unexpected findings regarding social presence call for further research to confirm or re-evaluate its role in synchronous online education, potentially leading to the development of new strategies to foster meaningful interactions that can positively impact learning outcomes.

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The daunting challenge of Artificial Intelligence in Education: a systematic literature review

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Abstract

This paper presents a Systematic Literature Review on the challenges that Artificial Intelligence (AI) poses in the field of education, specifically, on teaching and learning processes. Based on an exhaustive search in the Web of Science and Scopus databases, 1657 articles published between 2010 and 2024 were initially selected to be examined. The final sample consisted of 52 studies. To achieve this goal, the PRISMA 2020 protocol was employed. Identified challenges are grouped into several key categories. In pedagogical terms, the need to adapt teaching methods and curricula to leverage AI capabilities is highlighted, as well as the importance of maintaining a balance between AI-assisted teaching and human interaction. Additionally, training teachers to use these tools effectively is also considered as a significant obstacle to integrate the new ecology of learning. Finally, there are also ethical and social challenges that address concerns about the privacy of student data, equity in access to advanced technologies, and the potential of AI to perpetuate existing biases. Transparency in the operation of AI systems and the involvement of educational stakeholders are crucial to mitigating these risks. In conclusion, although AI has the potential to transform new ways of teaching and learning. These challenges encourage new paradigms where learning will be more flexible and closer to people's interests. Therefore, AI is not inherently good or bad; rather, it is the way we use it that will be the true key to promoting or not promoting changes in educational paradigms.

KEYWORDS: Artificial Intelligence; Teaching and Learning; Learning Ecology; Engagement; Systematic Literature Review.

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1. Introduction

There is no doubt that Artificial Intelligence (AI) and especially Generative artificial intelligence is going to change the way people teach and learn. Over the last few decades, we have witnessed changes in our daily practices where technology plays a more prominent social role. This trend is also evident in the educational context of teaching and learning. The concept of a learning ecology is considered as a set of technological contexts that evolve over time, providing new and compelling opportunities for learning (Kashiwa & Benson, 2018). The learning

ecology involves a holistic approach to understanding the influence of technological processes on learning (Barron, 2006; Coll, 2013). An examination of learning ecologies associated with different subjects, such as the Holocaust, highlights the importance of social media and how educational interventions can be adapted to enhance effective strategies within these learning environments (Manca & Raffaghelli, 2023). Understanding learning ecologies involves recognizing the diverse contexts, both physical and virtual, that provide opportunities for learning (Danielsson et al., 2023).

From the ecological perspective, each learner constructs a unique learning pathway influenced by various factors such as goals, interests, and available resources within the STEM learning ecosystem (Shaby et al., 2021). In this sense, an approach to learning applied to clinical education provided a framework for better understanding the learning process and designing effective learning opportunities adapted to a real-world context (Brymer & Schweitzer, 2022). However, the application of AI in education represents a paradigm shift in the pre-existing learning ecology.

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AI technologies provide educators with tools to support active social learning, conduct interactive training courses in virtual environments, track student progress, and analyze data to determine effective teaching methods based on individual student needs (Hinojo-Lucena et al., 2019). Teaching AI in schools has been recognized as a strategic initiative to educate the next generation and prepare them for the evolving technological landscape (Chiu et al., 2022). Nothing will be the same. The nature and significance of knowledge will be profoundly restructured, resulting in a reevaluation of its role and relevance in contemporary society. Personalized learning, powered by AI, will be possible by adapting the learning experience to individual student needs, thus enhancing engagement and comprehension (Ahmad, 2024).

Furthermore, AI contributes to the development of educational content, tutoring methods, student evaluations, and improved teacher-student interactions. In the context of higher education, the integration of AI tools has rapidly increased, offering new opportunities for enhancing the learning process and supporting students in their academic journey (Demir & Güraksin, 2022; Crompton & Burke, 2023). AI technologies are also being leveraged to automate the mapping of course outcomes, to program learning objectives, and to streamline educational program evaluations (Zaki et al., 2023).

AI's impact on teaching and learning extends beyond traditional methods, with the potential to revolutionize education through the automation of tasks, the personalization of learning experiences, and the enhancement of decision-making processes. Specifically, "multimodal data can accurately classify tutors and have the potential to support the intuitive decision-making of expert tutors in the context of evaluating trainee applicants" (Cukurova et al., 2019, p. 3044). By utilizing AI in education, institutions can provide tailored support to students, improve learning outcomes, and foster critical thinking skills necessary for the digital age. AI also can assist in monitoring student progress, identifying learning challenges, and offering solutions to enhance the overall educational experience (Flores-Vivar & García Peñalvo, 2023, How & Hung, 2019).

The incorporation of AI in education is not only limited to theoretical aspects but also extends to practical applications such as interactive medical simulations, clinical documentation drafting, and literature reviews in the medical field (Scherr, 2023). AI technologies like ChatGPT are being utilized to enhance learning experiences, support clinical decision-making, and improve educational outcomes for medical students. It is also reshaping the field of radiology, attracting medical students to specialties that leverage AI for advanced medical inferences and diagnostic capabilities (Akiba & Fraboni, 2023; Harari, 2017; Liu et al., 2023; Ratten & Jones, 2023).

Considering the Copernicanesque turn to introduce AI in teaching and learning processes, the following article aims to carry out a Systematic Literature Review (SLR) of the research that has been carried out so far on this subject to gain a deeper understanding of the risks and benefits of using AI in education.

2. Method

The methodology employed to achieve the research goal was the SLR. This involved a documentary analysis strategy utilizing methods recommended by specialized literature (Gough, 2017; Petticrew, 2006; Kitchenham, 2004; Moher *et al.*, 2009, Haddaway *et al.*, 2022). The objective was to analyze the benefits and risks of AI for teaching and learning by exploring the research published to date. The study was conducted using the scientific databases Scopus and Web of Science (WoS) covering the period from January 1, 2010, to June 30, 2024.

2.1 Search strategy

The object of study focused on selecting research carried out in the educational context where the impact of AI on teaching-learning processes was investigated and where the main agents analyzed were educators and students. To conduct the SLR, the following research questions were addressed: 1) Which authors have carried out the most relevant research on the topic?; 2) What were the strengths and weaknesses of the use of AI for teachers and students?; 3) What are the main challenges of AI in terms of digital and curricular competencies?; 4) What are the most challenging points of AI according to research found so far?

Following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines (PRISMA) 2020, the SLR applied the search strategy of the protocol (2020). This qualitative research technique is based on a search design for scientific articles using keywords defined by boolean operators. The strategies were defined by the search filters available in Scopus and WoS in the following fields: title (subject) + title-abs-key (subtopic) + subarea + tipdoc (ar) and the keywords combination implemented was: Artificial Intelligence (+education); Artificial Intelligence (+ competences); Artificial Intelligence (+ learning); Artificial Intelligence (+ skills); Artificial Intelligence + teaching); Artificial Intelligence (+ Learning design teacher); Artificial Intelligence (+ digital didactic skills).

2.2 Selection criteria

According to the PRISMA 2020 protocol, the selection of papers for conducting a SLR consists of three phases: Identification of articles in the databases, evaluation of eligibility, and finally, inclusion in the

final sample. The studies considered for review met the following selection criteria in the first stage:

1. Articles published in WoS and Scopus from January 1, 2010, to June 30, 2024.
2. Articles published in English and Spanish.
3. Articles published in the field of Social Sciences, especially in the educational domain.

In the second phase (screening), the title, abstract, keywords, and conclusions were reviewed, and three new criteria were set to assess their eligibility:

4. Studies that addressed empirical research on AI in the field of education.
5. Research that addressed the assessment of digital competencies using AI exclusively in teachers and/or students.
6. Studies published in open access in its various forms (green route / golden route).

As a result of this work, the detailed information from the database was made available in the freely accessible scientific repository [Zenodo](#).

3. Results

3.1 The final sample and the relationship of authors

Considering the first research question, the application of search combinations in the databases provided us an initial sample of 1.657 eligible articles. At the end of the identification stage, duplicate papers were discarded (421) and records that did not meet any of the first three initial criteria were excluded. Specifically, 272 articles were not included because they were published in another language and an additional 168 articles were excluded for not belonging to the field of education. At the end of the first phase of the protocol, we shifted from 1.657 initial articles to 796.

In the second phase of the protocol, 796 papers were reviewed, and a total of 12 articles were excluded because they were classified as pending verification under suspicion of journal retraction. Finally, of the remaining 784 papers, criteria 4, 5, and 6 described above were applied. A total of 380 articles were excluded for not being considered as empirical studies applied to the educational field: 102 studies for not addressing the topic of digital competence, and 249 for not having any of the open access versions.

As shown in Figure 1, the final sample selected for this Systematic Literature Review consists of 52 scientific articles.

Upon detailing the sample selection, the subsequent focus is on analyzing the relationships between the authors. In this regard, we present a list of the most relevant authors in the field of Artificial Intelligence and educational competence. To do so, we analyzed

the bibliography of the selected sample through a map of co-occurrences, and we observed what connection existed between the different authors and what was their degree of affinity in their research topic.

One of the major contributions that can be seen in this analysis is that there are two large blocks of authors connected to each other. In particular, the contribution of Lee (2021) is situated in a central axis that links with previous research by Knox (2020), Zaki (2021), Carin (2020) among others, and is an inspiration for research carried out subsequently, such as Civaner (2022), Guleria (2022) or Zaki (2022). Contrary to this research that is focused on teaching, Berendt 2020's research is more focused on student learning and gives continuity to research such as that of Han (2022) or Díaz-Tito (2021).

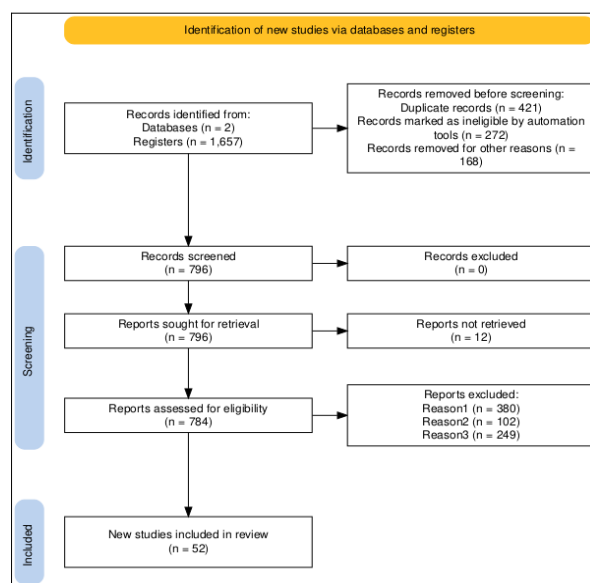


Figure 1 - Prisma Flow Diagram.

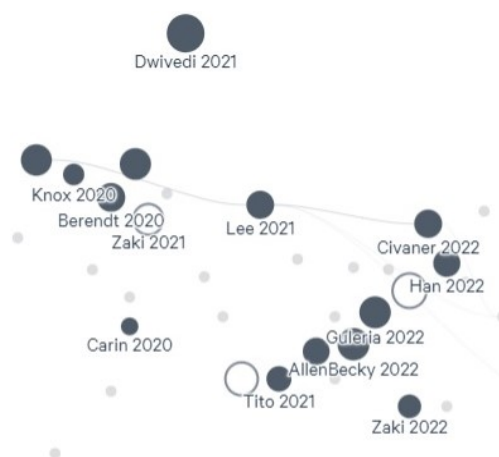


Figure 2 - Map of bibliographic co-occurrence (>2).

In short, the bibliography of all the articles in the selected sample shows, firstly, a very specific time sequence between 2020 and 2022 and, secondly, that

most of the articles have a stable analytical position, paying attention to a target group such as students, teachers or management groups.

3.2 The use and abuse of AI in learning

AI offers a wide array of benefits and opportunities for learners and educators alike. In the realm of educational technology, AI plays a pivotal role in monitoring and optimizing learning designs, offering insights into student progress and suggesting tailored solutions to address learning challenges. AI systems in education leverage data from past learners to enhance future learning experiences by providing intelligent tutoring and personalized learning pathways (Ahmad, 2023; 2024; Berendt et al., 2020; Cukurova et al.; Civaner et al., 2022; 2019; Dwivedi et al., 2021; Knopp, 2023; Popenici & Kerr, 2017; Zaleski, 2024).

Chatbots for educational purposes are emerging as effective tools in distance education, providing personalized support to learners and facilitating the teaching and learning processes through interactive tutoring and guidance (Allen et al., 2021; Chocarro et al., 2021; Kahn & Winters, 2021). The utilization of AI technologies in college English translation teaching has shown promising results in developing key competencies among future translators, highlighting the potential of AI in enhancing language learning and translation skills (Baesler & Sasaki, 2020; Nikonova et al., 2023; Teng et al., 2022; Wang, 2023;). The application of AI in predicting learners' needs and analyzing student data at scale presents opportunities to enhance decision-making processes and to effectively inform educational strategies (Parapadakis, 2020).

