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UNLOCKING EFFECTIVE TEACHING: THE MEDIATING POWER OF INSTRUCTIONAL TECHNOLOGY SKILLS IN A SYSTEMATIC LITERATURE REVIEW

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Abstract:

The rapid evolution of educational technologies has brought attention to the critical role of instructional technology skills in enhancing teaching effectiveness. While the adoption of digital tools is widespread, understanding how these skills function as mediators in transforming teaching practices remains underexplored. This study aims to systematically review recent literature to examine the mediating role of instructional technology skills in effective teaching and learning environments. Employing the PRISMA framework, a systematic search was conducted across Scopus, Web of Science, and ERIC databases using defined inclusion criteria. From an initial pool of 1,019 studies, 22 empirical articles published between 2022 and 2024 were selected for thematic synthesis. The findings were organized into three major themes: (1) instructional technology as a mediator, (2) teacher competency, beliefs, and self-efficacy, and (3) organisational and contextual factors influencing technology integration. The results reveal that instructional technology skills significantly mediate the relationship between digital tool adoption and improved student learning outcomes. These skills enhance pedagogical strategies, support learner motivation, and foster collaborative, student-centered learning environments. Moreover, teacher self-efficacy and

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institutional leadership emerged as key factors in facilitating successful integration. Studies also highlighted that without adequate training, emotional readiness, and systemic support, the impact of technology remains limited. In conclusion, instructional technology skills serve as a dynamic bridge between digital innovation and effective pedagogical practice. Their mediating influence underscores the need for holistic professional development, strategic leadership, and institutional investment. This review offers valuable insights for educators, policymakers, and researchers aiming to leverage instructional technology for sustained educational improvement.

Keywords:

Instructional Technology, Teaching Effectiveness, Technology Integration, Teacher Competency

Introduction

In the rapidly evolving landscape of education, the integration of instructional technology has emerged as a pivotal factor in enhancing teaching effectiveness and student engagement. Instructional technology encompasses a wide array of tools and methodologies designed to support and improve the educational process. The effective use of these technologies can transform traditional teaching methods, making learning more interactive, engaging, and efficient. For instance, integrating technology with instruction using a learner-centered pedagogy has been shown to significantly enhance student engagement and learning outcomes . This transformation is not merely about digitizing existing content but involves a comprehensive redesign of instructional strategies to leverage the full potential of technological tools . The role of instructional technology in education is multifaceted, involving the design of high-quality lessons, fostering inquiry-based learning, and building a community of learners within a technology-rich environment (Estes, 2016).

The successful implementation of instructional technology in classrooms hinges on the digital competence of educators. Teachers must possess the necessary skills and knowledge to effectively integrate technology into their teaching practices. This includes not only technical proficiency but also the ability to design and deliver content in a way that maximizes the benefits of technology for student learning 3(Лысова et al., 2020). Teacher preparation programs play a crucial role in this regard, providing future educators with the experiences and self-efficacy needed to implement technology-integrated instruction (Estes, 2016) Moreover, ongoing professional development is essential to keep educators updated with the latest technological advancements and pedagogical strategies (Yugang & Dan, 2017). The challenges faced by educators in adopting instructional technology are significant, including the need for adequate training, infrastructure, and support (Cormican et al., 2023). Addressing these challenges is critical to unlocking the full potential of instructional technology in education.

The mediating power of instructional technology skills is evident in their ability to bridge the gap between traditional and modern teaching methodologies. By equipping teachers with the right skills, instructional technology can enhance the effectiveness of teaching and learning processes. For example, the use of augmented reality in online distance learning has been shown to improve academic achievement and skills acquisition (Eldokhny & Drwish, 2021). Similarly, blended learning approaches that combine traditional classroom instruction with digital resources have been found to enhance pedagogical flexibility and engagement strategies (Shaker et al., 2025). The transformative potential of instructional technology is not

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limited to higher education but extends to all levels of education, from primary to tertiary (Olusola, 2017). As such, it is imperative for educational institutions to create enabling environments that support the use of instructional technology, thereby enhancing the overall quality and effectiveness of education (Olusola, 2017).

