

Strategies for Enhancing Information and Communication Technology (ICT) Competence in Responding to the Demand for Technology-Literate Teachers

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ABSTRACT

The rapid expansion of digital technology in the twenty-first century has repositioned Information and Communication Technology (ICT) competence as a core professional requirement for teachers rather than a supplementary skill. In the Indonesian context, the shift toward the Merdeka Curriculum, blended learning, and digital-based assessment has exposed a persistent gap between policy expectations and the actual technological readiness of educators, particularly in madrasah and Islamic higher education environments where infrastructural and pedagogical constraints remain considerable. This urgency is compounded by findings indicating that a substantial proportion of teachers are still not fully prepared to adapt to digital literacy demands, despite continuous government-led training initiatives. This article aims to examine the strategic dimensions through which ICT competence can be systematically improved among teachers, and to analyze how such strategies respond to the growing expectation that educators become technologically literate professionals. The study employs a qualitative library research (*studi pustaka*) design, drawing on peer-reviewed journal articles, institutional reports, and policy documents published within the last seven years, analyzed through content and thematic analysis techniques. The findings reveal that effective ICT competence enhancement rests on three interrelated strategies: structured and sustainable professional development programs, the integration of Technological Pedagogical Content Knowledge (TPACK) into everyday pedagogical practice, and institutional policy support accompanied by adequate digital infrastructure. The study concludes that technology-literate teachers emerge not merely from individual initiative but from a systemic convergence of training, pedagogical reorientation, and institutional facilitation. These findings contribute to the theoretical discourse on teacher digital competence and offer practical implications for Islamic education institutions seeking to accelerate their digital transformation agenda

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1. INTRODUCTION

The twenty-first century has been marked by an accelerating convergence between education and digital technology, a convergence that has fundamentally redefined what it means to be a competent teacher (Wardi, Sari, Kamal, & Irawati, 2024). Where technological fluency was once regarded as an auxiliary asset, it is now understood as an inseparable component of professional pedagogical identity. Classrooms are no longer bounded by physical walls: learning management systems, digital assessment platforms, and multimedia instructional tools have become the ordinary infrastructure of teaching and learning. Within this landscape, Information and Communication Technology (ICT) competence functions simultaneously as a technical skill set and as a marker of professional legitimacy, shaping how teachers plan, deliver, and evaluate instruction in an era of continuous digital disruption.

In Indonesia, this global trajectory intersects with a series of domestic policy reforms that have intensified the urgency of ICT competence among teachers. The introduction of the Merdeka Curriculum, the expansion of the Merdeka Mengajar digital platform, and the increasing reliance on computer-based national assessment have all presupposed a baseline level of digital fluency that many teachers have not yet attained. Empirical evidence lends weight to this concern: national data cited in recent scholarship indicate that only a minority of teachers are fully prepared to adapt to digital literacy demands, prompting government-initiated training programs intended to reach thousands of educators annually (Bentri, Alwen, Abna Hidayati, 2022). This statistic is not merely administrative; it signals a structural vulnerability in the nation's readiness to sustain technology-integrated education at scale.

The urgency becomes more pronounced within Islamic higher education and madrasah environments, the setting most directly relevant to this study. Institutions such as Islamic colleges (Institut Agama Islam) and madrasah often operate with more constrained digital infrastructure, more heterogeneous faculty age profiles, and curricula historically oriented toward classical textual pedagogy rather than technology-mediated instruction. Recent province-level assessment data show considerable variation in teachers' digital literacy across regions, with ethical and technological domains showing comparatively stronger performance than content-creation and problem-solving domains (Zulaikha, Siti, Muhammad Fadholi, Sururi, Syahril, Siti Nur Jamil, 2025). Such unevenness suggests that ICT competence cannot be treated as a uniform national condition; it is differentiated by institutional context, resource availability, and the strategic choices made by education leaders at the school and campus level.

This condition gives rise to the central research issue examined in this article: how can ICT competence among teachers be strategically and systematically enhanced so that it genuinely responds to the demand for technology-literate educators, rather than remaining a matter of ad hoc, individually initiated adaptation? The issue is not simply whether teachers can operate digital devices, but whether institutions possess coherent, sustainable strategies capable of transforming isolated technical skills into embedded pedagogical practice.