The engagement of educators, students, policymakers, and researchers is vital in shaping the incorporation of AI technologies in education (Grunhut et al., 2022; Guleria & Sood, 2022; Puerto & Esteban, 2022). On one hand, these stakeholders are instrumental in recognizing the potential benefits of AI in education, such as adapted learning experiences, increased teaching practices, and improved student engagement. Educators are key in utilizing AI technologies to adjust teaching methods and curricula to meet students' evolving needs and educational objectives (Cukurova et al., 2019; Díaz-Tito et al., 2021; North et al., 2024; Knox, 2020).

On the other hand, the introduction of AI in education could lead to transformations in traditional professions, potentially jeopardizing certain jobs (Grabinska et al., 2021). The utilization of AI technologies requires adaptability and continuous evolution, underscoring the importance of addressing ethical and legal dimensions of AI (Barakina et al., 2021; Cornejo-Plaza & Cippiatani, 2023; Díaz-Tito et al., 2021). The use of AI in learning environments poses significant risks that need to be carefully addressed to safeguard educational integrity and

student well-being. One of the primary concerns is the potential for AI tools to be exploited for academic cheating, undermining the fairness and credibility of educational assessments (Han et al., 2019; Hung & Chen, 2023). The rapid growth of AI technologies in academia has raised ethical concerns, particularly regarding the misuse of AI systems for unethical practices (Sun & Hoelscher, 2023; Garcia-Peñalvo & Llorens-Largo, 2024). The widespread adoption of AI in educational settings can have detrimental effects on student learning outcomes and engagement. The reliance on AI-powered systems without proper oversight and regulation may result in a lack of critical thinking development among students, as they may become overly dependent on AI for problem-solving. Moreover, the use of AI in education raises concerns about the potential dehumanization of the learning process, as students may interact more with AI systems than with human educators, leading to a reduction in social and emotional learning experiences (Mangera et al., 2023; Murugesan, et al., 2023; Schiff, 2020).

Another significant risk associated with the appropriate use of AI in learning environments is the potential for biased decision-making and discriminatory outcomes. AI algorithms are susceptible to biases present in the data used to train them, which can perpetuate existing inequalities and prejudices in educational settings (Guleria & Sood, 2022). Furthermore, the ethical use of AI in education can infringe on students' privacy and data security. The collection and analysis of vast amounts of student data by AI systems raise concerns about data protection and the potential misuse of sensitive information (Weidener & Fischer, 2023).

In conclusion, the involvement of diverse educational stakeholders is essential to harness the powerful flexibility and alignment of AI with people's interests in education. By engaging educators, students, policymakers, and researchers in dialogues about the benefits, challenges, and ethical considerations of AI technologies, educational institutions can establish a supportive and inclusive environment that maximizes AI's potential to enhance teaching and learning experiences. However, the inappropriate use of AI in learning environments can have far-reaching negative consequences related to ethical practices or dehumanization of the learning process. To mitigate these risks, it is essential for educators, policymakers, and stakeholders to establish clear guidelines and promote ethical AI practices.

3.3 The teaching paradigm shift

The integration of AI in education offers teachers a range of opportunities to improve their teaching practices and optimize student outcomes. Educators play a crucial role in adapting teaching methods to integrate AI technologies and facilitate meaningful

learning experiences for students (Tolentino et al., 2023). The use of AI in education empowers teachers to adopt innovative approaches that cater to diverse learning styles, customizing learning experiences, and simplifying evaluation processes (Han et al., 2019). AI-powered intelligent tutoring systems have transformed content delivery, student assessment, and feedback mechanisms, resulting in more engaging and effective learning experiences (Hung & Chen, 2023; Ni & Cheung, 2022; Teng et al., 2022; Wood et al., 2023).

The integration of AI in education curricula has also implications for teachers' professional development and pedagogical practices. Educators must acquire the necessary skills to effectively integrate AI tools into their teaching methodologies and utilize data-driven insights to enhance student outcomes (Cukurova et al., 2019; Grunhut et al., 2022; Schiff, 2020; Sun & Hoelscher, 2023). Training programs focusing on AI literacy and pedagogical best practices are crucial to support teachers in navigating the complexities of AI integration in educational settings (Boot et al., 2023; Celik, 2023).

The rapid progression of AI technologies in education requires continuous professional development for teachers to stay updated on the latest AI applications and pedagogical methods. Educators need to acquire the essential skills to effectively integrate AI tools into their teaching methodologies (Grunhut et al., 2022). One key challenge that educators must address to effectively utilize AI technologies in educational settings is its potential impact on students' critical thinking skills and cognitive development. Educators' overreliance on AI-powered systems for content delivery and assessment could impede students' ability to engage in deep critical thinking and problem-solving, potentially undermining effective AI use for learning (Sun & Hoelscher, 2023).

The integration of AI in education necessitates a shift in pedagogical approaches to accommodate diverse learning styles and to optimize student engagement (Lee et al., 2021). The implementation of AI in education underscores the importance of early and conscientious integration of AI content into curricula to prepare students for the digitalized healthcare systems and technological advancements in various fields facilitating accurate program evaluation and quality assurance processes (How & Hung, 2019; Weidener & Fischer, 2023; Xu et al., 2022; Zaki et al., 2023). By embracing AI techniques and educational methods, teachers can develop adaptive instructional systems that cater to diverse learning styles and engage students more effectively. Involving educators in the design and implementation of AI-powered educational programs is essential to ensure that AI tools align with pedagogical goals and enhance student learning experiences (Crompton & Burke, 2023; Han et al., 2019; Zhu et al., 2023).

In conclusion, the integration of AI in education provides teachers with opportunities to enhance teaching practices, personalize learning experiences, and optimize student outcomes. Adopting AI technologies allows educators to transform traditional teaching methods, promote student engagement and collaboration, and empower learners. Teaching through AI presents three significant challenges: 1) educators' familiarity with AI tools 2) the engagement of educational stakeholders and 3) adapting teaching methods and curricula. Only by fostering collaboration, communication, and involvement among stakeholders, educational institutions can effectively harness the power of AI tools to enhance teaching practices and prepare learners for the demands of a rapidly evolving digital world.

5. Conclusions

To best answer the research questions posed, the conclusions of this study indicate that the strengths of AI for learning are related to its effectiveness and suggestiveness for students and to a lesser extent for teachers. The integration of AI in education facilitates personalized learning experiences, exemplified by chatbots that assist learners in distance education (Allen et al., 2021; Chocarro et al., 2021). However, concerns regarding academic integrity have arisen, as AI tools may be exploited for cheating, undermining the credibility of assessments (Han et al., 2019; Hung & Chen, 2023). To mitigate these risks, it is essential to establish robust ethical frameworks that safeguard educational practices and promote equitable learning environments. Learning through AI can be positive to generate a more flexible form of learning that is closer to the interests of the student. The acquisition of new digital competencies will not only facilitate alternative modes of learning but also integrate AI as an additional tool to reach new objectives and horizons for humanity. It is equally true that this new paradigm involves a process of reflection for teachers, their collective collaboration, and specific curricular adaptations. While the major risks of AI are the dehumanization of the learning process and ethical issues related to its misuse, the foremost challenge of this paradigm shift are related to its curricular application. Only by setting very clear criteria and guidelines in the educational curriculum can a solid foundation be established for the teaching-learning process of the digital citizen.

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Personalized Learning Systems: essential components and their impact on Learning Outcomes

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Abstract

Personalized learning has emerged as a promising approach to meet the diverse needs of learners. Personalized learning flexibly provides various learning options to suit learners' needs and learning speed. Instructional designers and researchers need directions regarding the components of a personalized learning system that can support achieving learning objectives. Many researchers propose personalized learning components only to identify the characteristics of personalized learning. This paper explores and elucidates the key components of personalized learning as an instructional system to ensure the achievement of learning objectives. The research method used is a systematic literature review. This study reviews related literature to analyze the personalized learning system's input, process, and output components. We included literature that proposes personalized learning models in various application and experimental contexts to see the personalized learning components used and their impact. After the identification and screening process, we reviewed eligible works of literature. We proposed a conclusion that there are five components of personalized learning: 1) learner profile, 2) learning objectives, 3) learning path, 4) learning environment, and 5) learning result. This research recommends future research on personalized learning to measure and ensure the achievement of learning objectives with personalized learning.

KEYWORDS: Personalized Learning, System Approach, Instructional Systems, Personalized Learning Components, Systematic Literature Review.

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1. Introduction

Education is undergoing a paradigm shift fueled by advancements in technology, evolving pedagogical theories, and a growing recognition of the uniqueness of each learner. One-size-fits-all instructional approaches gradually shift to personalized learning, a learner-centered approach that tailors the learning experience to individual needs, preferences, and

abilities (Caporarello et al., 2020; Halverson, 2019). At its core, personalized learning incorporates various components that work synergistically to create a truly personalized educational experience (Peng, Ma, & Spector, 2019; Zhang, Basham, & Yang, 2020). Personalized learning recognizes that learners have various self-regulated skills, paces, and interests, and it seeks to optimize the educational journey for each learner, promoting deeper engagement, motivation, and academic success (Ghallabi et al., 2022; Zainuddin & Judi, 2022). The characteristics of personalized learning make researchers, academics, and practitioners believe that exploring and developing personalized learning is an appropriate investment for the future.

Many researchers have studied personalized learning from multiple perspectives. Some studies elaborate on how instructional technology could encourage various learning and assessment strategies to be offered by personalized learning, like learning analytics, artificial

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intelligence, learning management systems, and gamification. (Isaias, 2018; Källkvist et al., 2009). Some studies focus on learning behavior in personalized learning environments, exploring how personalized learning could affect self-regulation learning, students' interaction with learning, learning style, and intrinsic motivation in personalized learning contexts. (Ali, Eassa, & Hamed, 2019; Grant & Basye, 2014; Hooshyar et al., 2020; Perez-Ortiz et al., 2021; Thanyaphongphat, 2019). The variety of perspectives that enrich personalized learning research shows how personalized learning research has become such an important and urgent topic to be explored.

As a potential innovation in enhancing education quality, research in personalized learning faces its challenge, as insufficient empirical studies are dissecting how each component independently contributes to learning objectives (Davis et al., 2018; Shemshack, Kinshuk, & Spector, 2021; Zhang et al., 2020). Many studies proposed personalized learning components in the context of technology integration and innovation without providing a complete picture of other components to support successful learning (Jando et al., 2017; Peng et al., 2019; Tawafak et al., 2019). This condition aligns with how personalized learning focuses on technology development and innovation, so there is less research exploring how personalized learning can ensure the achievement of the expected learning objectives and present meaningful learning (Källkvist et al., 2009; Zhang et al., 2020). From the point of view of instructional design, components are essential to ensure the achievement of learning objectives (Bielik et al., 2023; Richey, Klein, & Tracey, 2011). For this reason, when viewing learning as a system, the design of a learning system must pay attention to how the learning system follows the conditions and circumstances of the environment. A proposal is needed to answer the existing research gaps and identify personalized learning components that can ensure the achievement of learning objectives in personalized learning systems.

The primary aim of this paper is to explore the key components of personalized learning within instructional systems and examine how these components interact to create cohesive and effective learning environments. This paper is structured to first explore the key components of personalized learning within instructional systems and then analyze how these components interact to form a cohesive and effective learning environment. Additionally, the paper investigates trends over the years, particularly in the use of technologies for personalizing learning environments, providing insights into how these technologies have evolved and their impact on instructional design.

2. Terms and Definitions

2.1 The Systems Approach to Instruction

This study adopts a systems approach to examine personalized learning, focusing on formulating the components within a learning system. Systematic approach theory generally explains how a system within an ecosystem influences its environment. Bertalanffy in Huang, Spector, and Yang defines systems as sets of interconnected elements in an environment (Huang, Spector, & Yang, 2019). Hall & Fagen in Buckley elaborates that a system comprises interconnected objects and their attributes, designed to function as a unified whole (Buckley, 2017). A system is the amalgamation of more than two elements into an integrated and interconnected organic entity that operates as a unified system (Bielik et al., 2023; Buckley, 2017; Richey, Klein, & Tracey, 2011).

In the educational context, the systems approach perceives education as a part of the broader societal framework, where education is considered a subsystem. The concept of the educational system is a collection of subsystems, including schools, curricula systems, assessment systems, grading systems, and learning objects. Mangan & Mangal in Huang, Spector, and Yang explain that a system comprises five fundamental elements (as illustrated in Figure 1):

1. various components that constitute the system,
2. interactions between each component within the system,
3. the environment in which the system operates, and
4. the output of the system to its environment (Huang et al., 2019).

The systems approach gives a clear guideline on how, as a system, personalized learning components should be an integral part of ensuring the achievement of learning objectives. Implementing the systems approach in understanding personalized learning emphasizes the function of each personalized learning component as input, process, and output elements.

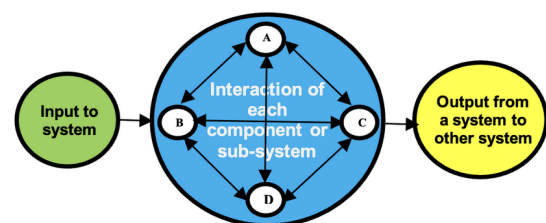


Figure 1 - Four Basic Elements of System.