Summary of Introduction

Aspect	Details
Role of Instructional Technology	Enhances teaching effectiveness and student engagement through interactive and efficient learning methods (Estes, 2016) (Summan, 2006)
Importance of Educator Competence	Essential for effective technology integration; involves technical skills and pedagogical strategies (Estes, 2016) (Лысова et al., 2020) (Yugang & Dan, 2017)
Challenges and Solutions	Includes need for training, infrastructure, and support; professional development and enabling environments are critical (Cormican et al., 2023) (Olusola, 2017).
Impact on Learning	Improves academic achievement and skills acquisition; enhances pedagogical flexibility and engagement (Eldokhny & Drwish, 2021) Shaker et al., 2025)
Scope	Applicable across all educational levels, from primary to tertiary (Olusola, 2017)

This structured approach highlights the critical elements of instructional technology in education, emphasizing the need for skilled educators and supportive environments to fully realize its benefits.

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To deepen the understanding of how instructional technology skills function as a mediating construct in teaching and learning, a conceptual map was generated using Scopus AI (Figure 1). This network visualization highlights key thematic clusters and their interconnections, revealing the structural relationships between the main concepts that have emerged in the literature over the past decade.

At the core of the network lies the theme of Instructional Technology Skills, which functions as a nexus linking both pedagogical practice and technological integration. The proximity of terms such as technology integration, TPACK, digital literacy, and teacher competence underscores the evolving expectation for educators to blend content knowledge with digital tools effectively. These skills are frequently co-mentioned with indicators of teaching effectiveness and student engagement, suggesting their pivotal role in enhancing classroom outcomes.

Surrounding this central cluster are nodes representing related domains. The Teaching Strategies cluster includes concepts such as course management, collaborative learning, and instructional design, indicating that instructional technology skills are often situated within broader pedagogical frameworks. Meanwhile, the Educational Technology cluster connects to tools and platforms such as online learning, mobile education, and virtual environments, reflecting the ecosystem in which instructional mediation occurs.

Interestingly, the conceptual map reveals that Instructional Technology Skills are rarely isolated; instead, they serve as a mediating link between external digital innovations and internal classroom practices. This supports the theoretical framing of this review, which posits that the effective use of technology in education depends not solely on access to tools, but on teachers' ability to mediate learning experiences through informed, purposeful integration.

Overall, this conceptual landscape validates the central thesis of the review that instructional technology skills serve as a critical mediator between digital innovation and pedagogical effectiveness. As educational contexts continue to evolve, particularly with the integration of artificial intelligence and adaptive platforms, the demand for these mediating competencies will likely intensify, reinforcing their importance in both theory and practice.

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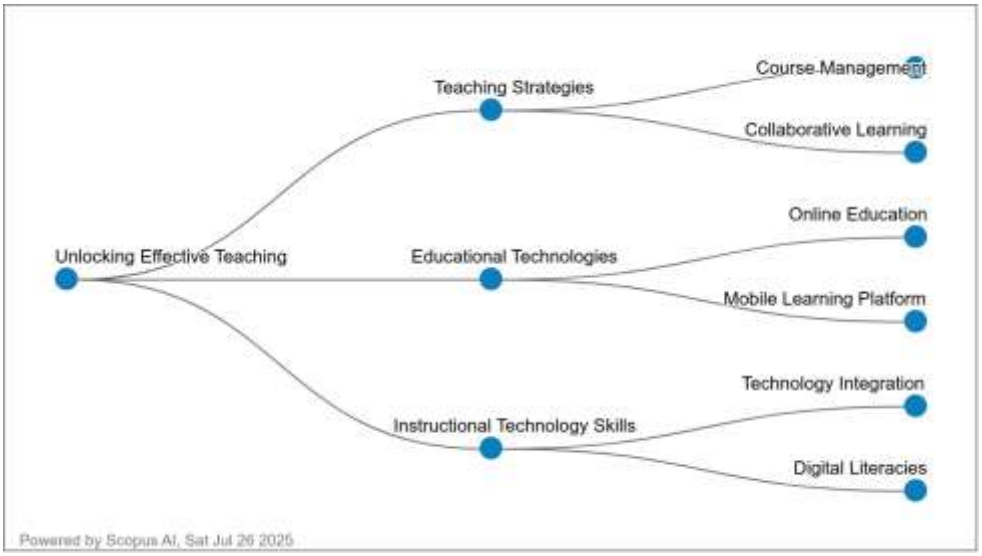