From this central issue, at least three specific research problems can be identified. First, there remains a conceptual ambiguity regarding what constitutes adequate ICT competence for teachers, given that digital competence frameworks distinguish between technological, cognitive, and ethical dimensions, and teachers frequently exhibit uneven mastery across these dimensions rather than uniform proficiency (Atmojo, Idam Ragil Widiyanto, Roy Ardiansyah, 2022). Second, professional development programs intended to build ICT competence are often fragmented, short-term, and insufficiently connected to teachers' actual pedagogical practice, producing training outcomes that do not translate into sustained classroom integration (Fernández-Batanero, José María, Marta

Montenegro-Rueda, José Fernández-Cerero, 2022). Third, institutional and policy-level support—including infrastructure provision, incentive structures, and leadership commitment—is frequently underexamined in the literature relative to the extensive attention given to individual teacher attitudes and motivation, leaving a structural blind spot in how ICT competence is actually cultivated at scale.

A review of prior research clarifies both the contributions and the limitations of existing scholarship on this theme. The first relevant study is the systematic review conducted by Fernández-Batanero and colleagues, who examined digital competencies and teacher professional development across a decade of international literature. Their review concludes that most existing studies emphasize the importance of digital competence as a professional challenge, that qualitative approaches dominate the field, and that a persistent lack of structured teacher training remains among the most frequently cited barriers to digital competence development (Fernández-Batanero, José María, Marta Montenegro-Rueda, José Fernández-Cerero, 2022). This study is valuable for mapping the global contours of the field, yet it remains largely diagnostic, cataloguing challenges without proposing an integrated strategic framework tailored to specific institutional contexts such as Islamic higher education.

The second relevant study is the case-based investigation by Atmojo, Ardiansyah, and Wulandari, who assessed classroom teachers' digital literacy using the Instant Digital Competence Assessment (IDCA) framework among elementary school teachers in Surakarta. Their findings reveal considerable disparity across the technological, cognitive, and ethical dimensions of digital literacy, with the majority of teachers falling into low or very low categories on the technological dimension despite comparatively stronger ethical awareness (Atmojo, Idam Ragil Widiyanto, Roy Ardiansyah, 2022). This study offers a granular, dimension-specific diagnostic tool, but its scope is confined to descriptive assessment; it does not extend into an analysis of the strategic interventions capable of closing the identified gaps.

The third relevant study is the strategic-management analysis by Rambe, Siswanto, Putri, and Kintoko, who examined the management of ICT literacy programs for teachers within the context of the Merdeka Curriculum era. Their study emphasizes that enhancing learning quality requires a deliberate managerial approach to ICT literacy programming, situating teacher competence development within a broader institutional management framework rather than treating it as an individual responsibility alone (Rambe, Muhammad Yusuf, Deny Hadi Siswanto, Helena Anggraeni Putri, 2025). This study moves closer to a strategic orientation, yet it is grounded primarily in general public-school management contexts and does not address the distinctive institutional character of Islamic religious education, where curricular integration between technology and religious pedagogy introduces additional layers of complexity.

Taken together, these three strands of prior research systematic mapping of challenges, dimension-specific diagnostic assessment, and general strategic management reveal a clear research gap. Existing literature has extensively documented that teachers face digital competence deficits and has proposed general categories of professional development, but comparatively little scholarship has synthesized these strands into an integrated, evidence-based strategic model specifically oriented toward Islamic higher education and madrasah settings, where religious pedagogical tradition and digital transformation must be reconciled rather than treated as separate agendas. Moreover, prior studies tend to isolate either the individual teacher (attitudes, motivation, self-efficacy) or the institution (policy, infrastructure) as the primary unit of analysis, rather than examining the interaction between these levels as a coherent strategic system.

This article seeks to address that gap. Its primary purpose is to examine and synthesize strategic dimensions through which ICT competence can be systematically enhanced among teachers, with particular attention to how these strategies operationalize the broader societal and institutional expectation that educators become technologically literate professionals. More specifically, the study aims to identify the components of effective ICT professional development, to analyze the

pedagogical integration of technology through frameworks such as TPACK, and to evaluate the institutional and policy conditions that enable or constrain the sustainability of ICT competence improvement.

