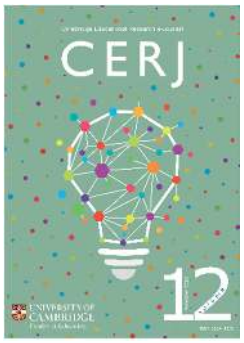

Cambridge Educational Research e-Journal

ISSN: 2634-9876 Journal homepage: http://cerj.educ.cam.ac.uk/

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To cite this entry:

Fitri, S. (2025). The (technology) implementation gap among Indonesian teachers: Understanding the disconnect between personal and professional technology use. *Cambridge Educational Research e-Journal, 12,* 211-225. https://doi.org/10.17863/CAM.123119

Link to the article online: https://www.repository.cam.ac.uk/handle/1810/392417

Published online: November 2025

The (Technology) Implementation Gap Among Indonesian Teachers: Understanding the Disconnect Between Personal and Professional Technology Use

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ABSTRACT

The transformation of education in the 21st century requires teachers to effectively integrate technology into their instructional practices. However, in many developing countries, like Indonesia, there is a significant disconnect between teachers' personal technology proficiency and their classroom implementation. This preliminary research investigates the "technology implementation gap," a concept referring to the measurable difference between teachers' personal technology use and their professional tech integration. Through a mixed-method survey of 69 Indonesian secondary English teachers across Indonesia's diverse geographical and institutional contexts, this research reveals a substantial implementation gap: while 78.3% of participating teachers use technology daily in their personal lives, only 26.1% integrate it consistently into their practice. Descriptive analysis reveals that this gap consistently persists across all participating teachers' demographic characteristics, suggesting that systemic rather than individual factors are driving this phenomenon. Complementary qualitative analysis identifies four primary factors that teachers perceived as contributing factors to the gap: challenges in infrastructure and accessibility; barriers related to institutional policy; lack of pedagogical efficacy, and disparity in contextual resources. Additionally, professional development (PD) emerges as a critical yet insufficient intervention point, where most teachers have participated in technology-related PD but still struggle to translate their learning into practice. The concept of the implementation gap offers a lens for understanding technology integration challenges by shifting the focus from mere accessibility or individual skills focus to the complex interplay of personal competence, institutional support, and contextual challenges.

KEYWORDS

Implementation gap, technology integration, teacher education, Indonesian education, digital divide

Introduction

The integration of digital technologies into education has become an essential priority for teaching and learning worldwide. Rapid developments in information and communication technology (ICT) and the acceleration of digital adoption during the COVID-19 pandemic have reinforced the need for teachers to not only access but also meaningfully integrate technology into classroom practice (Lee & Han, 2021; Okoye et al., 2025; Zou et al., 2025). While infrastructure provision has expanded globally, research consistently shows that access to devices and connectivity alone does not ensure pedagogical transformation. Instead, effective technology integration requires teachers to translate personal digital competence into professional practices that are consistent, pedagogically purposeful, and contextually responsive (Koehler & Mishra, 2005; Tondeur et al., 2017).

Indonesia, the world's largest archipelagic nation with more than 50 million school-age students, represents a particularly important site for examining technology integration challenges. The country has

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invested heavily in ICT for education through initiatives such as the *Merdeka Belajar* (Emancipated Learning) reform, which emphasizes student-centered learning, flexibility, and technology-enabled teaching (OECD, 2024). Yet, despite these policy ambitions, Indonesian classrooms remain characterized by uneven technology adoption. Studies highlight wide variations across regions, school types, and teacher backgrounds, with integration often falling short of policy expectations (Claudia Wang et al., 2023; GEM Report UNESCO, 2023). The geographic, infrastructural, and institutional diversity of Indonesia provides an ideal context for examining the misalignments between technology competence and practice.