Figure 1. Conceptual Network of Key Themes Related to Instructional Technology and Effective Teaching *Generated by Scopus AI on 26 July 2025*

Material and Methods

Identification

In this study, the systematic review process began with the careful identification of relevant literature. Keywords were first selected and expanded through the use of dictionaries, thesauri, encyclopedias, and prior research. From this, a comprehensive list of terms was compiled, and search strings were constructed for the Web of Science and Scopus databases (see Table 1). This initial stage resulted in the retrieval of 757 publications related to the study topic from the two databases.

Table 1

The Search String

Scopus	TITLE-ABS-KEY (("instructional technology" OR "educational technology" OR "technology integration") AND (mediating OR mediation OR mediator*) AND (teaching OR learning)) Date of Access: August 2025
Wos	https://www.webofscience.com/wos/woscc/summary/bd42f898-8ce8-40a3-9876-3019cdc6fda3-0170ae99f5/relevance/1 Date of Access: August 2025

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Screening

During the screening phase, all retrieved records were carefully assessed to determine their relevance to the research objectives, particularly the mediating role of instructional technology skills in enhancing teaching effectiveness. Titles and abstracts were reviewed to exclude studies outside the scope of instructional technology integration, mediation in teaching practices, and teacher competency. Non-English articles, book chapters, conference proceedings, and in-press items were removed, resulting in the exclusion of 608 publications. Duplicate entries (n = 3) were also eliminated.

Following this, 147 articles were subjected to full-text assessment for eligibility. Of these, 125 were excluded due to being out of field (n = 39), having titles with limited relevance (n = 39), or presenting abstracts unrelated to the study's objectives (n = 39). Ultimately, 22 studies met the inclusion criteria and were retained for qualitative synthesis.

The inclusion criteria emphasized peer-reviewed journal articles published in English between 2022 and 2025 that provided empirical evidence on technology integration in teaching, teacher digital competence, and instructional mediation. This rigorous screening ensured that the final dataset reflected only the most relevant and up-to-date contributions to the field.

Table 2
The Selection Criterion Is Searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2022 – 2025	< 2022
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject	Social science	Besides Social science,

Eligibility

In the eligibility phase, 147 full-text articles were assessed in detail to determine their alignment with the research objectives, which focus on the mediating role of instructional technology skills in enhancing teaching effectiveness. Each study was carefully examined, including its title, abstract, and full content, against the predefined inclusion criteria.

Out of these, 125 articles were excluded for reasons such as being outside the study's scope, limited relevance in title or abstract, lack of empirical evidence, or inaccessible full texts. Ultimately, 22 articles satisfied all eligibility requirements and were retained for inclusion in the final qualitative synthesis of this systematic review.

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Data Abstraction and Analysis

An integrative qualitative synthesis was adopted to guide the data abstraction and thematic analysis of the selected studies. This method was chosen to allow the comparison and synthesis of diverse research designs, particularly studies employing quantitative methods. The primary objective of this stage was to extract meaningful patterns related to the mediating role of instructional technology skills in teaching and learning processes.

The process began with the careful review of all 22 selected articles. Each study was examined for statements, outcomes, and constructs that align with the objectives of this review. Particular attention was given to how instructional technology skills function either as a mediator, as a dimension of teacher competency, or as a component influenced by broader institutional or contextual factors. Studies were mapped and coded using open and axial coding procedures to identify emerging patterns.

The development of themes followed a structured process involving iterative reading, memo writing, and conceptual clustering. Three main themes were derived from this process: (1) Instructional Technology as a Mediator, (2) Teacher Competency, Beliefs, and Self-Efficacy, and (3) Organisational and Contextual Factors Influencing Tech Integration. Each theme was supported by a distinct group of studies that collectively contributed to understanding the mediating role of instructional technology skills in enhancing teaching effectiveness.

To ensure the credibility and validity of the thematic development, the process involved independent coding by two experts in instructional technology and educational research. Any discrepancies in coding or thematic classification were discussed collaboratively and resolved through consensus. The themes were then refined and adjusted based on feedback to ensure clarity, internal consistency, and conceptual accuracy.