2.2 Instructional

Instructional represents a system promoting learning (Brown & Green, 2016). The instructional system comprises several key components: learners, teachers,

instructional materials, and the learning environment (Dick, Carey, and Carey, 2015). When considering personalized learning within the framework of an instructional system, it becomes crucial to ensure the seamless integration of all components. Integrating all components will ensure that personalized learning, operating as an instructional system at the micro level, can effectively interact with the more extensive educational system at the mesolevel. By comprehending how the systems approach influences education and instruction, this study lays the groundwork for applying the systems approach to identify the components of personalized learning systems.

2.3 Personalized Learning

Personalized learning is a strategy for reforming education by enabling learning experiences tailored to each learner's diverse interests and capabilities (Halverson et al., 2015; Halverson, 2019). In this context, educators and related roles should create an environment where learners and instructors can collaboratively design study plans to achieve specific learning objectives. Personalized learning allows learners to progress at their own pace and adopt approaches that best suit their needs (Halverson, 2019; Peng et al., 2019; Zhang et al., 2020). Within this framework, learning objectives, approaches, instructional materials, and sequencing can be adjusted based on the learner's self-initiated needs.

Personalized learning encompasses a learning paradigm that prioritizes supporting the individual development of learners. It emphasizes that teaching methods, techniques, content, starting points, processes, and evaluation methods should be adapted to suit individual characteristics and potential development so that all aspects can be fully, freely, and harmoniously developed (Reigeluth, Myers, & Lee, 2017). Personalized learning empowers learners to reach their maximum potential through tailored learning experiences considering individual needs and prior experiences (Watson & Watson 2017). From these explanations, one can infer that personalized learning pertains to educational methods or frameworks that revolve around learning. Personalized learning incorporates elements to meet individual learners' unique requirements and capacities (Tkachuk, 2021). Importantly, personalized learning aims not only at facilitating knowledge acquisition but also at the achievement of specific learning objectives. Personalized learning extends beyond mere knowledge acquisition and includes the cultivation of self-regulation in students' learning (Peng, Ma, & Spector 2019). In the context of this research, personalized learning signifies an educational system that offers a diverse range of customizable learning components, adaptable to suit learners' objectives, pace, preferences,

and individual traits, with a central focus on successfully attaining predefined learning goals.

3. Method

This study adheres to a systematic literature review framework guided by PRISMA standards for reporting results (Page et al., 2021). A Systematic Literature Review (SLR) is a comprehensive and structured approach utilized in academic and research settings to identify, assess, and synthesize existing, pertinent research studies on a specific topic or research question (Page et al., 2021; Kitchenham, 2004). The research questions guiding this literature review are as follows:

- What constitutes the elements of personalized learning within an instructional system?
- How do the various personalized learning components interact within the instructional system?

This research encompasses three critical stages in the Systematic Literature Review (SLR) process: 1) identification, 2) screening, and 3) inclusion, as illustrated in Figure 2. To establish a solid foundation for the literature review, we meticulously defined research objectives, eligibility criteria, search methods, data items, and comparisons for synthesis. The included literature review in this study varies from textbooks, scientific papers, and websites relevant to personalized learning components from 2013 to 2023. The primary search string used was: (“personalized learning” OR “personalized instruction”) AND (“components” OR “elements” OR “systems”) AND (“higher education” OR “professional training”). Searches were conducted in Scopus, Google Scholar, EBSCO, and ERIC, focusing on publications from 2013 to 2023. This timeframe captured contemporary developments in personalized learning technologies and methodologies.

This literature review focuses on personalized learning within the context of instructional systems, specifically targeting higher education and professional training environments. This focus was chosen to explore the integration and effectiveness of personalized learning components in structured educational settings. Studies related to K-12 education, while relevant, were excluded to maintain a focused scope on adult learning and its distinct characteristics in personalized learning systems.

To ensure transparency, we applied the following inclusion and exclusion criteria:

- *Inclusion:* Articles that address personalized learning components within instructional systems in higher education or professional training settings were included. To maintain the quality and rigor of the review, only peer-reviewed journal articles, books, and credible academic sources were included.

- *Exclusion:* Articles with restricted access or unavailable resources were excluded due to the inherent limitations in accessing and verifying the content. We deliberately excluded literature primarily centered on hardware and software technology specifications without explaining its use in learning. Additionally, unpublished articles, conference abstracts, editorials, opinion pieces, and marketing content were excluded to avoid bias and subjectivity. Articles that did not suggest personalized components from a system approach point of view were also excluded, as our focus is on literature aligning with the objective of examining personalized learning components within a unified instructional system.

The exclusion of certain types of literature was based on the need to ensure a coherent and focused review on personalized learning within instructional systems. By concentrating on higher education and professional

training, the review aims to provide insights that are directly applicable to structured learning environments where personalized learning strategies are increasingly implemented.

4. Result

After undergoing a series of processes involving identifying and screening literature related to personalized learning, we have included 43 works of literature in this study. The consideration that this literature offers sufficient explanations and elaborations enables us to conduct a more in-depth synthesis of the components comprising personalized learning as an instructional system.

Figure 2 will explain the outcomes of the identification and screening procedures.

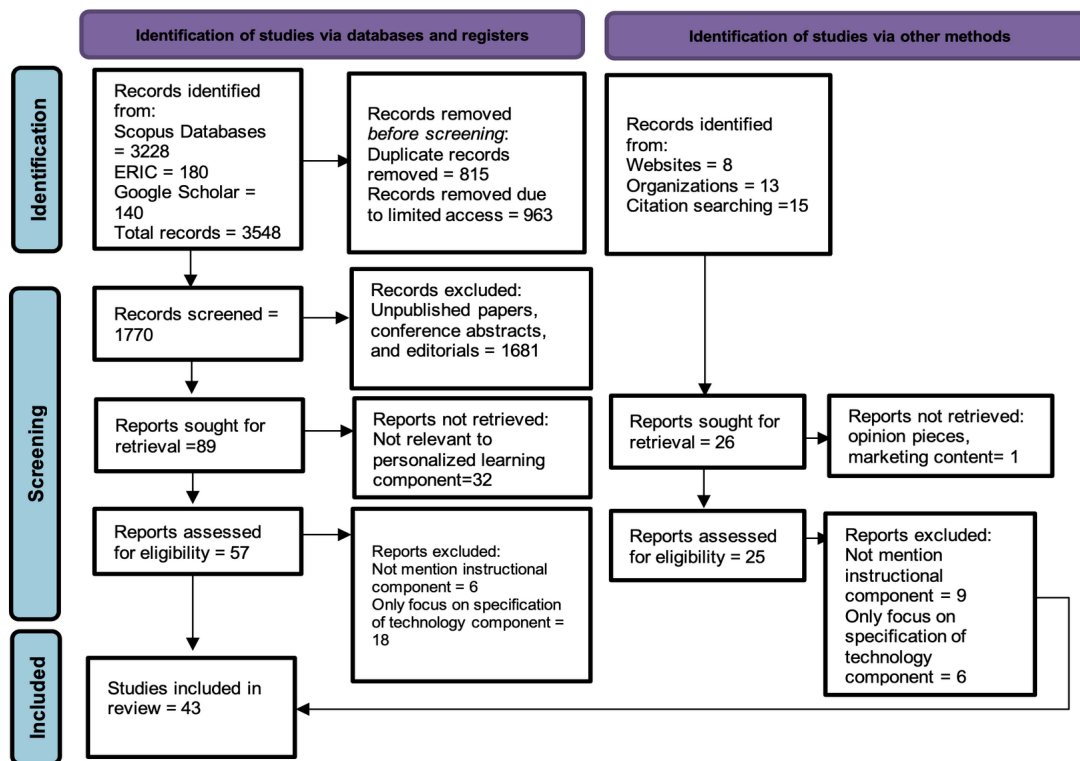


Figure 2 – PRISMA Flow of Literature Review.

5. Discussion

5.1 Personalized Learning Components

We have organized the study’s findings concerning the personalized learning component within the framework of personalized learning as an instructional system. An instructional system typically comprises three main parts: 1) input, 2) process, and 3) output. In the context

of personalized learning as an instructional system, the ‘input’ encompasses the various components of a personalized learning system. These input components originate from external systems and subsequently influence the elements within the ‘process’ section of the learning system (Huang et al., 2019). Meanwhile, the ‘output’ section comprises the outcomes of the executed processes (Huang et al., 2019).

We have identified and categorized the components of personalized learning as described in each literature source. We then classify them into the ‘input’, ‘process’, and ‘output’ categories within the context of personalized learning as an instructional system. In this section, we present the findings of our study on the various components that constitute personalized learning, shedding light on their effectiveness and impact on learner performance in learning objectives’ achievement. Through qualitative literature, we examine personalized learning components offered by other researchers and classify the components according to the direction of the system approach.

The components in the ‘input’ section pertain to external input into the personalized learning system, which guides and influences the process components within the context of personalized learning as an instructional system. Based on our mapping, the included literature describes two major components: 1) learner profile and 2) learning objectives.

Learner profile

As the literature shows, understanding the learner profile comprises attributes brought by an individual learner from outside the system, and these attributes will influence the processes within the personalized learning system. The identify learner profile is an effort to identify and classify learners’ traits, such as self-regulated learning skills, readiness, personality, characteristics, etc., as the basis of consideration. The learner profile component captures the learner’s characteristics and readiness to achieve the desired learning goals (Halverson, 2019). Meanwhile, the International Association for K-12 Online Learning (iNACOL) describes the student profile as an effort to record individual students’ skills, gaps, strengths, weaknesses, interests, and aspirations (Ferlazzo, 2017; Pipkin, 2015). Some literatures uses a different term to describe the learner profile, a learner model. A learner model refers to information and learner characteristics, including, among other things, the level of knowledge, learning style, personality type, emotional and motivational conditions, performance history, and cognitive abilities (Ghallabi et al., 2022; Grant & Basye, 2014). As an input component, initial information regarding the learner will influence the parameters and context of personalization that guide the personalized learning process (Ghallabi et al., 2022; Shemshack et al., 2021). The learner profile serves as a component that provides initial guidance for the processes within the personalized learning system. In this context, learners, with their diverse attributes, are entirely independent, necessitating facilitation to ensure a successful learning process. To facilitate this condition, instructional designers should consider conducting learner profiling before learning. This learner profiling can be a self-assessment report to assess the learners’ self-regulated skills, readiness, and

prior knowledge. Information related to the learner thus becomes a crucial input component in personalized learning systems.

Learning objectives

The second input component in the personalized learning system is the ‘learning objectives’ component, which refers to the intended skill, knowledge, or attitude the student achieves at the end of the instruction. We contend that learning objectives should capture the learning needs arising from societal needs or demands at the related meso or macrolevels. Considering these considerations, we categorize learning objectives as inputs in a personalized learning system. Halverson mentions competency-based development components encompassing goals and achievement standards that students must attain (Halverson, 2019). On the other hand, Tkachuk elaborates on the ‘implementation goal’ component, highlighting the need for enhancing the learning process through personalized learning (Du, Wu, & D, 2020; Tkachuk, 2021; Zualkernan, 2016). Watson and Watson (2017) expound on the personalization of goals, emphasizing that students must identify and periodically monitor their short-term and long-term learning goals with guidance through social interactions with teachers and parents. As input in the personalized learning system, the learning objectives component constructs individual learning trajectories and enhances students’ engagement in social participation (Halverson, 2019; Muslim et al., 2017; Tkachuk, 2021). This context illustrates that the learning objectives component serves as the input that shapes the trajectory of components within the personalized learning process as an instructional system.

The process of system involves the interaction and integration of components within the personalized learning system to ensure that the personalized instructional process necessary to achieve the expected learning objectives takes place. Based on a review of the included literature, we have identified two main components that facilitate the process within a personalized learning system: 1) learning path and 2) learning environment.

Learning path

We categorize the ‘learning path’ component, considering that some of the included literature describes components that pertain to a learning design offering various alternatives and flexibility based on existing input to ensure the achievement of learning objectives. The ‘learning path’ component encompasses learning strategies, assessment activities, content, and pedagogical conditions that enable personalization. Some researchers define a personal learning path as activities that can be adjusted to

support motivation and achieve learning goals (Halverson, 2019; Pipkin, 2015). Classify the learning path component as a static or dynamic learning path. The learner agent component refers to giving control to the learner to participate in designing their learning process and providing them with the option to demonstrate their learning objectives through performance-based assessments (Buitrago, Salinas, & Boude, 2023; Hans & Sachdeva, 2021; Pipkin, 2015). In line with this study, CIL Temple University explains a component related to personal competency, which refers to the competency needs chosen by the learner as the basis for all learning processes that prioritize a personalization context (Clarke, 2013; Colace, Santo, & Greco, 2014; Ghallabi et al., 2022; Murphy, 2016).