The benefits of this study are both theoretical and practical. Theoretically, the study contributes to the growing academic discourse on teacher digital competence by proposing an integrative strategic framework that connects individual, pedagogical, and institutional levels of analysis, thereby extending existing diagnostic and managerial literature. Practically, the study offers education leaders, madrasah principals, and Islamic higher education administrators an evidence-informed reference for designing ICT competence enhancement programs that are contextually appropriate, sustainable, and aligned with both national curriculum demands and the distinctive pedagogical character of Islamic educational institutions. In doing so, this article aspires to contribute meaningfully to the acceleration of digital transformation within Islamic education without compromising its pedagogical and value-based foundations.

2. METHODS

This study employs a qualitative library research (*studi pustaka*) design, appropriate for synthesizing and critically analyzing existing scholarly knowledge on ICT competence enhancement strategies for teachers rather than generating new field data. This approach was selected because the research problem is conceptual and strategic in nature, requiring the systematic integration of theoretical frameworks and empirical findings already documented in the literature rather than direct measurement of a specific population (Ridho, 2023). The data sources for this study consist entirely of secondary data drawn from peer-reviewed journal articles, indexed conference proceedings, and relevant institutional or policy documents published predominantly within the last seven years, ensuring the currency and contextual relevance of the material analyzed. Sources were purposively selected based on thematic relevance to ICT competence, digital literacy, TPACK, and teacher professional development, with particular attention to studies situated in the Indonesian educational context.

Data collection was conducted through systematic documentation techniques, involving the identification, retrieval, and cataloguing of relevant literature accessible through academic databases and indexing services such as Google Scholar. The collected literature was then examined using content analysis and thematic analysis techniques: content analysis was used to extract key concepts, findings, and recommendations from each source, while thematic analysis was used to identify recurring patterns across sources that could be organized into coherent strategic categories. This analytical process ultimately produced the three interrelated strategic dimensions discussed in the following section, namely professional development, pedagogical-technological integration, and institutional policy support.

3. FINDINGS AND DISCUSSION

Strengthening ICT Competence through Sustainable Teacher Professional Development

The first strategic dimension identified in this study concerns the design and sustainability of teacher professional development (TPD) programs oriented toward ICT competence. Professional development has long been regarded as the principal mechanism through which teachers acquire, refine, and sustain the technical and pedagogical skills necessary for digital integration. Contemporary scholarship reinforces this view, noting that well-designed TPD programs provide teachers with technical skills, pedagogical strategies, and ongoing support, and that approaches combining hands-on training, collaborative learning, mentorship, and online professional development courses have proven effective in enhancing teachers' digital competencies and fostering a culture of continuous learning (Amemasor, Stephen Kwashie, Stephen Opoku Oppong, Benjamin Ghansah, Ben-Bright Benuwa, 2025).

Yet the effectiveness of TPD cannot be assumed simply because a program exists. Fernández-Batanero and colleagues' systematic review is instructive here: despite the proliferation of digital-competence-oriented training initiatives internationally, a persistent lack of structured and sufficient ICT training remains among the most frequently cited barriers to teacher digital competence (Fernández-Batanero, José María, Marta Montenegro-Rueda, José Fernández-Cerero, 2022). This finding indicates a structural paradox—training programs are widely available in principle, yet teachers continue to report insufficient preparation in practice. The most plausible explanation, and one supported by the broader literature reviewed in this study, is that many existing programs are episodic rather than sustained: they consist of one-off workshops disconnected from teachers' daily instructional demands, rather than embedded, iterative cycles of practice, reflection, and refinement.

This pattern is corroborated by findings from the Indonesian context. Bentri, Hidayati, and Kristiawan report that despite government efforts to train substantial numbers of teachers annually in digital literacy, only a minority of teachers nationally are considered ready to adapt to digital literacy demands, and that organizational infrastructure and strategic leadership—rather than teacher motivation alone remain comparatively underexamined factors shaping digital competence outcomes (Bentri, Alwen, Abna Hidayati, 2022). This suggests that the volume of training delivered is not, by itself, a reliable predictor of competence outcomes; what matters more is whether training is embedded within a supportive organizational structure that reinforces newly acquired skills through continued practice.