A coding logbook was maintained throughout the process to document analytic decisions, reflections, and interpretations that arose during the data abstraction. This reflexive process helped the authors trace the development of key findings and ensured that the synthesis was grounded in the evidence from the included studies.

The guiding questions during the thematic synthesis were:

1. How do instructional technology skills act as a mediating variable in influencing teaching effectiveness and student learning outcomes?
2. What competencies, beliefs, or attitudes enable teachers to integrate instructional technology effectively in their practice?
3. How do organisational structures, leadership, and school-level factors facilitate or hinder the mediating impact of instructional technology skills?

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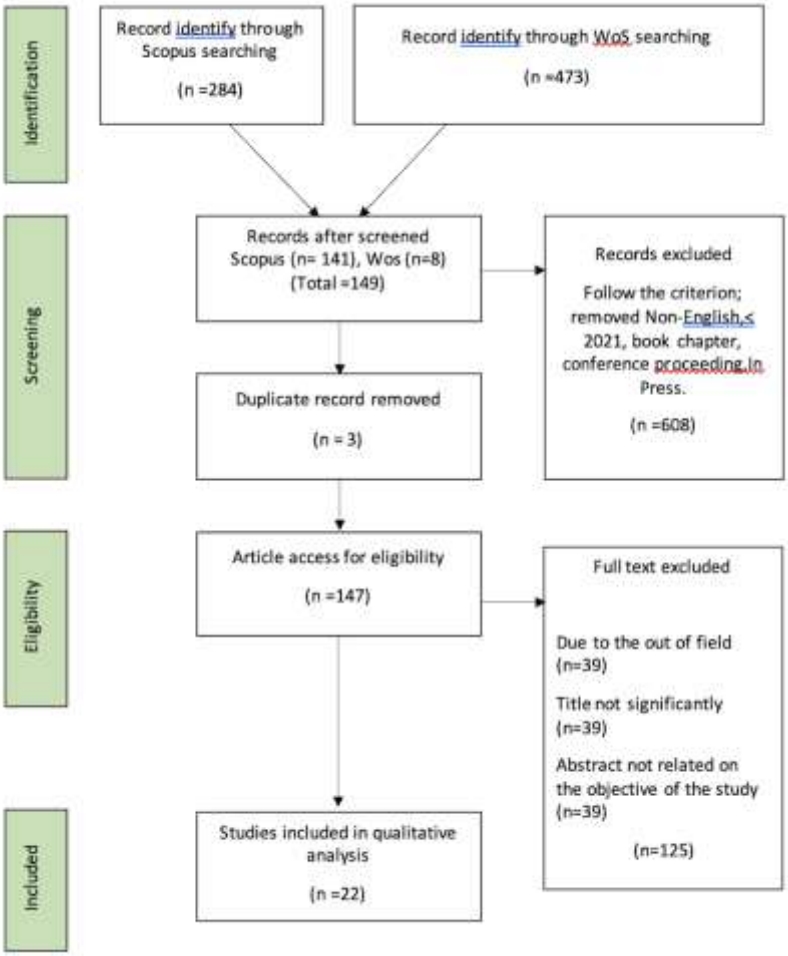

Figure 2. Flow Diagram Of The Proposed Searching Study [1]

Result and Finding

Theme 1: Instructional Technology as a Mediator in Enhancing Teaching and Learning Effectiveness

A growing body of literature highlights the mediating role of instructional technology in bridging teaching strategies and improved educational outcomes. One notable study conducted in India examined how educational technology affects teacher performance through the mediating variable of teaching innovation. The findings confirmed that innovation plays a critical role in translating technology use into measurable teaching effectiveness (Minz et al., 2025). This aligns with findings in digital learning system studies where system quality significantly influenced user satisfaction via perceived usefulness and ease of use, demonstrating that learner interaction with technology systems is not direct but mediated by user perceptions (Yahya et al., 2024).

The mediating influence of motivation within technology-enhanced learning is also well-documented. In the Indonesian context, the relationship between service quality, social media use, pedagogical competence, and student learning satisfaction was mediated by online

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learning motivation. The results suggested that instructional improvements alone are insufficient unless they stimulate learner motivation (Puja, 2024). Similarly, in a Nigerian study, learner motivation mediated the impact of educational technology on peer learning outcomes, emphasizing that the social aspects of technology adoption are essential for meaningful collaborative learning (Inegbedion, 2024).