Aligned with those reviews, several included works of literature explicitly suggest other components that we consider classifying as 'learning path' components within the process of a personalized learning system. Watson and Watson (2017) explain the 'personalized scaffolding of instruction' component, emphasizing how the learning platform must be personalized according to the learner's self-regulation abilities in the personalized learning system. In addition to the 'personalized scaffolding of instruction' component, they also mention the 'personalized assessment of learning and performance' component. This component dictates that task performance and achievement assessments must be personalized by choosing among instructors, external experts, peers, or computer systems (Watson & Watson, 2017).

To enhance understanding of the learning path settings in personalized learning systems, we categorize the 'adaptation mechanisms' components as part of the 'learning path' components within the processes of personalized learning systems. The 'adaptation mechanisms' are various techniques and methods to support the learner's adaptation process in personalized learning settings (Ghallabi et al., 2022). Additionally, we include the 'learning schedule and pace' component proposed by Halverson (2015), which pertains to learning design that empowers students to control their own learning time and pace (Halverson et al., 2015).

We group the two components mentioned in Tkachuk's literature under the 'learning path' component. The first component is the 'main phase of implementation', which refers to managing learning activities and content used with software and technical support (Tkachuk, 2021). In addition, Tkachuk also explains the 'implementation principles' component, which refers to the basic rules and regulations for implementing personalized learning that form the structure and logic of the learning process, such as the principle of awareness, the principle of accessibility, the principle of flexibility, the principle of consistency, the principle of social participation, and the principle of control (Tkachuk, 2021). In the context of these studies, we ensure that the learning path component

allows students to determine their own learning goals, choose diverse learning experiences tailored to their individual needs, and prioritize personalization.

Learning environment

Based on the research we conducted, we found that the 'learning environment' is a component that pertains to the arrangements required to facilitate essential interactions between students and learning resources, students and their peers, and students and facilitators. According to our study, 'learning environments' not confined to structured classrooms with fixed settings. The 'learning environment' refers to an environment that is managed flexibly based on the learners' needs and extends beyond the physical environment by encompassing both physical and social components of the learning space (Halverson et al., 2015; Halverson, 2019; Ismail et al., 2023; Pipkin, 2015). Unlike classifications in other literature, Watson and Watson specifically mention the 'personalized task environment' component. The term 'environment' is coupled with 'task', signifying environmental settings that permit task personalization based on the learner's interests, goals, and initial abilities (Boubouh et al., 2020; Montebello, 2021; Watson & Watson, 2017). Within the context of this component, personalization of the task environment also governs how we should personalize collaboration between students and learners to complete tasks.

In managing the learning environment, a 'pedagogical condition' component is needed, which encompasses 1) conditioning the learning environment, 2) conditioning the readiness of the learner and facilitator, 3) conditioning the readiness of logistical and pedagogical support, including hardware and software, information technology, and the learning environment (Soltan et al., 2020; Tkachuk, 2021; Zainuddin & Judi, 2022). In more detail, the components of 'pedagogical knowledge' refer to the general elements used to create learning. These elements include domain models, learning materials, pedagogical models, learning resources, learning objects, content, learning activities, tests, and course structure (Ghallabi et al., 2022; Hwang & Fu, 2020; Tsatsou, Vretos, & Daras, 2017). Furthermore, Halverson guides the 'content' component, suggesting that content in personalized learning must give students control over the topic and direction of their learning (Halverson et al., 2015).

One of the core elements in the learning environment component is technology. The review observed significant changes in the technologies used to personalize learning environments over the last decade. Early implementations often relied on static content delivery systems, whereas recent advancements include adaptive learning platforms, AI-driven analytics, and real-time feedback mechanisms (Peng et al., 2019; Peyrony et al., 2018; Zhong et al., 2020). These technological evolutions have enhanced the ability to

tailor instructional content to individual learner needs, providing more dynamic and responsive learning experiences.

The 'learning environment' component within the personalized learning system process establishes the necessary boundaries and openness to facilitate the personalization process. The relevant boundary is where the learning environment maintains settings geared towards enabling students to attain their expected learning goals and fostering the personalization of the learning process. Conversely, the 'learning environment' must possess flexible openness to provide physical and social spaces for students to interact and plan their learning processes according to their preferences. The studies covered in the literature that elucidate the components of the 'learning environment' emphasize the need for a learning environment that supports the achievement of learning objectives while still offering the flexibility and openness characteristic of personalized learning.

The 'output' comprises a learning result component that gives the measurement guidance of students' achievement of learning objectives to ensure the effectiveness and efficiency of personalized learning systems. Some of the included literature describes this component using various terms. For example, Tkachuk uses the term 'result', which refers to measuring learning effectiveness in attaining learning goals and solving existing organizational problems (Tkachuk, 2021). Watson and Watson identified the 'personalized reflection' component, which pertains to reflection on the learning process and reflection on learning objectives, flexibly organized to reflect the achievement of expected outcomes (Beghetto, 2019; Peng, Wu, & Technology, 2019; Watson & Watson, 2017). The International Association for K-12 Online Learning (iNACOL) explains the 'individual achievement' component, referring to an arrangement where students measure learning completion based on their respective learning targets according to clearly defined standards and goals (Beghetto, 2019; Pipkin, 2015; Yang, Flanagan, & Ogata, 2022).

5.2 Interaction between Personalized Learning Components

In this section, we try to explain the interactions between components in personalized learning systems.

Figure 3 illustrates the relationship between components in personalized learning systems. Personalized learning systems consist of three main components: 1) input, 2) process, and 3) output.

In the input section, the 'learner profile' component encompasses the learner's characteristics, interests, expectations, and self-regulated learning skills as inherent attributes outside the personalized learning system. The elements of the learner profile will

influence the personalized learning path choices made by the learner in the process section of the personalized learning system. Another component in the input section is 'learning objectives', which refer to the response of the organization and society that needs to be achieved by the end of the learning process. These learning objectives are personalized based on the learner's interests and aspirations.

The process section has two main components: 1) the 'learning path' and 2) the 'learning space'. These components interact with each other to offer personalized learning choices for students. The 'learning path' component provides a range of strategies, assessments, timeframes, and learning speed options that students can flexibly choose based on their student profile and the learning goals they aim to achieve. The 'learning environment' component encompasses various learning resources, learning objects, and physical and social learning spaces, all designed to support a variety of learning activities in line with the choices made by the learner profile.

The output section includes measuring the results stemming from the processes carried out. In the context of personalized learning systems, the output refers to the attainment of learning goals set by students. The output from personalized learning systems subsequently becomes input for the next phase of the system.

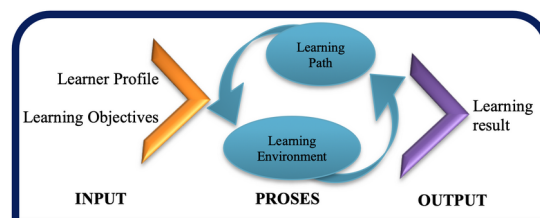


Figure 3 - Interaction between Personalized Learning Components.

6. Conclusion

This study posits that, with all its existing advantages and limitations, personalized learning indicates the future of education. From the perspective of systems approach theory, personalized learning design is a unified learning system with integrated components. Current research and studies in personalized learning predominantly emphasize learning technology components and infrastructure supporting personalized learning. Therefore, this study aims to explore literature that examines personalized learning as an instructional system and synthesizes its components to ensure the effectiveness and efficiency of personalized learning in supporting learning objectives.

This research addresses the problem formulation by searching and selecting literature that meets predefined

criteria and limitations. We included 43 pieces of literature for a comprehensive analysis to link and map the components of the personalized learning system. The selected articles encompass textbooks, scientific journals, research reports, and websites from reputable sources found during the search. The literature included spans the last ten years.

Based on a literature review, we identified components in the input, process, and output sections. The input component includes components 1) learner profile and 2) learning objectives, which provide direction and input to the process in the personalized learning system. The learner profile refers to the efforts to identify and classify learner attributes as considerations in designing and directing the learning process in a personalized learning system. The second input component in the personalized learning system is the 'learning objectives' component. This component pertains to the intended skills, knowledge, or attitudes students should achieve by the end of the instruction. The process section consists of components that ensure personalization supports achieving learning goals based on individual learner needs. The process includes 1) the learning path and 2) the learning environment. The learning path refers to a learning design offering various alternatives and flexibility, consisting of learning strategies, assessment activities, content, and pedagogical conditions that enable personalization. The learning environment is a component that maintains the arrangements required to facilitate essential interactions between students and learning resources, students and their peers, and students and facilitators. Finally, in the output, we consider the component of learning results, which refers to the measurement guidance of students' achievement of learning objectives to ensure the effectiveness and efficiency of personalized learning systems.

We aim to convey the personalized learning component from the learning design perspective within the scope of personalized learning as a learning system. Our study aims to provide new insights into research related to personalized learning. The insights provided by our study can assist researchers, practitioners, decision-makers, and instructors in designing personalized learning as a system that supports the achievement of expected learning goals. In the systems approach, personalized learning is detailed based on integrated components that mutually support each other to achieve the expected goals. Implementing personalized learning is challenging in the field, requiring significant efforts such as technology investment and readiness among instructors and learners. Therefore, the direction of this research is crucial to ensure that the implementation of personalized learning, with all its complexity and flexibility, still delivers meaningful learning objectives and ensures the achievement of expected learning objectives.

Through this study, we propose five complete components in the input, process, and output of a personalized learning system: 1) the learner profile, 2) the learning objectives, 3) the learning path, 4) the learning environment, and 5) learning results. The component classification scheme that we offer is different from previous research, such as the study that identified the main components of personalized learning, including learner profiles and attitudes, prior knowledge and beliefs, personalized adaptive learning paths, and flexible self-paced learning (Shemshack et al., 2021). The study has outlined the input and processes contained in personalized learning but has not explained how the achievement of learning objectives is then measured.

Meanwhile, many studies in personalized learning propose personalized learning components from the perspective of technology preparation. A study examines standard components, tools, and the foundational theory as a guideline for developing a personalized e-learning model (Jando et al., 2017). This study thoroughly reviews personalized learning as an entity supported by various technologies. This study is not incorrect, given that integrating communication and information technology is vital in supporting education. However, technology alone cannot guarantee that all technological investments can ensure memorable and practical learning. We address this gap through the findings of the study we conducted.

Limitations in this research include the limited literature that discusses personalized learning components from a systems approach perspective. With a limited literature review, we aim to present a proposal for personalized learning components that describe a personalized learning system. One potential area for further exploration is developing a personalized learning system model based on our proposed components, specifically for learning contexts in specific scientific areas. Researchers can investigate the effectiveness of personalized learning systems in promoting self-regulated learning and achieving learning goals. Additionally, researching the specifications and minimum criteria for each component of a personalized learning system in a specific scientific field could be a potential focus for future research.

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Integrating educational technologies: critical analysis and perspectives from teacher training students

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Abstract

The growing spread of Information and Communication Technologies (ICTs) across multiple contexts of use has triggered the transformation of traditional educational environments to welcome their use in ordinary teaching and learning processes. However, the mere availability and supply of educational technologies does not guarantee the activation of meaningful and inclusive trajectories for technology integration in the classroom, as the knowledge and competences of teachers and students is still the primary factor to drive an equitable and effective use of technology as a didactic mediator. Considering the challenges of teacher training within an ever-changing technological landscape, this paper focuses on the Italian national context, analysing the perceptions of 830 Italian teachers participating in a training course for teachers (30 credits Training, Prime Ministerial Decree of 4 August 2023) with reference to the use of ICTs in their previous teaching experience. The Italian version of the Intrapersonal Technology Integration Scale (ITIS) was implemented as a tool to collect data and examine the dynamic relationship between the teachers' perceived competences on educational technologies and the factual use they make of them to support teaching across disciplines. Results show useful insights on the reasons underlying the choice of implementing and integrating technology in ordinary teaching practices and unveil possible trajectories to reshape the training paths for teachers. In this sense, this contribution unfolds a deeper analysis of the intersection between teacher professionalism, educational technologies and educational systems' inclusiveness and efficacy.

KEYWORDS: Teacher Training, Information and Communication Technologies, Educational Technologies, Inclusive Education, Intrapersonal Technology Integration Scale.

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1. Introduction

Continuous learning for teachers represents a topic of pedagogical interest not only in light of the social role that teaching is recognised with by scientific literature (Butera et al., 2020; Pantić & Florian, 2015; OECD, 2005), but also with reference to the ongoing transformations that have been affecting the formal educational systems, including the Italian one (Prime Ministerial Decree of 4 August 2023; Potestio, 2022).