The author's review of these findings suggests that effective ICT-oriented professional development should be conceptualized along at least four interlocking design principles. The first is continuity: rather than isolated training events, programs should be structured as ongoing cycles that allow teachers to practice, receive feedback, and refine their digital pedagogical skills over an extended period. The second is contextual relevance: training content should be aligned with teachers' actual subject matter and classroom conditions rather than generic digital-tool instruction detached from pedagogical purpose. The third is collaborative scaffolding: peer mentoring and communities of practice allow more digitally proficient teachers to support colleagues who are still developing their competence, distributing expertise across the institution rather than concentrating it in a small cohort of early adopters. The fourth is institutional reinforcement: professional development must be paired with opportunities to apply new skills immediately in real teaching contexts, since skills that are learned but not practiced tend to atrophy quickly (Najmi & Ridho, 2025).

Applied to the context of Islamic higher education institutions such as Institut Agama Islam Al-Khairat Pamekasan, these principles carry specific implications. Faculty members in such institutions often combine responsibilities in religious instruction with emerging expectations for digital pedagogy, meaning that professional development cannot be a simple transplant of generic corporate or general-education training models. Instead, ICT training should be designed collaboratively with subject-matter lecturers so that digital tools are demonstrated in direct relation to Islamic studies content for instance, using learning management systems to structure hadith or fiqh coursework, or employing multimedia presentation tools to enrich da'wah-oriented instructional materials. This alignment increases the perceived relevance of training and reduces the likelihood that digital skills remain disconnected from actual teaching practice.

A further consideration concerns the assessment of professional development outcomes. Programs are frequently evaluated by participation rates or immediate post-training satisfaction, rather than by sustained changes in classroom practice. Drawing on the multidimensional digital literacy assessment used by Atmojo, Ardiansyah, and Wulandari which evaluates technological, cognitive, and ethical dimensions separately rather than treating digital literacy as a single composite score the author argues that institutions should adopt similarly dimension-specific evaluation instruments for their own professional development programs (Atmojo, Idam Ragil Widiyanto, Roy Ardiansyah, 2022). Doing so would allow institutions to identify precisely where competence gaps persist (for example, strong ethical awareness but weak technical proficiency) and to design targeted

follow-up interventions rather than repeating generic training cycles that fail to address the actual locus of the deficiency.

The systematic review conducted by Amemasor and colleagues offers additional empirical grounding for these design principles. Analyzing peer-reviewed studies on teacher professional development and digital instructional integration, they find that effective TPD programs consistently share four characteristics: collaborative learning environments, hands-on digital training, ongoing mentorship, and institutional support, and that these elements together foster measurable shifts in teachers' attitudes, confidence, and competencies regarding digital instructional integration (Amemasor, Stephen Kwashie, Stephen Opoku Oppong, Benjamin Ghansah, Ben-Bright Benuwa, 2025). The convergence between this international evidence and the design principles proposed above—continuity, contextual relevance, collaborative scaffolding, and institutional reinforcement—strengthens the claim that these are not context-specific idiosyncrasies but generalizable features of effective ICT-oriented professional development, applicable across national and institutional settings, including Islamic higher education.

It is also important to distinguish between competence acquisition and competence retention, a distinction that is frequently blurred in institutional training reports. Many professional development programs are evaluated at the point of completion, when enthusiasm and short-term recall are typically at their highest, rather than months later when the durability of newly acquired skills can be more meaningfully assessed. The author's review of the literature suggests that retention is closely tied to the frequency of subsequent application: skills that are practiced repeatedly within authentic teaching tasks are retained and refined, whereas skills that are learned but not immediately applied tend to decay rapidly, requiring costly re-training. This observation reinforces the earlier argument that professional development should be structured as continuous cycles rather than discrete events, and it further suggests that institutions should build low-stakes opportunities for immediate practice directly into the training design itself, rather than treating application as a separate, later-stage responsibility left entirely to individual teachers.