The role of teacher self-efficacy and self-regulated learning strategies also plays a central mediating function in shaping digital competency. For instance, preservice teachers' belief in their ICT integration abilities influenced actual ICT competence not directly, but through online self-regulated learning strategies such as goal-setting and task management (Peng et al., 2023). In the domain of second language acquisition, online learning engagement was found to mediate the relationship between learners' L2 grit and English language achievement, highlighting the importance of behavioural and emotional investment in digitally mediated instruction (Luan et al., 2025).

In higher education, flipped and online teaching strategies serve as key mediators linking digital tool usage and teaching effectiveness. A study on university students demonstrated that the perception of online teaching and the inverted classroom model played a mediating role between technology use and teaching effectiveness, suggesting that student-centred learning models enhance the impact of digital tools (Morris et al., 2025). Meanwhile, in mathematics education, student interest acted as a mediator between variables like collaborative learning, motivation, and technology integration, although with varying levels of significance across contexts (Boadu & Boateng, 2024).

The integration of artificial intelligence (AI) in instructional contexts further expands this mediation model. In one study, learners' AI literacy and enjoyment significantly mediated the impact of technical and pedagogical stimuli on willingness to communicate in English as a foreign language classrooms (Luan et al., 2025). Similarly, in the field of physical education, the relationship between IT teaching and innovative instructional practices was fully mediated by the methods and content used, showing that innovation emerges only when technology is embedded meaningfully within pedagogy (Zhao et al., 2025).

Overall, the literature consistently supports the notion that instructional technology skills do not function in isolation but as mediating agents that convert technological inputs into effective instructional outcomes. These findings reinforce the conceptual positioning of instructional technology as a pivotal mediating construct in teaching and learning.

Theme 2: Teacher Competency, Beliefs, and Self-Efficacy

A recurring theme across the reviewed literature is the central role of teacher competency, self-efficacy, and beliefs in shaping effective instructional technology integration. This theme highlights how teachers' internal dispositions such as their perceived digital capabilities, emotional responses, and motivational orientations interact with external variables like institutional support and pedagogical frameworks to mediate teaching effectiveness in technology-enhanced settings.

Several studies underscore the importance of self-efficacy as a mediating construct in technology integration. For example, (Peng et al. (2023) examined in-service teachers in Henan Province, China, using structural equation modeling (PLS-SEM) and found that attitudes, self-

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efficacy, digital competence, and digital tools utilization significantly predicted ICT integration. Crucially, digital competence and attitudes mediated the relationship between demographic factors (e.g., age, gender, teaching experience) and the level of integration, indicating that competency perceptions are essential in facilitating the uptake of digital tools.

Similarly, the emotional dimension of technology use is evident in the work of (Qi (2024), who explored the mediating effect of positive emotional experiences on learners' social anxiety and suppression in a technology-enhanced language learning environment. Although focusing on students, the implications extend to educators, suggesting that the emotional climate fostered by digitally competent teachers can significantly shape technology acceptance and classroom interaction.

Expanding this perspective, (Satrio & Sahid, 2023) found that self-efficacy acts as a mediator between Technological Pedagogical Content Knowledge (TPACK) and career choice motivation among economics teacher candidates in Indonesia. Their findings revealed a significant indirect effect, indicating that higher TPACK competence leads to stronger career motivation via improved self-efficacy. This supports the idea that TPACK alone is insufficient unless accompanied by belief in one's ability to implement it effectively.

From the standpoint of teacher educators, (Nelson et al. (2019) identified mediating factors such as institutional support and personal technology knowledge as predictors of TPACK and alignment with ISTE standards. Their large-scale U.S. study showed that these mediators significantly influenced educators' ability to model and apply instructional technology frameworks in pre-service teacher training programs. Importantly, TPACK directly predicted the alignment with technology standards, reinforcing the dual importance of competence and support.