The need to address a multitude of novel issues, assuming increasingly complex roles and functions, draws attention to the centrality of continuing education to foster constant update and the acquisition of new knowledge and competences. As a result, the constant learning of teachers allows the renewal of didactic practices as a response to new discoveries, methodologies and tools (Starkey, 2020; Hankey et al., 2017). In particular, the evolving landscape of educational technology, endorsed by the rapid and increasingly diffused spread of Information and Communication Technologies (ICTs), represents one of the primary drivers for the transformation of teaching and learning environments and practices (Bilyalova et al., 2019), raising the need for digital literate teachers (Sánchez-Cruzado et al., 2021). Although educational technologies have become increasingly available and affordable for schools, their mere presence in the classroom does not guarantee instant benefits for students' learning outcomes and experience (Benigno et al., 2023; Bocconi et al.,

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2020). If, on one hand, scientific literature underlines the need to investigate accessibility and usability requirements to promote technology as an inclusive didactic mediator (Di Paolo et al., 2023; Cadet et al., 2022; Kye et al., 2021; Reeves et al., 2021; Morganti & Riva, 2006), teachers' knowledge, competences and perceptions is still the main factor that drives (or obstacles) their use (Giaconi et al., 2024; Caldarelli et al., 2023; Giaconi et al., 2023). Consequently, continuing education should address teachers' perceptions and skills in order to effectively train them in responding to contemporary challenges in education. When looking at the contemporary scenario, educational systems are immersed in a Digital Transformation Era (Braga, 2017) that raises the need to acknowledge and understand the advantages and disadvantages of technologies to foster inclusive learning environments as facilitators (Pinnelli & Fiorucci, 2020; WHO, 2001). As ICTs have been spreading across Italian schools due to investments promoting their use (e.g., National Recovery and Resilience Plan, 2022), their meaningful application and integration still poses critical issues from a pedagogical perspective. If the efficacy of ICTs in didactics is primarily connected to teachers' competences and awareness on the use of such tools (Masenya, 2021; Limone et al., 2016; Muscarà & Messina, 2014; Ertmer, 2005; Rogers, 2000), their implementation raises several challenges with reference to concrete and human resources (Haleem et al., 2022). Specifically, scientific literature underlines how teachers' sense of self-efficacy, perception of benefits and the interest related to ICTs might facilitate or obstacle the adoption of innovative approaches and technological tools (Joo et al., 2018; Kent & Giles, 2017; Lemon & Garvis, 2016; Muscarà & Messina, 2014; Ismail et al., 2010, Sugar et al., 2004). In this direction, the influence of factors such as gender and disciplinary background is still to be fully investigated. Such dimensions would then appear to be intrinsically relevant to digital transformation and inclusion. In this sense, fostering digital competences acquires paramount importance for the renewal of educational processes and methodologies, reshaping the frames of reference that orient teacher agency and welcoming ICTs in ordinary didactics. As highlighted by Alférez-Pastor et al. (2023), a fruitful implementation of educational technologies requires not only technical knowledge and competences, but also a renewed sensitivity on teaching methods. Indeed, as teachers are asked to manage hardware and software tools successfully, they should also be able to choose, integrate and adapt the most suitable supports in light of the pedagogical and didactic needs they wish to respond to. Such an approach is often reversed, as the use of mediators for their own sake might prevail on pedagogical perspectives and educational goals (Pinnelli & Fiorucci, 2015). The promotion of such a shift of paradigm in education

inevitably calls into question teachers' knowledge, opinions and beliefs on the use of ICTs for education (Eickelmann & Vennemann, 2017), which are directly connected to their willingness and concrete possibilities of integrating technology in didactics (Ismail et al., 2010). For these reasons, understanding the opportunities and obstacles that teachers perceive becomes a primary step to identify how teacher continuous training could be enriched and renewed. In line with previous studies on the topic (Caldarelli et al., 2023; Starkey, 2020; Iommi et al., 2021; Moursund & Bielefeldt, 1999), this paper aims at collecting and analysing the perceptions of teachers in training with reference to the implementation of ICTs for inclusive didactic practices, focusing on the Italian national context. In harmony with the topics of interest of Special Pedagogy and Didactics (Pinnelli & Fiorucci, 2020; Hamburg & Bucksch, 2015; Calvani & Vivinet, 2014), this paper aims at investigating Italian teachers' practices, attitudes and perceptions regarding the use of ICTs within inclusive education processes. Specifically, the research questions (RQs) are the following:

- RQ1: How often do teachers use ICTs in everyday practices?
- RQ2: How do teachers perceive their use of ICTs in relation to self-efficacy, outcome expectation and interest?
- RQ3: Do the factors of gender, school level, disciplinary background, and seniority influence teachers' use of ICTs and perceptions? If so, how?

To answer the RQs, 830 Italian teachers in training were interrogated through the Italian adaptation of the Intrapersonal Technology Integration Scale (ITIS Scale) (Niederhauser & Perkmen, 2008), unveiling the factors that impact the frequency, the skills and the perceived self-efficacy with which teachers implement ICTs in their everyday practices. In this sense, this study can provide original insights on the factors that facilitate or obstacle the use of ICTs in education, unfolding the multidimensional nature of such a topic and contributing to existing literature. Accordingly, the results could offer relevant guidance for the implementation of teacher training paths.

2. Materials and Methods

In line with existing literature on the topic (Benigno et al., 2013; Muscarà & Messina, 2014; Perkmen & Pamuk, 2011; Niederhauser & Perkmen, 2008), the Italian adaptation of the Intrapersonal Technology Integration Scale was used as primary assessment tool (Benigno et al., 2013). The choice of the tool is connected to the topics of interest that it allows to investigate: the concepts of Self-efficacy, Outcome expectation, Interest and Behavioural Intentions on the

didactic use of technologies in learning environments (Sugar et al., 2004).

3.1 Measuring Tool

The Intrapersonal Technology Integration Scale was used as an assessment tool to investigate beliefs and perceptions of teachers on the use of ICTs for inclusive education. The Italian version of the questionnaire, adapted by Benigno et al. (2013), was administered through the Google Form software. The adopted tool is composed of four main sections, with the ITIS scale placed as fourth and last section, as implemented in Muscarà & Messina (2014). The three previous sections allow for the collection of additional data relevant to the analysis. The first section collects anagraphic information on the interviewee (i.e., age, sex, education level, school level they teach in, disciplinary area they teach in, and total years of service). The second section investigates the Frequency of use of didactic technologies made by interviewees in their everyday teaching. Participants are asked to choose between the following answers: Never; A few times a year; A few times a month; A few times a week; Everyday. This section allows the identification of the participants who choose the answer “Never”: in this case the questionnaire ends. The third section consists in a series of questions aimed at investigating teachers’ proficiency with reference to four items: Tech Tools (e.g., computer, DVD player, Interactive Whiteboard); PC Apps (eg., Microsoft Word, Microsoft Excel, Microsoft PowerPoint); Internet Apps (e.g., e-mails, websites); Collaborative Writing Softwares (CollSW) (e.g., Google Docs). For each item, participants can indicate their level of proficiency through a 5 point Likert scale (where 1 corresponds to “No competences” and 5 corresponds to “Excellent level”). The fourth and last section consists in the Italian version of the ITIS Scale, composed of 21 items to be assessed through a 5 point Likert scale (1 = “Strongly disagree”, 5 = “Strongly agree”). The Scale investigates the following factors:

- *Self-Efficacy* (SE): the level of self-efficacy and confidence that teachers perceive when using ICTs in the classroom (6 items);
- *Outcome Expectation* (OE): the perception of potential benefits related to ICTs implementation, divided in *Social Outcome Expectations* (SOE), *Self Evaluation Outcome Expectations* (SEOE) and *Performance Outcome Expectations* (POE) (9 items);
- *Interest* (INT): teachers’ willingness to integrate ICTs in didactic activities (6 items).

3.2 Participants

Participants sample is composed of 830 Italian teachers working at any school level, attending the 30

credits Training (Decree Law n.59/2017; Prime Ministerial Decree of 4 August 2023). Participants were recruited on a voluntary basis through an online form. Participants’ age ranges between 24 and 61 years (M = 45.24; SD = 7.804), with a service age between 0 and 38 years (M = 11.63; SD = 6.998). The sample consists of 610 (73.5%) females and 220 (26.5%) males. Among these, 524 (63.1%) declare to possess a postgraduate qualification (e.g., specialisation or PhD). Figure 1 shows the distribution of teachers with reference to their disciplinary area, while Figure 2 shows the school level they work at. As we can see, the majority of teachers work in scientific disciplines (38.9%). With reference to school level, the vast majority of teachers work in secondary schools (87.7%).

Figure 3 shows the relationship between usage of ICTs and disciplinary area, while Figure 4 shows the relationship between usage of ICTs and school level. Only 5 participants out of the total sample declared to have never used ICTs in teaching. Additionally, 17 participants did not complete the ITIS Questionnaire. These participants were excluded from the analysis.

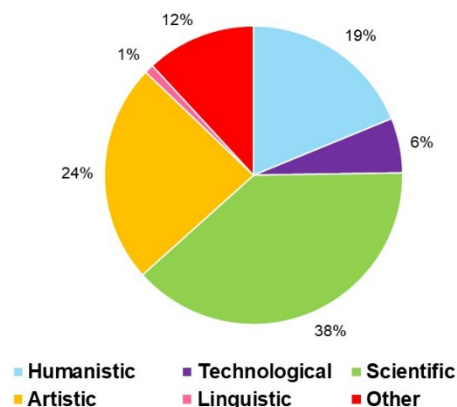
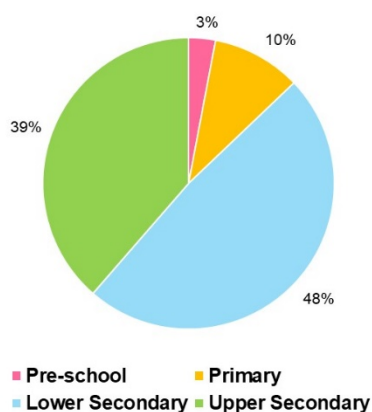


Figure 1 - Distribution of disciplinary areas.



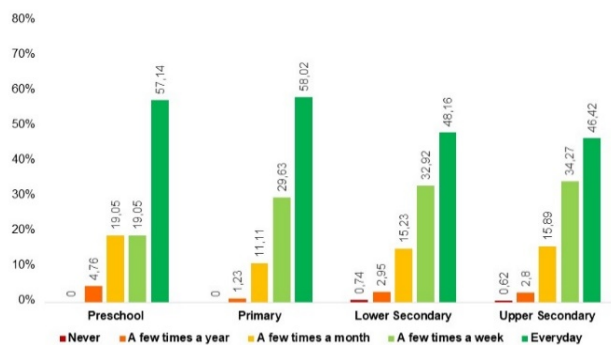


Figure 3 - Relationship between usage of ICTs and disciplinary area.

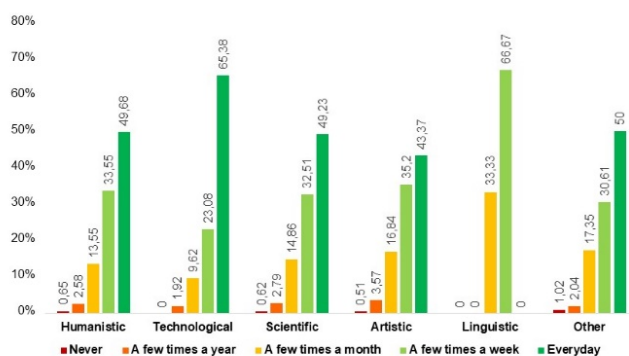


Figure 4 - Relationship between ICTs usage and school level of teaching.

3.3 Data Analysis

Data analysis focused on the answers provided by the 808 participants who completed the questionnaire. Data analysis was carried out through the software SPSS v20. Alpha Cronbach Index was extracted to assess the reliability of each factor, with successful results (Alpha Chronbach: SE = 0.909; INT = 0.893; OE = 0.838; POE = 0.829; SOE = 0.907; SEOE = 0.881). For each participant, SE, INT and OE results (as well as POE, SOE and SEOE) were calculated through the mean of the expressed evaluation for every item.

Based on the results of the Shapiro-Wilk tests that were conducted, none of the distributions of the collected data with respect to the metric variables considered (SE, OE, POE, SOE and SEOE, levels of proficiency with the various technologies) were normal ($p < 0.001$). Accordingly, nonparametric tests were used to test the effect of the various factors of interest on the variables considered. In particular, the Mann-Whitney U-test was used to investigate the effect of the factor “gender” on the variables of interest (teachers’ perceptions of their own technological competence, SOE, OE, POE, SEOE, and INT). To explore the differences in the other considered factors (disciplinary area, school level, frequency of use of educational technologies) regarding the variables of interest, the Kruskal-Wallis

H-test was used. Finally, Kendall’s Tau correlation coefficient was used to explore the relationships between the factors of age, seniority and the variables of interest.

3. Results

For the sake of brevity, this section illustrates the most relevant results emerging from the collected data in light of the study focus defined through the RQs.

In the first place, Mann-Whitney U-tests show a statistically significant difference between males and females on TechTools proficiency ($U = 55884.500$, $p = .004$) and CollSW ($U = 56523.500$, $p = 0.012$). Additionally, they show statistically significant differences between males and females on SE factors ($U = 55386.500$, $p = 0.005$) and SOE factors ($U = 55418.000$, $p = 0.005$). As Table 1 shows, proficiency levels indicated by male participants with TechTools and CollSW proficiency, as well as the perceived levels of Self-Efficacy (SE) and Social Outcomes Expectations (SOE). No significant differences were found between male and female participants with references to other items. Kruskal-Wallis H-tests show statistically significant differences between groups of participants teaching at different school levels on the perceived proficiency level with PCApp ($\chi^2(df=3) =$

25.532, $p < 0.001$), InternetApp ($\chi^2(df=3)= 10.774$, $p = .013$) and CollSW ($\chi^2(df=3)= 21.894$, $p < .001$). Dunn's test for pairwise multiple comparisons highlights statistically significant differences between primary school teachers and lower secondary school ones, as well as between primary school teachers and upper secondary school ones. In all cases, perceived proficiency on PCApp, InternetApp and CollSW use are higher in secondary school teachers compared with primary school ones. Table 2 illustrates such results.

