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THE INSTITUTIONAL GAP IN TEACHER CONTINUING EDUCATION: CROSS-NATIONAL EVIDENCE ON BARRIERS TO TECHNOLOGY INTEGRATION

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Abstract

Continuing professional education (CPE) for teachers faces growing pressure to equip educators with technological competencies that instructional practice now demands – yet the infrastructure through which such competencies are developed remains poorly understood and underexamined. International comparative data indicate that existing CPE systems are failing to meet this demand at both scale and quality. Drawing on data from OECD TALIS 2024, Pearson School Report 2023, Tech4Teachers 2024, and the TCEA/SETDA EdTech Landscape Report (2024), this paper identifies and analyses six systemic barriers constraining technology integration in teacher CPE: coverage deficits, knowledge gaps, low programme effectiveness, superficial adoption patterns, absent mandatory competency standards, and structural time constraints. The analysis demonstrates that these barriers do not operate independently but form a self-reinforcing institutional system – one that resists incremental, single-barrier intervention. The analysis draws on the DigCompEdu and TPACK theoretical frameworks, with UNESCO SDG4 and ISTE Standards as policy reference points. The paper argues that before evidence-based CPE redesign is feasible, the nature, scope, and interdependence of these barriers must be systematically established – a diagnostic contribution this paper makes explicit. The findings conclude with research-oriented propositions for future programme-level and policy-level investigation.

Keywords: *continuing professional education, in-service teacher training, educational technology integration, digital competence, TPACK, DigCompEdu, technology adoption barriers, teacher certification policy, OECD TALIS*

1. Introduction

Emerging technologies have reshaped the competency demands of classroom teaching faster than institutional systems have been able to respond. International policy frameworks – from UNESCO's Education 2030 (UNESCO, 2018) to the ISTE Standards for Educators (ISTE, 2017) – have set progressively more explicit requirements for teacher technological competence. Yet the systems through which practising teachers are expected to develop these competencies – programmes of continuing professional education – are, on the latest international evidence, critically underprepared for this task (UNESCO. 2018).

Data from Pearson School Report 2023 and Tech4Teachers (2024) indicate that only 17% of teachers currently access CPE specifically addressing digital tools and educational technology – leaving the overwhelming majority of the practising workforce without formal institutional support in this domain. OECD TALIS 2024 data deepen this picture: among teachers who do not use instructional technology, 75% identify lack of knowledge as the primary barrier – a figure that points not to individual unwillingness but to a structural failure of professional preparation. Concurrently, only 55% of teachers report that their CPE programmes positively affect classroom practice – indicating that where provision exists, its design fails to connect with practical instructional contexts (Pearson. 2023).

These patterns are not geographically isolated or incidental. They recur across contexts as varied as the United States, England, and the broader OECD zone, implicating failures of both scale and substantive programme quality. They therefore warrant analytical attention not as a loose collection of separate policy failures but as a coherent and interconnected institutional phenomenon.

This paper is explicitly diagnostic in character. It does not report on specific interventions or programme evaluations. Rather, it establishes the systematic groundwork that must precede any serious reform of teacher CPE: a structured analysis of what the international evidence reveals about why technology integration in teacher professional education is failing, and how these failures relate to one another. This diagnostic function constitutes a substantive scholarly contribution in its own right. The central research question is: What is the nature, severity, and systemic character of the barriers constraining effective technology integration in teacher CPE, as documented in major international datasets from 2023 to 2024. The paper argues that these barriers – spanning coverage, knowledge, programme quality, adoption depth, standards alignment, and time – constitute an interconnected system of institutional failure whose self-reinforcing logic accounts for both the persistence of the problem and the insufficiency of previous targeted interventions.

The paper is organised as follows. Section 2 reviews the theoretical and empirical literature on CPE effectiveness and technology integration. Section 3 describes the methodological approach to data synthesis. Section 4 presents a taxonomy of six barriers identified in the international evidence base. Section 5 discusses the systemic interdependencies among these barriers. Section 6 advances research-oriented propositions for future inquiry and programme redesign. Section 7 concludes with a synthesis of the diagnostic argument.