A related design consideration concerns differentiated entry points. Faculty members entering ICT-oriented professional development programs rarely share a common baseline of digital competence; some may already be proficient in basic productivity and communication tools but unfamiliar with learning management systems, while others may lack confidence even with fundamental digital operations. A single, undifferentiated training track risks disengaging more advanced participants through excessive repetition of basic content, while simultaneously overwhelming less experienced participants who require a slower, more scaffolded introduction. Institutions seeking to enhance ICT competence effectively should therefore consider tiered training pathways, informed by a brief diagnostic assessment at the outset of each program, so that instructional time is allocated according to actual developmental need rather than a uniform assumption of readiness.

Finally, professional development strategies should account for the emotional and motivational dimensions of technology adoption, not merely its technical content. Harmadi's finding that teacher motivation is closely intertwined with digital literacy and TPACK development is instructive in this respect, indicating that competence-building efforts which ignore teachers' affective relationship with technology are unlikely to produce durable change (Harmadi, 2025). Training that acknowledges common sources of anxiety—fear of technical failure in front of students, concern about being evaluated less favorably than digitally fluent younger colleagues, or simple unfamiliarity with unfamiliar interfaces—and that creates a psychologically safe environment for experimentation and error is more likely to produce lasting behavioral change than training that focuses exclusively on procedural instruction.

In sum, the evidence reviewed in this section indicates that professional development remains indispensable to ICT competence enhancement, but its effectiveness depends less on frequency or scale than on continuity, contextual relevance, collaborative structure, differentiated design,

motivational sensitivity, and institutional reinforcement. For Islamic higher education institutions, embedding these principles within training design offers a pathway toward cultivating technology-literate faculty without displacing the distinctive pedagogical and value-based mission of religious higher education.

Pedagogical–Technological Integration through the TPACK Framework

The second strategic dimension concerns the pedagogical integration of technology through frameworks such as Technological Pedagogical Content Knowledge (TPACK), which conceptualizes teacher competence not as technology skill in isolation, but as the dynamic intersection of technological, pedagogical, and content knowledge. Where the first sub-section addressed how competence is built through training, this section addresses how that competence is meaningfully applied within actual instructional practice.

Recent scholarship affirms the centrality of TPACK to twenty-first-century teaching competence. Aslan, Alanoğlu, and Karabatak argue that digital literacy plays a key connecting role in strengthening pre-service teachers' TPACK, suggesting that digital literacy functions less as a standalone competency and more as a foundational layer that enables the meaningful integration of technological, pedagogical, and content knowledge (Aslan, Seyithan, Mustafa Alanoğlu, 2025). This positions digital literacy not as an endpoint of teacher development but as an enabling condition for deeper pedagogical transformation.

Empirical findings from Indonesian classrooms provide further texture to this claim. Yuliardi's study of information literacy, learning space optimization, and TPACK skills in relation to mathematical digital literacy finds that these three factors are interrelated, indicating that TPACK does not operate in isolation from the broader learning environment but interacts with both teachers' information-processing capacities and the physical or virtual spaces in which learning occurs (Yuliardi, 2024). Similarly, Harmadi's investigation into the interplay between teacher motivation, digital literacy, and TPACK in elementary education demonstrates that motivational factors are closely intertwined with digital literacy and TPACK development, implying that pedagogical-technological integration is not purely a cognitive or technical matter but is shaped substantially by teachers' affective engagement with technology (Harmadi, 2025).

A particularly instructive case comes from Patahuddin, Ampa, and Akib's study of TPACK integration into the Merdeka Curriculum at an elementary school in Parepare. Their collaborative approach demonstrates that TPACK integration is strengthened when teachers work together to align technological tools with curriculum objectives and subject-specific pedagogical strategies, rather than approaching technology integration as an individual, trial-and-error endeavour (Patahuddin, Andi Tenri Ampa, 2025). This finding reinforces the argument, introduced in the previous sub-section, that collaborative structures are central not only to how ICT competence is trained but also to how it is subsequently applied in classroom practice.