Kruskal-Wallis H-tests show how the factor "disciplinary area of teaching" has a statistically significant effect on SE ($\chi^2(df=5)=22.507$, $p < .001$), TechTools ($\chi^2(df=5)=35.055$, $p < .001$), PCApp ($\chi^2(df=5)= 41.494$, $p < .001$), InteretApp ($\chi^2(df=5)= 20.640$, $p = .001$) and CollSW ($\chi^2(df=5)=22.991$, $p < .001$).

Figure 5 illustrates the results of each disciplinary area with reference to the mentioned items. Results show how teachers of Humanistic disciplines attest to lower levels of proficiency in the use of TechTools compared to those belonging to the Technological, Scientific or Artistic fields. On the other hand, teachers of Technological disciplines claim the highest levels of proficiency in this field. Similarly, with reference to PCApp proficiency,

Humanistic disciplines teachers attest the lowest levels of proficiency, while Scientific and Technological disciplines teachers claim the highest ones. Considering InternetApp, humanistic disciplines teachers still present the lowest levels of perceived proficiency. In CollSW proficiency, teachers of humanistic disciplines attest the lowest levels, while those of technological disciplines claim the highest ones. Lastly, teachers of technological disciplines showed the highest levels of SE compared to teachers of the other areas. No statistical differences were found in the assessment of OE, POE, SEOE, SOE and INT levels.

Lastly, correlations between age and seniority with reference to the analysed factors shows that there is no statistically significant correlation +between the Frequency of use of didactic technologies and age or seniority of participants. However, it appears that the perceived proficiency levels on the use of TechTools, PCApp, InternetApp and CollSW are negatively correlated with age and seniority (although mildly, since all correlation coefficients are below 0.3) with statistical significance. Similarly, a mild but statistically significant negative correlation between participants' age and SE and INT factors was assessed ($r < 0.3$).

Table 1 - Results of statistically significant indicators between sex-differentiated groups.

	Sex	Numerosity	Mean	SD	Average rank
TechTools	F	594	4,07	0.753	391.58
	M	214	4,24	0.695	440.36
CollSW	F	594	3,51	0.994	392.66
	M	214	3,73	0.889	437.37
SE	F	594	3,55	0.750	390.743
	M	214	3,71	0.728	442.685
SOE	F	594	2,61	1.072	390.796
	M	214	2,85	1.135	442.537

Table 2 - Results of school level comparisons.

	Sample1-Sample 2	Test statistics	Std error	SD test	p
PCApp	Primary-Lower secondary	-123.141	26.204	-4.699	.000
	Primary-Upper secondary	-120.680	26.843	-4.496	.000
InternetApp	Primary-Lower secondary	-77.932	25.858	-3.014	.015
	Primary-Upper secondary	-78.156	26.489	-2.951	.019
CollSW	Primary-Lower secondary	-126.403	27.124	-4.660	.000
	Primary-Upper secondary	-103.801	27.786	-3.736	.001

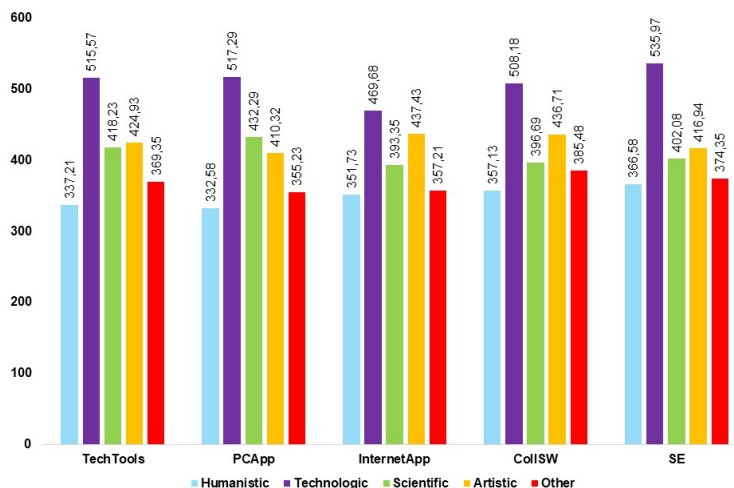


Figure 5 - Average rank across disciplines.

4. Discussion and Conclusions

When looking at the main results collected from this analysis, the first aspect that emerges is related to differences in perceived proficiency and self-efficacy on the use of ICTs based on participants' gender. As male participants claim higher levels of perceived proficiency and self-efficacy, female participants show lower levels in these areas, also with reference to the SOE factor. As such results confirm existing literature on the topic (Mariscal et al., 2019; Gudmundsdottir & Hatlevik, 2017; Muscarà & Messina, 2014; Jimoyiannis & Komis, 2007), it appears relevant to reflect upon the factors which this gap could stem from. EU's 2022 Women in Digital Scoreboard underlines how educational backgrounds influence the acquisition of specialist digital skills among people. Indeed, ICT specialists and graduates in STEM are almost entirely male. Additionally, the gender gap in digital skills grows with the increase of complexity of such digital skills according to the Report, meaning that the gap is smaller when considering internet user skills or basic digital skills. EU data could provide an explanation to our results, considering how the application of ICTs in teaching practices would reasonably require a higher level of proficiency than basic digital skills. With reference to the Italian context, national data confirm the European tendencies, proving how academic careers in STEM areas are less pursued by female students, evidencing a consistent gender gap (ISTAT, 2021). Kuroda et al. (2019) recognise how the gender gap in digital skills includes a relationship between the access to digital technologies and the development of the skills that allow to design, develop and make use of them. In this sense, the mere access to ICTs does not guarantee women the agency and competences to successfully leverage such access, as they miss the opportunity to successfully implement them in their everyday lives

(Mariscal et al., 2019). However, it is still important to acknowledge that the results obtained for self-efficacy levels do not necessarily imply that males are effectively more capable of using ICTs, as they could be over-reporting their skills (Gudmundsdottir & Hatlevik, 2017).

The school level within which teachers work appears to constitute another relevant factor influencing the use of ICTs. Specifically, secondary school teachers tend to perceive a higher level of proficiency compared to primary school or preschool teachers. Such results, which are consistent with existing literature (Tzafilkou et al., 2023), could suggest how the different paths of teacher training, specialisation and continuing education for each school level might impact teachers' familiarity and perceived proficiency with ICTs application in didactics (Benigno et al., 2023; Hennessy et al., 2005). The need to foster primary school teachers' digital skills appears relevant when considering how young learners have the opportunity to develop digital skills in informal scenarios (Pérez-Escoda et al., 2016). As highlighted by Alférez-Pastor et al.'s review (2023), training programs should consider the pedagogical aspects of implementing ICTs in the classroom, and not only technical issues. In fact, research highlights how primary school teachers risk lacking the skills to implement such technologies in everyday teaching (Stringer et al., 2022; Perifanou et al., 2021). These considerations align with the strategic trajectories identified by the Italian Ministry of Education (Ministerial Decree of 14 June 2022).

Disciplinary fields appear to represent a significant factor in determining the relationship between teachers and ICTs use in the classroom. Confirming the results of previous research on the topic (Muscarà & Messina, 2014), teachers belonging to STEM disciplines claim to possess the highest levels of proficiency in use and self-efficacy perceptions. Conversely, teachers that

work within humanistic disciplines show lower levels of competences and self-efficacy. It appears reasonable to partially explain this difference by acknowledging how teachers in the STEM area might have been trained on ICTs more thoroughly, having more opportunities to familiarise with their use (Muscarà & Messina, 2014; Hennessy et al., 2005). Although ICTs proficiency varies across STEM subjects and contexts (Vieira et al., 2023), literature confirms how STEM teachers tend to perceive themselves as more competent in ICTs use compared to other domains, claiming to use them often and seeing more potential benefits in their application (Zubkovic et al., 2022). Although ICTs can enhance students' learning in humanities disciplines as well (Scolaro, 2020; Ni, 2012), existing research confirms how non-STEM teachers lack confidence and skills in implementing them (Adu & Zondo, 2023; Ray et al., 2020), highlighting the need to foster support and digital training.

Lastly, the correlations between age, seniority and ITIS factors should be considered. The analysis' findings illustrate how the perception of self-efficacy and the interest towards technologies seems to decrease with the increase of participants' age. Similarly, a negative trend can be found in the correlation between seniority and self-efficacy, interest and outcome expectations. Such findings reflect existing literature, illustrating how younger teachers show higher levels of proficiency with digital tools (Mortis et al., 2013; Suárez-Rodríguez et al., 2012). Such a result underlines the centrality of teacher training in technology-supported teaching to allow continuous education, as older adults might have had less opportunities to experience new technologies compared to digital natives, consequently facing barriers of various kinds (Bhattacharjee et al., 2021; Hargittai et al., 2019). In this context, teacher training is the only vehicle through which they can approach the latest advances of ICTs, learning how to make use of them in their teaching practices.

In conclusion, the results obtained by the present work, in light of the research questions, draw attention to the needs that should be addressed by initial and continuing education programs in order to strengthen teachers' knowledge and skills on the didactic use of ICTs. Specifically, with reference to RQ1, the study highlights how disciplinary fields play a central role in the frequency of use of ICTs in education. With reference to RQ2 and RQ3, perceptions regarding self-efficacy, outcome expectations and interest appeared to be considerably impacted by factors such as gender, school level, disciplinary fields and seniority. Further into detail, the results evidenced a significant gender gap in the perceived self-efficacy of ICTs favouring male teachers in comparison with female teachers. With regards to school levels, secondary school teachers showed higher levels of proficiency and confidence in the use of ICTs compared to primary

and preschool teachers. Disciplinary fields appeared as another relevant factor in the perception and use of ICTs, proving how teachers belonging to the STEM area are more likely to feel confident in their application. Lastly, the level of seniority and teacher's age appeared to negatively impact self-efficacy, outcome expectations and interest in the use of ICTs. In this sense, disparities across teachers of different gender, age, school level or disciplinary field influence the perceptions on ICTs use in education. As ICTs become increasingly embedded within daily activities, theoretical and practical knowledge on education should embrace their integration, providing pre-service and in-service teachers with the opportunity to understand their practical use and pedagogical implications. International research confirms how teacher training is central for the acquisition of such didactic and methodological competences, underlining the role of policies in giving value to such a topic (Gil-Flores et al., 2017). Accordingly, educational institutions should encourage the acquisition of digital teaching competences, addressing the need to continuously update teachers' practices. If teachers lack sufficient digital skills (Chandrasena, 2019; Nowak, 2019), the didactic use of ICTs in everyday teaching practices risks being limited, and its potential mostly unexploited (Escudero et al., 2019). In this context, initial and continuing education programs for specialised teachers provided by Italian universities provide a viable opportunity to renew teacher training programs and promote an informed use of technologies in education, benefitting from their potential to support personalization of didactic, inclusive processes and learners' active participation, discovering innovative learning resources that could increase the quality of education (UN, 2015). As the use of ICTs directly reflects teachers' beliefs and pedagogical attitudes (Loveless & Ellis, 2001), teacher training should focus not only on the acquisition of practical skills for the integration of ICTs, but also on motivation and perceived value of such tools (Giaconi et al., 2019; Muscarà & Messina, 2014). Accordingly, it should encourage teachers to perceive their agency and protagonism in the technological landscape, creating innovative content and sharing best practices. This study highlights how existing teaching training should be improved to foster digital competences across teachers and fill gaps related to gender, disciplinary field of teaching or age. Future lines of research should dive deeper into the understanding of internal and external motivations linked to the choice of implementing ICTs in didactic practices with reference to different contexts and educational stages. As a result, meaningful trajectories for the design of effective teacher training paths could be identified, reshaping the educational system's methods and tools starting from the needs of learners in these times of constant change and rapid evolution of technologies

(Giaconi et al., 2023). If teachers have the responsibility and mandate to inhabit the forefront of educational processes as main drivers to promote inclusion, innovation and students' wellbeing in the classroom (Larsen, 2010), fostering their professional growth represents a key trajectory to support the renovation of educational systems in the Digital Transformation Era.

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Automating the analysis of social interactions in educational settings: a scoping review

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Abstract

Social interactions are crucial for children’s development, attracting significant interest from educators and researchers. Traditional methods of data collection in educational settings have limitations, prompting the exploration of ICT devices for more accurate and efficient quantitative data collection. This systematic review, following the PRISMA framework, analysed 21 studies that used sensor devices to collect data on social interactions among children aged 0-12 in educational environments. The studies investigated various aspects such as interaction mapping, disease transmission, homophily, and play types, predominantly using observational or descriptive approaches. They were categorized into three levels of ecological complexity: (1) validation of sensor devices, (2) interaction analysis as a predictor of disease spread and vocabulary growth, and (3) examination of children’s social dynamics. Findings indicate that sensor devices are particularly effective when combined with Social Network Analysis (SNA), which facilitates comprehensive analysis and graphical representation of social networks. Quantitative data on social interactions could help identify and support children facing exclusion or marginalization, allowing for targeted educational interventions. However, there is a notable gap in the literature regarding the use of sensor devices in educational interventions, underscoring the need for further research to evaluate their effectiveness and facilitate their application in education.