2. Literature Review

2.1 Conceptual Framework: TPACK and DigCompEdu as Analytical Lenses

The predominant theoretical framework for understanding technology integration in teaching practice remains Technological Pedagogical Content Knowledge (TPACK), introduced by Mishra and Koehler (Mishra P., Koehler, M. J., 2006). TPACK posits that effective technology use in the classroom requires not merely technical proficiency but an integrated command of content knowledge, pedagogical knowledge, and technological knowledge simultaneously. The framework implies that CPE programmes targeting technology integration must engage all three knowledge domains – a standard that, as subsequent research has shown, most existing programmes fail to meet (Mishra P., Koehler, M. J., 2006).

Complementary to TPACK, the European Digital Competence Framework for Educators provides a policy-oriented competency model specifying six areas of digital competence for teaching professionals, from professional engagement to facilitating learners' digital development. DigCompEdu has been incorporated into teacher education policy across multiple EU member states and offers a developmental progression model – from foundational to highly specialised competency – that can inform both curriculum design and CPE benchmarking (Redecker C., 2017).

Together, TPACK and DigCompEdu define the theoretical horizon against which existing CPE provision can be assessed. Both frameworks make clear that digital competency in teaching is not a discrete skill but a complex, developmentally structured professional capacity – a characterisation with direct implications for the adequacy of prevailing CPE formats.

2.2 The Effectiveness of Teacher Continuing Professional Education

The research literature on CPE effectiveness converges on several design principles. Darling-Hammond in a comprehensive review commissioned by the Learning Policy Institute, identify content focus, active learning, coherence, sustained duration, and collaborative participation as defining characteristics of high-quality professional development. Short, one-off workshops – historically the dominant format for in-service teacher training – are consistently associated with negligible or transient effects on classroom practice (Darling-Hammond L., Hyler M. E., Gardner M., 2017; Guskey T. R., 2022). Joyce and Showers (2002) estimate that the transfer of new skills to practice requires not only initial instruction but follow-up coaching – resources that most CPE providers do not systematically offer (Joyce B., Showers B., 2003).

These findings are particularly salient in the context of technology-focused CPE, where skills evolve rapidly and where the gap between nominal exposure and actual pedagogical application is especially pronounced. Voogt argue that sustainable technology integration requires school-level conditions – shared vision, collaborative culture, leadership support – that training programmes alone cannot create (Voogt J., Fisser P., Pareja Roblin N., Tondeur J., van Braak, J., 2013). This positions CPE effectiveness as a problem not merely of programme design but of institutional ecology.

2.3 Technology Integration in Education: Emerging Evidence

Scholarly attention to technology-specific teacher competencies has grown substantially since 2019 Holmes in his analysis of educational technology policy, argue that the pace of instructional technology adoption has consistently outrun the development of supporting pedagogical frameworks and teacher preparation capacity (Holmes W., Porayska-Pomsta K., Holstein K., Sutherland E., Baker T., Shum S. B., Santos O. C., Rodrigo M. T., Cukurova M., Bittencourt I. I., Koedinger K. R., 2022). A conceptually important distinction – applicable to emerging instructional technologies of all kinds – separates foundational understanding of a technology's mechanisms from the practical pedagogical capacity to deploy it for specific instructional ends. Evidence from OECD TALIS 2024 illustrates this gap clearly: among teachers who do use instructional technologies, use is anchored at lower-complexity tasks (summarisation, content generation, lesson planning) rather than at pedagogically critical applications such as student performance analysis or adaptive differentiation (OECD. 2024). This distribution suggests that even where technology adoption has occurred, it has not penetrated the functions where its transformative potential is greatest.

Celik empirically examined teachers' perceptions of digital competency and found significant variation across subject areas and school types, with the majority of respondents reporting insufficient institutional support for technology skill development (Celik I., Muukkonen H., Dede C., 2024).

2.4 Barriers to Educational Technology Adoption

The literature on barriers to EdTech adoption distinguishes between first-order barriers (external, resource-related constraints: access, time, institutional support) and second-order barriers (internal, belief-related constraints: teacher attitudes, confidence, pedagogical values), synthesised findings from 48 studies and identified lack of knowledge and skills, lack of resources, and lack of time as the three most frequently reported barriers – a taxonomy that maps directly onto the data examined in the present paper. The persistence of these findings across nearly two decades of research underscores that the barriers under analysis are structural rather than transient (Ertmer P. A., 1999).