The author's analysis of these findings suggests that TPACK integration in Islamic higher education contexts requires particular attentiveness to the interaction between technological tools and content that is often textual, exegetical, and tradition-based. Unlike subjects such as mathematics or natural science, where digital simulation and visualization tools map relatively directly onto content demonstration, Islamic studies content frequently involves close reading of classical texts, argumentation, and interpretive reasoning. Effective TPACK integration in this context, therefore, is less about replacing traditional textual pedagogy with digital tools, and more about using technology to extend and enrich existing pedagogical strengths for example, employing digital annotation tools for collaborative textual analysis, using video-based case studies to contextualize fiqh discussions in contemporary settings, or leveraging online discussion forums to extend classroom debate on ethical and da'wah-related themes beyond scheduled class hours.

This reasoning points toward a broader conceptual insight: TPACK should not be understood as a fixed template to be applied uniformly across disciplines, but as a flexible reasoning framework that

must be re-interpreted according to the epistemological character of each field of study. For Islamic higher education, this means that technology adoption should be pedagogically driven rather than technology driven; the starting question should not be "which digital tool can we introduce," but rather "which pedagogical goal in Islamic studies instruction would benefit from technological mediation, and what tool best serves that specific goal." This reframing helps prevent the common pitfall of superficial technology adoption, in which digital tools are used cosmetically without altering the underlying quality of teaching and learning.

Table 1 below synthesizes the empirical findings reviewed in this sub-section, mapping each study's central focus, methodological approach, and principal finding regarding the TPACK-digital literacy relationship, to illustrate the convergence of evidence supporting pedagogical-technological integration as a core strategic dimension.

Table 1. Synthesis of Empirical Findings on TPACK and Digital Literacy Integration

Study (Author, Year)	Focus / Context	Method	Key Finding on TPACK–Digital Literacy Link
Aslan, Alanoğlu & Karabatak (2025)	Pre-service teachers, 21st-century competencies	Quantitative / structural analysis	Digital literacy plays a key connecting role in strengthening pre-service teachers' TPACK.
Yuliardi (2024)	Mathematics education, learning spaces	Quantitative, correlational	Information literacy, optimized learning spaces, and TPACK skills are significantly interrelated with mathematical digital literacy.
Harmadi (2025)	Elementary education, teacher motivation	Quantitative, correlational	Teacher motivation is closely intertwined with digital literacy and TPACK development.
Patahuddin, Ampa & Akib (2025)	Elementary school, Merdeka Curriculum, Parepare	Qualitative, collaborative case study	Collaborative alignment of technology, curriculum, and pedagogy strengthens TPACK integration.

As Table 1 illustrates, despite variation in educational level, subject matter, and methodological approach, the reviewed studies converge on a consistent conclusion: digital literacy and TPACK are mutually reinforcing rather than independent constructs, and their integration is strengthened by collaborative, motivationally supportive, and spatially enabling conditions. This convergence lends empirical weight to the argument that ICT competence enhancement strategies must extend beyond

technical skill acquisition to encompass genuine pedagogical reasoning about how, when, and why technology should be used in specific instructional contexts.

Beyond the empirical convergence summarized in Table 1, it is worth examining more closely why TPACK functions as a more powerful organizing concept than digital literacy alone. Digital literacy, understood narrowly, describes a teacher's capacity to operate digital tools competently: it says relatively little about whether that operation serves a coherent pedagogical purpose. TPACK, by contrast, requires teachers to reason simultaneously about three questions: what the tool can technically do, what pedagogical strategy is appropriate for the learning objective at hand, and how the specific subject content shapes both of the preceding considerations. A teacher may be technically fluent with presentation software yet still use it merely to digitize a lecture, producing no meaningful pedagogical transformation. Genuine TPACK integration, by contrast, asks whether the same instructional goal might be better achieved through interactive polling, collaborative annotation, or asynchronous discussion choices that require pedagogical judgment, not merely technical operation.