KEYWORDS: Sensor Devices, Assessment Technologies, Children Interaction, Educational Context, Social Network Analysis.

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1. Introduction

Social interaction is crucial for children’s social, emotional and cognitive development (Casotti, 2022). Understanding the dynamics of social interactions within educational settings is essential for fostering children’s overall growth. Research consistently

demonstrates that the quality of the context profoundly impacts learning outcomes (Zöggeler-Burkhardt et al., 2023). Esteemed educational practices (e.g., Montessori and Reggio Emilia) underscore the importance of observation as a tool for professionals (Becker et al., 2023) to evaluate group dynamics and adjust educational strategies to foster the inclusion of all children. Despite their validity, traditional observation techniques face significant challenges. Observers cannot capture all the information in noisy settings like classrooms (Chun et al., 2011), and, as human beings, can be subject to personal and cultural biases (Pronin et al., 2023; Stubbersfield, 2022). Moreover, observation in educational settings require substantial resources in terms of training and time. Modern sensors technologies can overcome some of these limitations (Altman et al., 2020). Proximity tags,

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audio recorders, and cameras can capture vast amounts of accountable data from social interactions (Atzmueller et al., 2018) and, when combined with advanced data analysis methods like Social Network Analysis (SNA), can reveal unnoticed patterns. SNA is a well-established analytic approach for studying social relationships that has been implemented in various settings. Foundational to the development of SNA were the contributions of Jacob Moreno, who introduced the term “sociometry” to describe the measurement of social relationships. Moreno also developed the sociogram, a graphical tool representing the structural characteristics of a group (Felaco, 2019), that has been extensively utilised in educational settings to explore and visualise social dynamics among children via peer nomination (Jackson et al., 2022). However, the sociogram is subject to assessment-related limitations (Avramidis et al., 2017), which might be resolved using the aforementioned digital tools. This review aims to examine the extent to which the academic literature has addressed automated methods for observing and analysing social interactions in educational contexts.

2. Materials and Methods

The PRISMA framework was used for this literature review (Moher et al., 2009). An inquiry was launched on January 17, 2024. The search was conducted across four databases: PsycInfo, PubMed, Scopus and Web of Science. The following keywords string were used: AB (“social network” or “social interaction*” or child

interaction or sociometry or “social status” or “social dynamics” or centrality or “core-periphery” or homophily or “social density” or “network analysis” or “organizational network”) AND AB (kindergarten or “primary education” or “primary school” or elementary or child*) AND AB (“sensor network” or “interaction tracking” or “wearable sensors” or “sensing technologies” or proximity or “physical distance”). The inclusion criteria were: (1) automatic tool for data collection of social interaction; (2) simultaneous involvement of at least two children; (3) educational setting; (4) age range 0-12 years; (5) type of publication: peer-reviewed journal; (6) language: English; (7) research studies. Initially, 422 studies were identified; however, after the screening process, 409 were excluded for failing to meet the criteria. Additionally, 8 studies were identified through other systematic reviews (Elbaum et al., 2024; Horn et al., 2024), resulting in 21 relevant studies.

The full process is represented in Figure 1.

Based on their commonalities, we grouped the selected studies into three categories corresponding to increasing levels of ecological complexity. First, we present the studies that aimed at validating sensor devices compared to traditional techniques (Table 1). Second, we scrutinise studies analysing interaction as a predictor of diseases’ spread and vocabulary expansion (Table 2). Lastly, we move to studies that employed those devices to analyse social dynamics and interactions among children within naturalistic educational environments (Table 3).

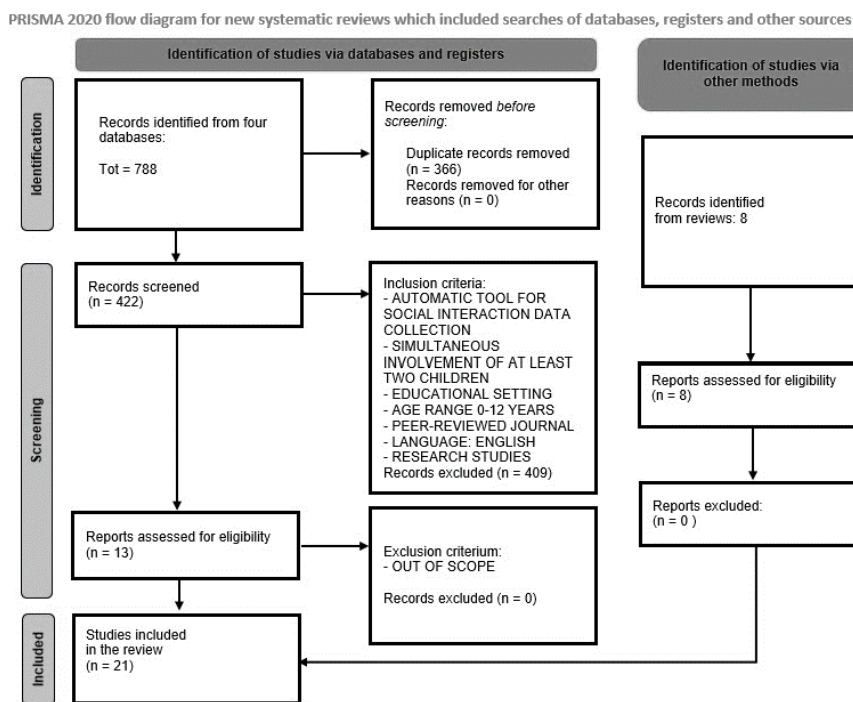


Figure 1 - PRISMA 2020 flow diagram.

3. Results

Although digital tools, such as cameras and audio recorders, have been widely used to support observational practices (Marsh & Mitchell, 2014), more sophisticated methods that integrate sensor devices with data analysis techniques and software have yet to be considered within educational settings. Among the scrutinised studies, some use cameras and audio recorders alongside analytical software to analyse video and audio data (Duan et al., 2017; Hansen et al., 2019; Irvin et al., 2021). Other studies propose using wearable devices (mainly radio wave technologies) to measure distances between people or between a person and a specific element of the environment. According to our knowledge, this type of device was first used in a higher education setting in 2003 and was introduced in the educational context 0-12 around 2011 (Choudhury & Pentland, 2003; Stehlé et al., 2011). Notably, 17 of 21 studies included in this review utilised this type of device. Depth-sensing cameras, such as the Microsoft Kinect, bridge these two typologies of technology by detecting spatial distances with greater accuracy than radio waves but with a more limited spatial range of detection (Komatsubara et al., 2018; Cocco et al., 2022).

3.1 Studies aimed at validating sensor devices

Compared to traditional techniques, data from the sensor devices provide a deeper understanding of children's social interactions, thus aiding in error identification and ultimately enhancing the validity of the research. Altman et al. (2020) compared the data of continuous social interaction with indicators of peer affiliation. Despite a limited sample size (9 children), the results show positive correlations between continuous measures of dyadic social interaction and teacher reports of friendship and sociability. Dai et al. (2020) analysed proximity data from wireless devices and validated them with ground truth data obtained with different methods, such as researcher observation of relative distances between children and teachers, achieving up to 90.03% accuracy. Duan et al. (2017) categorised children's social play using visual attention and proxemic cues based on head and hand detection. The system classified behaviours into solitary, parallel, and group play with an average head tracking accuracy of 95.73% and play-type classification accuracy of about 75%. Eichengreen et al. (2023) examined the changes in children's peer connections before and after the COVID-19 lockdowns, finding an increase in social interactions and diversity of play partners post-lockdown. The authors cross-referenced data obtained from wireless devices with data collected through peer nominations, observations, and self-reports to ensure accuracy and consistency in measuring changes in peer connectedness. Komatsubara et al. (2018) used face recognition and depth-sensing cameras with a social

robot to estimate social status. The data gathered via devices were compared to an index of the sociometric status score derived from questionnaires, thus achieving an accuracy of 71.4%. Validation in the study by Grantz et al. (2021) involved comparing the data gathered by wearable proximity sensors with data collected from self-reported contact surveys. The study found good correspondence in aggregate measures of age-specific interactions; however, proximity sensors captured contacts more precisely. Nasri et al. (2022) employed wearable sensors to deduce social networks from individual behaviours during recess in two Dutch schoolyards. To confirm the precision and reliability of the sensor data, the researchers corroborated it with video recordings. The video data primarily corroborated the accuracy of recorded events and was reported as successful in confirming the presence of children in specific areas during recess.

3.2 Studies analysing interaction as a predictor of diseases' spread and vocabulary expansion

Some studies have examined the potential spread of infectious diseases or measured the evolution of language use and skills through interaction with other individuals. Although different, these two themes are united by their dependence on face-to-face interaction (physical or verbal). Authors are not concerned with particular social relations and dynamics; instead, they employ data from sensor devices to predict the likelihood of infection or the frequency of verbal communication. Leoni et al. (2022) used the Janus system (a wireless wearable device that combines UWB and Bluetooth) to collect high-resolution spatio-temporal data and monitor the interaction among small groups of children in Italian summer camps during the COVID-19 pandemic. They showed that proximity and duration of contacts can be used to analyse contagion risk effectively. In an earlier study, Stehlé et al. (2011) analysed the contact patterns between classrooms of a French primary school. Their findings showed that each child had, on average, three times fewer contacts with children from other classes. Turning to studies on vocabulary expansion, Perry et al. (2018) examined how verbal interaction among peers or teachers affected language use and development. Data was collected through a wearable device (LENA) capable of picking up vocalisations. The results show that verbal interactions between peers and teacher turn-taking were associated with increased vocabulary over a school year. Similarly, a study by Hansen et al. (2019) aimed to improve children's language development by analysing their verbal communication patterns. They combined a tracking device (Ubisense) with a vocalisation analysis tool (LENA) to track verbal production in different spaces of the classroom. They also used an optimised voice activity detection algorithm to reduce classification errors by 21.34% compared to conventional voice detection systems.

Their findings showed where and how children interacted verbally, revealing different levels of engagement with adults and peers, depending on the classroom's area and the times of the day. Perry et al. (2022) investigated the influence of peer vocalisations on language development in inclusive classrooms for children with and without hearing loss. The findings indicated that the frequency and intensity of vocal interactions among peers were predictors of improved language skills across all children at the end of the year.

3.3 Studies scrutinising children's social dynamics

To enhance the interpretation of children's social interactions, researchers often supplement sensor-collected data with information related to the specific time and location or about the children (e.g., sex or type of development). Veiga et al. (2017) examined the impact of different forms of social play, focusing on children's social competence between boys and girls. The authors combined wireless devices with observational assessments to analyse children's play behaviours during recess. Boys and girls participated equally in social play and no significant differences in social competence between boys and girls. Stehlé et al. (2013) explored similar dynamics with 232 French schoolchildren by examining gender homophily (i.e., the tendency to associate with peers of the same gender). They used wearable sensors to monitor face-to-face interactions and found that this tendency was more pronounced among boys, particularly in the 4th and 5th grades, and increased with age. Messinger et al. (2019) used wireless technology to monitor and analyse children's spatial and social dynamics in kindergarten, finding that students of different genders gathered in separate areas of the class and formed groups with little gender mixing. Nasri et al. (2023) tracked the spatio-temporal proximity between children in a schoolyard to study their social behaviours with a new metric, the "average spatio-temporal proximity". The findings indicated that children tended to interact with peers from the same groups and that the clusters of most open children used the common playground areas. Another focus in observing educational settings was the interaction between typically and atypically developing children. According to Banarjee et al. (2023), children in similar developmental condition dyads (typical development, TD and developmental disabilities, DD) approached each other faster and spent more time in social contact than those in mixed dyads (TD-DD). DD children were approached at lower velocities compared to TD children. Analyses also showed that social approach velocities correlated positively with the amount of time spent in social contact. Similarly, in the study by Fasano et al. (2021), children with autism spectrum disorder, ASD, engaged in fewer vocal interactions and occupied less central positions in classroom networks compared to TD peers. Studying

friendship dynamics in young children, Irvin et al. (2021) found that children spent the most time and exhibited the highest vocalisation rates in a specific classroom area, suggesting that activity areas significantly influence spatial proximity and interactive behaviours. Cocco et al. (2022) conducted an imagined contact intervention to foster inclusion between typically and atypically developing children. Typically developing participants trained via imagined contact condition showed improved attitudes and increased helping intentions towards the outgroup compared to those in the control group. Iacopini et al. (2023) examined the socio-temporal patterns of group interactions in various educational settings, comparing interactions in preschool and university. The authors used an available dataset generated from wearables proximity devices and found that the chance of group changing is similar across the two different educational contexts; specifically, the older a group gets, the stronger it becomes, and the chance for an individual to change/exit it decreases.