While first-order barriers have diminished with the proliferation of affordable devices and broadband access, second-order barriers – particularly knowledge and confidence deficits regarding instructional technologies – remain persistent and, in the view of some scholars, more consequential (Ertmer P. A., Ottenbreit-Leftwich A. T., Sadik O., Sendurur E., Sendurur P., 2012).

3. Methodology

This paper employs a critical document analysis approach, drawing on secondary data from four major international datasets published in 2023–2024: OECD Teaching and Learning International Survey (TALIS) 2024, Pearson School Report 2023, Tech4Teachers 2024, and the TCEA/SETDA EdTech Landscape Report (2024) (OECD. (2024).

The selection of these sources was guided by three criteria: international or multinational scope, recency, with all primary data collected no earlier than 2022, and methodological transparency. Data were extracted, systematically organised, and analysed with respect to six thematic categories corresponding to distinct types of structural barrier. Barriers were categorised by type and assessed for severity of impact, drawing on criticality evaluations in the source documentation where available.

This approach is appropriate for generating a structured, evidence-grounded diagnostic analysis of a policy-relevant problem domain – precisely the kind of foundational scholarly work that must precede effective programme reform. Its principal limitation is reliance on reported aggregate data rather than primary observation or experimental intervention, findings should accordingly be interpreted as descriptive and diagnostic rather than causal. A further limitation relates to source verification: several dataset reports remained in final publication processing at the time of writing, and all figures cited refer to data as reported in publicly available summary documentation.

The value of this methodological approach lies in its capacity to surface structural patterns across diverse national contexts. Where individual case studies or programme evaluations might capture local variation, the cross-dataset synthesis employed here reveals the systemic character of CPE failures – a level of analysis essential to informing policy-level intervention.

4. Structural Barriers to Technology Integration in Teacher CPE: A Cross-Dataset Analysis

4.1 Coverage Deficit: Systemic Gaps in Access to Technology-Focused CPE

The most foundational barrier is one of scale. Data from Pearson School Report and Tech 4 Teachers (2024) indicate that only 17% of teachers currently access CPE specifically addressing digital tools and educational technology – leaving the overwhelming majority of the practising workforce without formal institutional support in this domain (Pearson. 2023). This pattern is consistent with earlier estimates from the European Commission's Education and Training Monitor 2023, which documented persistent disparities in access to technology-focused CPE across member states (European Commission. 2023).

The scale of this deficit reframes the technology integration problem at its root. Inadequate technology use in classrooms is not primarily a question of teacher attitudes or motivation; it is a consequence of the system's failure to deliver the professional education through which relevant competency could be developed. A CPE infrastructure that reaches one in six teachers is not a functional system operating below capacity – it is a system that has not been built for the task it is assigned.

4.2 The Knowledge Gap as the Dominant Self-Reported Barrier

OECD TALIS 2024 data indicate that 75% of teachers who do not use instructional technologies cite lack of knowledge as the primary reason – by a substantial margin the most frequently reported barrier. This figure is consistent with two simultaneous dynamics: CPE provision has not reached most teachers, and where it has, it has not adequately addressed technology-specific knowledge needs. The evidence examined here suggests both operate concurrently rather than in sequence (OECD. (2024).

The analytical significance of the knowledge gap extends beyond its prevalence. It functions as a pre-conditional barrier – one that renders other proposed interventions ineffective until it is addressed. A teacher without foundational understanding of available instructional technologies cannot benefit from institutional support structures, collaborative professional cultures, or protected learning time, however generously these are provided. Closing the knowledge gap is therefore not one reform priority among several; it is the precondition for others.

4.3 Low Perceived Effectiveness of CPE Programmes

OECD TALIS 2024 data indicate that only 55% of teachers report their CPE programmes have a positive effect on classroom practice – meaning that nearly half of those who do access professional education find it without practical value. This figure shifts the analytic frame: the problem is not reach alone but quality (OECD. (2024). The predominance of short, lecture-format workshops – consistently identified as the least effective CPE modality likely accounts for much of this pattern, compounded by content that is generic rather than subject-specific or practice-embedded (Darling-Hammond L., Hyler M. E., Gardner M., 2017).