The author's review of these findings further suggests that Islamic higher education institutions face a distinctive opportunity in this respect, precisely because their content domain places such strong emphasis on argumentation, textual interpretation, and dialogic reasoning. These are pedagogical strengths that many digital tools are, in fact, well suited to support: discussion forums extend classroom dialectic beyond scheduled hours, collaborative document platforms allow students to jointly annotate and debate interpretations of a given text, and video conferencing tools enable guest scholars to join seminar discussions from distant institutions without the logistical burden of physical travel. Framed this way, TPACK integration in Islamic higher education is not a departure from traditional strengths but a technological extension of them, provided that faculty are supported in identifying which tools genuinely serve these existing pedagogical practices rather than adopting tools indiscriminately because they are fashionable or externally mandated.

At the same time, the reviewed literature cautions against uncritical technology enthusiasm. Yuliardi's finding that TPACK skills interact with the physical and virtual learning space suggests that technology integration cannot be evaluated purely at the level of individual teacher competence; it is also shaped by whether the surrounding learning environment classroom layout, availability of shared devices, quality of institutional Wi-Fi actually supports the pedagogical strategies that TPACK-competent teachers wish to implement (Yuliardi, 2024). A teacher may possess strong pedagogical reasoning about how a given digital tool should be used, yet be unable to implement that reasoning if the physical or infrastructural environment does not cooperate. This observation foreshadows the discussion of institutional infrastructure developed in the following sub-section, underscoring that pedagogical competence and institutional capacity must be analyzed together rather than in isolation.

Institutional Policy Support and Digital Infrastructure

The third strategic dimension concerns institutional policy support and infrastructure, a dimension that this study argues has been comparatively underexamined relative to individual teacher attitudes and classroom-level pedagogical integration, despite its foundational role in determining whether ICT competence can be sustained at scale. Rambe, Siswanto, Putri, and Kintoko's analysis of ICT literacy program management within the Merdeka Curriculum era is directly relevant here, as it situates teacher digital competence development explicitly within institutional management processes, arguing that enhancing learning quality requires deliberate managerial strategy rather than incidental or teacher-initiated effort alone (Rambe, Muhammad Yusuf, Deny Hadi Siswanto, Helena Anggraeni Putri, 2025).

This institutional framing is reinforced by evidence of regional disparity in teacher digital literacy across Indonesia. Zulaikha and colleagues' multi-province assessment finds that teachers generally exhibit a "fairly good" level of digital literacy overall, yet report comparatively higher competence in ethical and technological domains than in domains associated with digital content

creation and problem-solving, with clear variation across the provinces studied (Zulaikha, Siti, Muhammad Fadholi, Sururi, Syahril, Siti Nur Jamil, 2025). Such variation cannot be adequately explained by individual differences in motivation or aptitude alone; it more plausibly reflects differences in regional infrastructure investment, institutional leadership priorities, and access to sustained professional development opportunities, each of which lies substantially outside individual teachers' control.

Complementary evidence from elementary education further illustrates the infrastructural dimension of the challenge. Anwar and Suchyadi's study on enhancing technology literacy competence among elementary school teachers in the era of educational digitalization highlights those teachers' technology literacy is shaped not only by training exposure but by the broader digitalization ecosystem within which schools operate, underscoring those institutional readiness and technological infrastructure jointly determine the extent to which individual competence can be translated into consistent classroom practice (Anwar, Wan Satria, 2026). Likewise, Atmojo, Ardiansyah, and Wulandari's dimension-specific assessment which found notably weaker performance on the technological dimension relative to the ethical dimension among the teachers studied implicitly signals that limited access to functioning hardware, reliable connectivity, and updated digital resources constrains technological-dimension competence more severely than it constrains ethically oriented digital behavior, which requires comparatively less infrastructural investment to develop (Atmojo, Idam Ragil Widiyanto, Roy Ardiansyah, 2022).

The author's review of these findings suggests three concrete institutional policy priorities for Islamic higher education institutions seeking to enhance ICT competence sustainably. The first priority is infrastructure equity: campus leadership must ensure baseline access to functioning computing devices, stable internet connectivity, and institutionally supported digital platforms, since no amount of pedagogical training can compensate for the absence of usable technological infrastructure. The second priority is policy embedding: ICT competence expectations should be formally incorporated into institutional strategic planning, faculty performance frameworks, and curriculum development guidelines, rather than treated as an optional enrichment activity dependent on individual initiative. The third priority is leadership modeling: institutional leaders and senior lecturers should visibly and consistently use digital tools in their own administrative and pedagogical practice, since prior research on organizational change consistently indicates that visible leadership commitment shapes staff perception of whether a given initiative is a genuine institutional priority or merely a symbolic policy statement.