Lastly, Molefi et al. (2024) focused on the integration of artificial intelligence (AI) technologies in the classroom, revealing that school support and resources mediate the relationship between teachers' perceived ease of use and their intention to adopt AI tools. Their findings highlight the role of perceived usefulness and ease of use, further emphasizing that even when advanced technologies are introduced, it is the teacher's belief system and the institutional ecosystem that ultimately determine implementation success.

Collectively, these studies demonstrate that while digital skills are fundamental, they must be supported by strong teacher self-beliefs and values to translate into effective classroom integration. Institutional policies and teacher training programs should therefore prioritize not only technical competence but also the psychological and motivational scaffolding that enables educators to use instructional technology meaningfully and sustainably.

Theme 3: Organisational and Contextual Factors Influencing Technology Integration

The integration of technology in education is not solely dependent on individual teacher competencies or beliefs; it is equally shaped by the broader organisational and contextual factors surrounding the school environment. This theme explores how institutional structures, leadership practices, and systemic frameworks influence the successful implementation of digital technology in primary and secondary education settings.

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One pivotal study by (Perrotta, 2013) highlighted the mediating role of institutional characteristics in shaping teachers' perceived benefits of digital technology. Drawing on survey data from 683 teachers across 24 UK secondary schools, the study found that social and cultural contexts had greater influence than individual traits in determining the perceived value of technology integration. This finding challenges the notion that teacher training alone is sufficient and underscores the critical role of school-level support systems.

The influence of school leadership, particularly during disruptive periods such as the COVID-19 pandemic, was examined by Morris et al. (2025). Their Bayesian mediation model analysis revealed that pedagogical support and professional freedom provided by school leaders had a significant positive impact on teachers' intrinsic motivation. Notably, pedagogical support enhanced teachers' feelings of competence and relatedness core psychological needs that contribute to sustained motivation in remote instruction settings. However, access to digital tools alone did not guarantee higher motivation, indicating that relational and strategic leadership practices are more influential than infrastructure alone.

Expanding on leadership, Nurhadi et al. (2024) explored how digital leadership among principals contributes to sustainable technology integration through Professional Learning Communities (PLCs). Their structural equation modeling (PLS-SEM) analysis with 257 high school teachers showed that while digital leadership did not directly enhance teachers' innovation skills, it significantly influenced the growth of PLCs, which in turn improved innovation and technological adoption. This indicates an indirect yet powerful effect of leadership in fostering collaborative cultures that support technology use.

Similarly, Schmitz et al. (2023) analysed transformational leadership in Swiss schools and found it significantly correlated with improved teacher digital competencies, positive attitudes, and integration practices. Interestingly, while digital school infrastructure was improved through leadership, it was the teachers' technical and pedagogical skills that most strongly predicted integration outcomes. This supports the claim that leadership strategies that focus on human capacity development yield more substantial benefits than those focusing solely on infrastructure expansion.

On a conceptual level, Blayone (2019) utilised activity theory to theorise how socio-contextual factors mediate technology use. By positioning humans as active agents within socially mediated systems, Blayone argued that effective digital learning environments are co-constructed through interactions between institutional conditions, technologies, and personal agency. This theoretical lens helps to synthesise findings from the empirical studies, offering a multidimensional framework that avoids technological determinism.

Together, these studies highlight that effective technology integration in education cannot occur in isolation from the institutional ecosystem. Key enablers include supportive leadership, the development of collaborative learning cultures, psychological needs fulfilment, and acknowledgment of systemic constraints. Therefore, policies aimed at enhancing digital transformation in education must take a holistic approach investing not only in infrastructure but also in leadership development, community building, and the cultural adaptation of teaching environments.

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Discussion and Conclusion

The accumulated evidence underscores the pivotal role of instructional technology as a mediating construct in enhancing teaching and learning effectiveness across diverse educational contexts. Rather than serving as a standalone tool, instructional technology operates through various psychological, pedagogical, and motivational mediators that translate digital inputs into improved outcomes. Studies across countries such as India, Indonesia, Nigeria, and Malaysia consistently show that variables like teaching innovation, learner motivation, online engagement, and self-regulated learning strategies are essential conduits that determine whether technology integration results in meaningful pedagogical impact. Furthermore, models such as flipped classrooms and AI-driven instruction illustrate how learner-centred approaches enhance the mediation effect of technology, especially when supported by factors such as perceived usefulness, instructional design, and emotional engagement. These insights suggest that for technology to be effective in educational settings, it must be purposefully embedded within instructional practices and supported by both teacher competencies and learner agency. Ultimately, this reinforces the need for strategic investment in not just infrastructure, but also in developing the mediational skills that bridge technology use and learning success positioning instructional technology not merely as a tool, but as a dynamic enabler of pedagogical transformation.