Low perceived effectiveness carries compounding institutional consequences. Teachers who do not experience CPE as practically useful are less likely to engage with subsequent professional learning opportunities, generating a cycle of disengagement that reinforces the coverage deficit identified in Section 4.1. Effectiveness failure and access failure are thus mutually sustaining rather than independent problems.

4.4 Superficial Technology Adoption Patterns Among Current Users

Among teachers who do use instructional technologies, OECD TALIS 2024 US subsample data reveal a pronounced concentration of use at low-complexity, administrative tasks: topic summarisation (73%), lesson planning (70%), and generating instructional materials (70%). By contrast, only 18% use available tools for student performance analysis – one of the functions with the greatest potential for instructional impact (OECD. (2024). Even where adoption has occurred, it has not reached the pedagogically critical applications where the transformative potential of instructional technology is greatest.

This distribution is precisely what TPACK theory predicts when technology access outpaces pedagogical integration. Without CPE that develops the intersection of technological and pedagogical knowledge, adoption defaults to the path of least resistance: familiar, low-stakes tasks that require minimal reconceptualisation of practice. Access to tools is necessary but not sufficient; what is absent is the professional education that converts tool access into pedagogically meaningful use.

4.5 Absent or Inconsistent Mandatory Digital Competency Standards

In the United States, only 11% of states require school districts to maintain educational technology plans (TCEA/SETDA) (TCEA, SETDA. 2024). In England, digital competencies remain unembedded in Initial Teacher Training or Qualified Teacher Status standards as of 2024 (Tech4Teachers) (Tech 4Teachers. (2024). The absence of mandatory standards removes the institutional incentive structure through which CPE providers would otherwise develop technology-specific content – and leaves individual teachers without a professional benchmark against which to assess or direct their own competency development. In EU DigCompEdu has been adopted as a binding instrument, more systematic integration of digital competency into teacher education curricula has followed (European Commission, 2023) (European Commission. 2023; Redecker C., 2017).

4.6 Time as a Structural Constraint

OECD TALIS 2024 data indicate that 63% of teachers cite insufficient time as their primary barrier to technology-focused CPE, with approximately 60% reporting scheduling conflicts as the operative mechanism (OECD. 2024). The structural character of this barrier is sharpened by the nature of the domain: unlike subject content knowledge, which evolves gradually, instructional technology landscapes shift substantially within a single academic year. CPE in this domain must therefore be conceived as a continuous, embedded professional process rather than a periodic event – a conception that is particularly difficult to sustain within existing workload and scheduling structures.

The time barrier operates through two distinct pathways. Directly, it excludes teachers from available CPE opportunities. Indirectly, it precludes the sustained, practice-embedded professional learning that research consistently identifies as most effective (Darling-Hammond L., Hyler M. E., Gardner M., 2017). Both pathways lead to the same outcome: the reinforcement of the knowledge gap documented in Section 4.2. Time is accordingly not a peripheral logistical constraint but among the most structurally entrenched of the six barriers analysed here.

5. Discussion

5.1 The Barriers as an Interconnected System

Considered in isolation, each of the six barriers presents as a distinct and tractable problem. Taken together, however, they constitute a self-reinforcing institutional system: the absence of mandatory standards reduces institutional investment in CPE, low investment produces coverage deficits, coverage deficits perpetuate knowledge gaps, knowledge gaps limit technology adoption, where adoption occurs, time constraints and ineffective CPE design restrict its pedagogical depth, low perceived CPE effectiveness reduces teacher engagement with professional learning, and reduced engagement reinforces coverage deficits. This causal loop explains both the persistence of the problem and the insufficiency of single-barrier interventions.

The systemic character of these barriers has direct implications for research and policy design. Studies that examine isolated barriers – time alone, or access alone – will consistently produce findings that appear tractable in principle but prove intractable in practice, because the unaddressed barriers reconstitute the problem through alternative pathways. Research that maps the interdependencies, as this paper attempts, provides the structural understanding necessary to design coordinated interventions.