4. Discussion and Conclusions

This systematic review aimed to locate examples of partial or complete automation of social and relational data gathering in educational settings. The reviewed research is recent (with the oldest studies dating back to 2011) but relatively scarce (only 21 studies met the inclusion criteria), indicating potential for further investigation. Sensor technologies are increasingly integrated into schools and classrooms; nevertheless, they are hardly used by/for professionals (e.g., educators and teachers) to support specific educational actions. The collected research suggests that sensors could provide more precise and objective data than conventional methods (e.g., Grantz et al., 2021). However, research does not assume an intrinsic validity of the data gathered by sensors. There is an understanding that a rigorous validation process is required (Dai et al., 2020). Several studies are dedicated to this endeavour, employing methodologies that juxtapose data collected via automated devices against "traditional" techniques. Data gathered from sensors have often shown good correspondence with other sources. This convergence enhances the validity of the findings obtained from these technologies and highlights their importance in inferring social networks from individual behaviours. Nevertheless, it remains to be seen if the existing research adequately supports the use of comparable sensor devices or whether new technologies should be subject to an analogous verification process.

Several studies employed SNA (Fasano et al., 2021; Grantz et al., 2021; Nasri et al., 2023).

Table 1 - Studies aimed at validating sensor devices.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Altman et al., 2020	USA	Observational-Descriptive	<ul style="list-style-type: none"> - Teacher social engagement reports - Teacher friendship reports - Peer likeability reports - Children friendship reports - Proximity interactions, orientation and vocalization 	2 - 3	9	<ul style="list-style-type: none"> - LENA, wearables audio recorders - Ubisense, wearables and static sensors, UWB 	Validating a method that combines proximity and vocal data into social interaction metrics.	The dyadic social interaction was positively associated with teacher friendship reports. The individual measure of social interaction correlated with children's likeability reports and teacher sociability reports.
Dai et al., 2020	France	Observational	<ul style="list-style-type: none"> - Physical proximity between children - Direct visual observation 	2.5 - 6.5	170	<ul style="list-style-type: none"> - Sequanta, wearables and a central device, IoT-LPWD 	Studying the co-evolution of children's language and social networks. Developing a method to model social interactions through data from wearable devices.	Temporal network reconstruction via LSTM models achieved up to 90% accuracy in reconstructing real interactions; naïve methods show the worst performance.
Duan et al., 2017	Cina	Observational-Descriptive	<ul style="list-style-type: none"> - Visual attention and proxemics of children calculated on head or hands without toys 	Not specified	Not specified	<ul style="list-style-type: none"> - Static cameras - Hidden conditional random field - Support vector machine 	Developing a method to categorise children's social play based on visual attention and proxemics cues.	Computation of proxemics and attention of children based on head detection and pose data showcased effective results in categorising children's play.
Eichengreen et al., 2023	Netherlands	Observational	<ul style="list-style-type: none"> - Proximity interaction and orientation - Duration and numbers of interactions - Direct observation - Peer nomination - Self-reports of loneliness - Self-reports of social contact in lockdown 	8 - 12	43	<ul style="list-style-type: none"> - OpenBeacon, wearables, RFID and BLE 	Comparing children's peer connections before and after COVID-19 lockdowns via different assessment methods.	Post-lockdown children showed more willingness to interact and play with a broader circle of peers.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Grantz et al., 2021	USA	Observational	<ul style="list-style-type: none"> - Self-reported contact surveys - Proximity interaction - Duration of interaction 	5 - 18	2155 with contact surveys 1834 with sensor devices	- TelosB wireless wearables sensors	Understanding social interaction as indicator of disease transmission.	Proximity sensors recorded more contacts than surveys, but both methods effectively tracked age-related disease transmission trends.
Komatsubara et al., 2018	Japan	Observational	<ul style="list-style-type: none"> - Time spent alone - Distance outside personal area - Time spent around the robot - People around the robot - Face identification - Sociometric questionnaires 	10 -11	70	<ul style="list-style-type: none"> - Static cameras (RGB) and face identification software Omeron, OKAO vision 3 - Microsoft Kinect, depth sensor 	Extracting information from children's classroom behaviour to estimate social status.	Estimated children's social status (71.4% accuracy), position tracking (93.4% accuracy) and identification (65.5% accuracy).
Nasri et al., 2022	Netherlands	Observational	<ul style="list-style-type: none"> - Children location - Face-to-face contact - Spatial activity level - Video observations 	5 -15	150	<ul style="list-style-type: none"> - i-gotU GT-120 USB, wearables, GPS - OpenBeacon, wearables and static sensors, RFID - MMR sensor, wearables 	Examining schoolyards to identify obstacles that can hinder social participation.	Development of a novel sensor data-driven approach that integrates data and differentiate between physical, social, and cultural affordances.

Table 2 - Studies analysing interaction as a predictor of diseases' spread and vocabulary expansion.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Hansen et al., 2019	USA	Observational - Descriptive	<ul style="list-style-type: none"> - Duration and quantity of child-to-adult and child-to-child conversations - Conversational turn-takings - Location tracking 	2.5 - 5	33	<ul style="list-style-type: none"> - LENA, wearables audio recorders - Ubisense, wearables and static sensors UWB - Support vector machine - Threshold-optimized speech activity detector 	Studying children's communication, identifying conversation-promoting activities, and introducing a new method to track children.	Children spent different amounts of time vocalizing in different activity areas.
Leoni et al, 2022	Italy	Observational	<ul style="list-style-type: none"> - Proximity detection - Face to face interactions 	6 - 14	43	<ul style="list-style-type: none"> - Janus system, wearables, BLE and UWB 	Improving the understanding of close proximity interactions between children and educators at summer camps in Italy during the COVID-19 pandemic.	Assessed educator-child and child-child social interactions during the pandemic confirmed the effectiveness of the social bubble strategy in summer camps.
Perry et al., 2018	USA	Observational - Descriptive	<ul style="list-style-type: none"> - Teacher report of vocabulary expressed - Children vocal interaction - Conversational turn-takings 	2 - 3	13	<ul style="list-style-type: none"> - LENA, wearables audio recorders 	Examining the relation between individual language input, children's language use and vocabulary development in a early intervention classroom over a year.	Structured activities were associated with an increase in vocalizations, and children who vocalized more received more input from peers. Children who engaged in more conversational turns showed faster vocabulary growth.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Perry et al., 2022	USA	Observational - Descriptive	<ul style="list-style-type: none"> - Preschool language scales (PLS-5) - Social contact - Rate of children's vocalisation 	2.5 - 3.5	29	<ul style="list-style-type: none"> - Ubisense, wearables and static sensors, RFID - LENA, wearables audio recorders 	Studying the impact of peer vocalisations on language development in inclusive classrooms for children with and without hearing loss.	Social contact and vocalisation rates were different based on hearing status. Children with higher peer vocalisation had better end-of-year language abilities.
Stehlé et al., 2011	France	Observational	<ul style="list-style-type: none"> - Number of recorded contact events - Time spent in contact 	6 - 12	232	<ul style="list-style-type: none"> - OpenBeacon, wearables and static sensors, RFID 	Studying children's interaction patterns in schools to quantify the potential for respiratory infection transmission.	Each child interacted on average with 47 peers through 323 daily contacts. Children spent three times more time with classmates than others. An exposure matrix was determined to inform mathematical modelling.

Table 3 - Studies scrutinizing children's social dynamics.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Banarjee et al., 2023	USA	Observational	<ul style="list-style-type: none"> - Proximity interaction and orientation - Duration and numbers of interactions 	M = 48.26 months, with an SD = 7.47 months	77	- Ubisense, wearables and static sensors, UWB and RFID	Investigating homophily by using social movement and quantifying it in children with developmental disabilities and typical development.	Peers with similar developmental stages had faster approach speeds and longer engagement times. Children with developmental delays were approached with less velocity and had shorter interactions than typically developing peers.
Cocco et al., 2022	Italy	Experimental	- The physical distance between participants and a child with a disability during a five-minute interaction	6 - 9.75	122	- Microsoft Kinect, static camera	Assessing the effectiveness of imagined contact intervention in improving attitudes and behaviour towards disabled children.	Imagined contact improved outgroup attitudes and behaviour among high-status children but not among low-status children.
Fasano et al., 2021	USA	Observational	<ul style="list-style-type: none"> - Children vocal interaction - Proximity interaction and orientation (social contact) 	3 - 6	56	<ul style="list-style-type: none"> - LENA, wearables audio recorders - Ubisense, wearables and static sensors, UWB 	Assessing how children's verbal interactions with peers relate to language skills, focusing on children with autism and their classmates.	Peers' vocalisations influenced vocal responses to peers. Children with autism were more affected by peer input than those with developmental delays.
Iacopini et al., 2023	France	Observational	<ul style="list-style-type: none"> - Proximity interactions - Duration of interactions - Presence of isolated participants 	3 - 6	174	- Wearables wireless proximity sensors RFID	Examining traces of group dynamics derived from proximity data across various social and temporal settings.	Despite differences in age, contexts, and data collection methods, similar group dynamics were observed.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Irvin et al., 2021	USA	Observational – Descriptive	<ul style="list-style-type: none"> - Children location - Children vocalization - Demographic survey - Survey for teachers about friendship and playmates 	3	3	<ul style="list-style-type: none"> - Ubisense, wearables and static sensors, UWB - LENA, wearables audio recorder Combined speech-activity detection algorithm 	Studying friendship dynamics in young children in inclusive classrooms, focusing on proximity and speech interactions of at-risk children.	Children at disability risk and their playmates engaged in vocalisation near each other in different areas.
Messinger et al., 2019	Germany	Observational	<ul style="list-style-type: none"> - Children location - Movement velocity - Location distribution - Social contact radius 	5	16	<ul style="list-style-type: none"> - Ubisense, wearables and static sensors, RFID 	Demonstrating how automated, location-based analysis can effectively offer fresh perspectives on interactions within classrooms.	Confirmed existing research on gender differences in preschool. Provided new insights into how children use space and interact socially with peers.
Nasri et al., 2023	Netherlands	Observational - Descriptive	<ul style="list-style-type: none"> - Proximity of nodes in a graph considering both temporal and spatial characteristics - Proximity data - Location of the interaction 	4 - 12	32	<ul style="list-style-type: none"> - Wearable proximity tags and static sensors, BT - i-gotU GT-120 USB, wearables, GPS 	Using wearable sensors to infer social networks from individual behaviours and introducing a new metric for analysing human behaviour dynamics with time and space.	Children were more accessible to peers within their groups; physical space and play structures influenced interaction patterns and clustering.
Stehlé et al., 2013	France	Observational	<ul style="list-style-type: none"> - Number of recorded contact events - Time spent in contact 	6 - 12	227	<ul style="list-style-type: none"> - OpenBeacon, wearables and static sensors, RFID 	Assessing homophily behaviours related to gender using sensor data on face-to-face interactions.	Gender homophily was prevalent across all primary school grades, more pronounced in boys, especially in 4th and 5th grades, and increased with age.

AUTHORS (YEAR)	COUNTRY	STUDY TYPE	DEPENDENT Or OBSERVED VARIABLES	CHILD AGE	SAMPLE	AUTOMATIC TOOL FOR DATA COLLECTION	AIM	MAIN RESULTS
Veiga et al., 2017	Portugal	Observational	<ul style="list-style-type: none"> - Strengths and difficulties questionnaire - Children's play behaviour - Peer interactions 	4 - 6	73	- OpenBeacon, wearables and central device, RFID	Studying if a specific category of social play holds greater significance in shaping children's social competence compared to other forms of play.	Exercise play was linked to higher social competence, while fantasy play had no association. Smaller peer groups and more extended interactions improved social competence.

The study by Stehlè et al. (2011) recorded data on face-to-face interaction in French primary schools, mapping them into an aggregated network of contacts where nodes represent children and edges represent interaction longer than 2 minutes. Iacopini et al. (2023) analysed group dynamics with new data-driven models, finding similar patterns despite variations in age, context, and data collection methods. Taken together, these studies suggest that employing SNA in education is feasible and potentially beneficial. While the large quantity of data extracted by sensor devices may require complex data analysis, researchers and professionals in education can appreciate the history of interactions recorded by sensors. Indeed, can graphically represent the dynamics between children while preserving informative characteristics such as centrality and density, as it allows to calculate both group indices and individual indices. This relatively innovative approach provides a clearer lens to examine the complexities of child development and socialisation. Moreover, sensor devices can capture the duration of conversations and the approximate distance between individuals to help evaluate the quality of relations in the classroom or the effectiveness of educational interventions. Among those scrutinized in the present review, only one was experimental and implemented an intervention in this direction. In this sense, more research is needed to verify the possibility of using sensor devices to evaluate the effectiveness of educational interventions.

In conclusion, this systematic review reveals that sensor technologies collect data precisely and objectively, but need a strict validation process. SNA can effectively visualise complex social interactions from sensor data, yet its complexity might limit accessibility to non-experts. Lastly, the ecological application of sensor technologies is still scant and highlights the need for accessibility improvements in educational contexts.

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