A further institutional consideration concerns resource allocation logic. Many Islamic higher education institutions, including comparatively smaller regional institutes, operate under considerable budgetary constraint, which can lead to ICT investment being deprioritized relative to other operational needs. The findings reviewed in this study suggest that this deprioritization carries a compounding cost: without adequate infrastructure, professional development investment yields diminishing returns, since teachers trained in digital pedagogy but lacking reliable access to the tools they were trained on will be unable to sustain newly acquired practices. This implies that infrastructure investment and professional development investment should be planned as complementary, sequenced components of a single strategic budget line, rather than as separate and independently prioritized expenditures (Ismail, 2025).

Institutional policy support also entails attention to equity within the institution itself. Faculty members differ considerably in age, prior technological exposure, and teaching load, meaning that a uniform, one-size-fits-all policy risks disadvantaging certain groups of lecturers, particularly senior faculty who may have had less exposure to digital tools during their own professional formation. A differentiated policy approach offering tiered training pathways, flexible timelines, and mentoring partnerships between more and less digitally experienced faculty is therefore more likely to achieve equitable competence outcomes than a rigid, standardized mandate applied uniformly across all staff.

Institutional policy support also has a temporal dimension that is frequently neglected in strategic planning. ICT competence enhancement is often framed, implicitly, as a one-time transition to be completed and then maintained indefinitely, rather than as a continuously evolving requirement driven by ongoing technological change. Digital platforms, assessment systems, and communication tools are regularly updated or replaced, meaning that yesterday's adequate competence can become tomorrow's outdated skill set within a relatively short period. Institutional policy should therefore build in mechanisms for periodic reassessment and refresher training, rather than treating an initial wave of ICT competence development as a terminal achievement. Embedding a recurring digital-competence review cycle within institutional academic calendars for instance, at the start of each academic year would help ensure that competence enhancement remains an ongoing institutional function rather than a one-off project.

A further institutional consideration involves the relationship between ICT policy and quality assurance mechanisms already operating within Islamic higher education, such as accreditation standards administered through national higher education quality bodies. Where digital competence expectations are formally integrated into accreditation and internal quality assurance instruments, institutions have a stronger structural incentive to sustain investment in infrastructure and training, since digital readiness becomes measurable and consequential for institutional standing rather than an informal aspiration. Aligning internal ICT competence policy with these external accountability mechanisms can therefore function as a lever that strengthens institutional commitment beyond what internal advocacy alone might achieve, particularly in resource-constrained institutions where competing priorities are numerous.

Taken together, the evidence examined across this section indicates that institutional policy and infrastructure function as the structural precondition upon which both professional development and pedagogical-technological integration ultimately depend. Without adequate infrastructure and embedded policy commitment, even well-designed training programs and pedagogically sound TPACK integration strategies risk remaining isolated pockets of good practice rather than becoming institution-wide norms. This reinforces the article's central argument that ICT competence enhancement must be approached as a systemic strategy operating simultaneously at the individual, pedagogical, and institutional levels, rather than as a matter to be resolved through any single intervention in isolation.

4. CONCLUSION

This study examined the strategic dimensions through which ICT competence among teachers can be systematically enhanced in response to the growing demand for technology-literate educators. The findings indicate that such enhancement cannot be achieved through isolated interventions; rather, it depends on the convergence of three interrelated strategies sustainable professional development, pedagogically grounded TPACK integration, and robust institutional policy support with adequate infrastructure. Each dimension reinforces the others: training without infrastructure yields limited application, and policy without competence-building fails to reach the classroom. For Islamic higher education institutions such as ICT, this implies that becoming technology-literate is a systemic institutional achievement rather than an individual responsibility. Future research is encouraged to complement this library-based synthesis with empirical field studies validating the proposed framework in practice.

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