The reviewed literature consistently affirms that teacher competency, beliefs, and self-efficacy are critical enablers and mediators in the successful integration of instructional technology. While access to digital tools and technical infrastructure is important, it is ultimately the internal dispositions of educators, such as confidence in their technological skills, motivation to innovate, and emotional resilience that determine the depth and sustainability of technology use in classrooms. Studies employing structural equation modeling across diverse contexts (Peng et al., 2023; Satrio & Sahid, 2023)reveal that self-efficacy acts as a powerful mediating factor between knowledge (such as TPACK) and action (such as ICT adoption), confirming that belief in one's capabilities is a necessary bridge between training and application. Moreover, emotional factors, as highlighted in Qi's (2024) research, suggest that teachers' ability to foster emotionally supportive environments is crucial in facilitating student engagement with technology. At the institutional level, support structures, digital leadership, and alignment with recognized technology standards (Molefi et al., 2024; Nelson et al., 2019) further mediate the relationship between teacher beliefs and actual integration. Together, these findings stress that technological fluency alone does not guarantee successful implementation; it must be accompanied by a conducive environment and nurtured self-belief. Thus, professional development programs should go beyond skill acquisition to foster reflective confidence, emotional readiness, and a positive digital mindset, ensuring that technology becomes a pedagogical asset rather than a source of anxiety or resistance.

The evidence from Theme 3 firmly establishes that the integration of instructional technology is deeply embedded within organisational ecosystems and broader contextual influences, transcending the boundaries of individual teacher capacity. Rather than positioning technological adoption as a linear outcome of teacher readiness or digital proficiency, the reviewed studies demonstrate how leadership styles, school culture, and institutional frameworks mediate and shape the effectiveness of technology-enhanced teaching. For instance, institutional characteristics and social contexts were found to outweigh personal traits in influencing the perceived value of digital tools (Perrotta, 2013), challenging the assumption that teacher training alone is sufficient. Furthermore, strategic leadership emerged as a critical

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force, with pedagogical support, autonomy, and emotional alignment during disruptive transitions such as the shift to online teaching shown to significantly influence teacher motivation (Morris et al., 2025). Transformational and digital leadership, while not always directly enhancing technological skills, facilitated the development of Nurhadi et al., (2024) and empowered teachers to build digital competencies through shared practices and collaboration (Schmitz et al., 2023). On a conceptual level, frameworks such as activity theory Blayone, (2019), offer a robust lens to understand these mediations, reinforcing the idea that effective technology integration arises from the dynamic interplay between people, tools, and sociocultural conditions. Thus, organisational factors are not peripheral, but central in enabling or constraining digital innovation in schools. Educational reforms and policy initiatives must therefore adopt systemic strategies that prioritise leadership development, community engagement, and cultural alignment alongside infrastructure upgrades to foster truly transformative digital learning environments.

In conclusion, the integration of instructional technology into educational practice is a multifaceted process that operates through interconnected mediating mechanisms spanning individual teacher competencies, psychological dispositions, pedagogical strategies, and broader institutional and contextual factors. This systematic review affirms that technology alone does not drive educational transformation; rather, it is the alignment of digital tools with reflective teacher beliefs, learner engagement, and organisational ecosystems that unlocks its full potential. Effective implementation hinges on a confluence of self-efficacy, emotional readiness, collaborative cultures, and supportive leadership, which together form the mediational pathways linking technology adoption to meaningful learning outcomes. Therefore, future policies, training programs, and research must embrace a holistic and systemic perspective one that elevates not only technological infrastructure but also the human and institutional capacities that mediate its success. Instructional technology should not be seen merely as a supplement to traditional methods but as a transformative agent capable of reconfiguring teaching and learning when strategically positioned within a supportive pedagogical and organisational environment.

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