5.2 Alignment with International Policy Frameworks

The barriers identified stand in sharp contrast to the expectations of internationally recognised frameworks. UNESCO Education 2030 (UNESCO) calls for qualified, professionally supported teachers as a prerequisite for SDG4 (UNESCO. 2018). ISTE Standards (ISTE) specify educator roles – digital citizen, designer, analyst – that require competencies well beyond the surface-level technology use patterns currently documented. EU DigCompEdu posits six progressive competency areas, the foundational tier of which presupposes access to functional digital CPE infrastructure (Redecker C., 2017).

The gap between these frameworks and the empirical reality documented here indicates that policy commitment to digital teacher competency has not been translated into the institutional mechanisms necessary for implementation at scale. This is not a knowledge problem – the design principles for effective CPE are well established and internationally documented. It is a structural problem, in which the incentive architecture of CPE systems has not been aligned with the competency expectations embedded in policy frameworks.

The preceding analysis illustrates why the diagnostic work undertaken in this paper constitutes a necessary precondition for evidence-based CPE reform rather than a lesser contribution to be superseded by intervention studies. A field that moves to programme redesign without first establishing the structural character of the problem risks repeating the pattern that the 55% effectiveness figure reflects: well-intentioned programmes that address visible symptoms while leaving the underlying architecture intact.

6. Research Propositions and Recommendations for Programme Redesign

The following propositions are advanced not as programmatic prescriptions but as evidence-grounded directions for inquiry and design. Each is derived directly from the diagnostic findings of Sections 4 and 5 and is intended to guide the agenda-setting work that must precede systematic CPE reform.

Proposition: Mandatory Competency Standards as Structural Lever. The most structurally significant intervention is the integration of technology competency requirements into teacher certification and ongoing professional accreditation. Research is needed to examine the mechanisms through which mandatory standards have produced CPE infrastructure change.

Proposition: CPE Programme Redesign on Evidence-Based Principles. CPE programmes should be redesigned in accordance with established effectiveness principles: sustained duration, active and contextualised learning formats, subject-specific content, and embedded coaching. Technology-specific content should explicitly address higher-complexity pedagogical applications – student performance analysis, adaptive differentiation, technology-enhanced formative assessment – rather than administrative efficiency tasks alone. Programme evaluation studies using pre-post designs with practice observation data are needed to assess which redesign elements produce the greatest gains in classroom technology integration.

Proposition: Protected Time as a Policy Variable. The time constraint documented in Section 4.6 requires policy-level attention: research examining jurisdictions that have institutionalised protected professional learning time within teachers' contractual schedules.

Proposition: Longitudinal Research on CPE and Technology Integration Trajectories. The field requires longitudinal studies tracking not only CPE participation rates and self-reported confidence but observable changes in teaching behaviour, the quality and complexity of technology application over time, and downstream effects on student learning outcomes. Such studies would transform the diagnostic picture offered in this paper into a causal understanding capable of informing programme investment decisions at both institutional and policy levels.

7. Conclusion

This paper has identified and critically analysed six structural barriers to technology integration in continuing professional education for teachers, drawing on international comparative data from 2023 to 2024. The central argument has been that these barriers – coverage deficits, knowledge gaps, low CPE effectiveness, superficial technology adoption, absent mandatory standards, and time constraints – do not constitute isolated policy challenges but form a self-reinforcing institutional system, each barrier enabling and amplifying the others.

This systemic character has two important implications. First, it explains why incremental, single-barrier interventions have consistently proven insufficient: addressing one node of a causal loop while others remain intact does not break the loop. Second, it establishes the diagnostic function of this paper as a substantive scholarly contribution in its own right. Before effective CPE reform can be designed, the structural architecture of the problem must be understood – not assumed, not approximated from case studies, but mapped through systematic analysis of the available evidence base.

The teaching profession's capacity to meaningfully deploy instructional technology in service of student learning is, increasingly, a prerequisite for educational quality at scale. The evidence reviewed here indicates that this capacity is not being systematically developed through existing CPE infrastructure, and that the structural conditions required to develop it – mandatory standards, adequate coverage, effective programme design, and protected learning time – are well understood, internationally documented, and in principle achievable. The work of achieving them begins with the clarity of diagnosis.

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