This study introduces the concept of a 'technology implementation gap' to capture and analyze this phenomenon. The term refers to the measurable disconnect between teachers' personal digital use and their professional classroom practices. Whereas personal technology use reflects individual competence, familiarity, and motivation, professional integration is shaped by additional systemic factors such as institutional policies, infrastructure reliability, pedagogical confidence, and resource availability. By conceptualizing the problem in terms of an implementation gap, this study moves beyond deficit perspectives that shoulder the responsibility for integration primarily within individual teachers. Instead, it highlights the relational dynamics between competence and context, thereby offering a more comprehensive understanding of integration challenges.

While the literature on technology integration is extensive, several gaps remain. First, research has tended to frame barriers as static obstacles to be overcome, often distinguishing between "first-order" (external) and "second-order" (internal) barriers (Ertmer, 1999; Hew & Brush, 2007). Although influential, this binary distinction overlooks how barriers interact across multiple system levels and how they can persist despite increasing teacher competence. Second, relatively few studies explicitly measure the difference between personal and professional technology use. Some literature suggests that teachers' value beliefs about technology are key predictors of classroom integration, with teachers more likely to use technology when they perceive it as valuable for addressing professional and student needs (Ottenbreit-Leftwich et al., 2010). However, recent evidence indicates persistent gaps between technology availability and actual pedagogical use, with teachers continuing to demonstrate limited integration despite institutional technology initiatives (Mercader & Gairín, 2020). Third, while research on technology integration in Indonesian education has grown, studies examining the complex interplay between teachers' personal technology proficiency and their classroom implementation practices remain limited, particularly in understanding how cultural and contextual factors unique to Indonesia influence this relationship.

This study addresses these gaps by examining the implementation gap among Indonesian secondary school English teachers. English teaching represents a particularly important domain for investigation, as it is both a compulsory subject in Indonesian schools and one often associated with technology-mediated learning resources such as online platforms, multimedia materials, and digital communication tools. Yet despite the availability of such resources, integration remains inconsistent, making English teaching a valuable case for understanding broader patterns of technology use in schools.

The research investigates the following questions:

1. To what extent does a technology implementation gap exist among Indonesian secondary school English teachers, and how does it manifest across demographic groups?
2. What contextual and institutional factors contribute to the persistence of this gap?
3. How do professional development (PD) experiences relate to teachers' ability to translate personal digital competence into classroom integration?

By addressing these questions, the study makes both theoretical and empirical contributions. Theoretically, it advances the concept of the implementation gap as a lens for analyzing technology integration challenges that move beyond simple barrier models. Empirically, it provides evidence from Indonesia, a context where technology reform is a national priority but where integration remains limited, thereby offering insights that might be relevant to other developing countries facing similar systemic constraints.

Literature Review

Technology Integration in Indonesia's Context

Technology integration in education extends beyond the use of digital tools; it involves embedding technology into pedagogy in ways that enrich learning, foster higher-order thinking, and support equitable participation (Demissie et al., 2022; Koehler & Mishra, 2005). Simply providing access to devices or online platforms does not guarantee integration. Instead, successful integration requires alignment with curriculum objectives, responsiveness to learner needs, and adaptation to local/ classroom realities. Scholars therefore distinguish between *technology adoption*: the act of using digital tools and *technology integration*: their pedagogically meaningful application (Tondeur et al., 2017). This distinction is particularly salient in developing contexts like Indonesia, where policy mandates often require adoption, but systemic barriers limit the deeper pedagogical transformation implied by integration.

Indonesia offers an illustrative case. Government initiatives over the past decade, culminating in the *Merdeka Belajar* (Emancipated Learning) reform, have emphasized technology as a central pillar of educational modernization (OECD, 2024). *Merdeka Belajar* promotes curriculum simplification, student-centered learning, and flexible teaching with technology positioned as a tool to enhance engagement and expand learning resources. Substantial investments have been directed toward digital infrastructure, teacher training, and platform development (Claudia Wang et al., 2023). However, evidence suggests a persistent gap between policy aspirations and classroom realities.

The digital divide remains one of the most prominent challenges. Rural and remote schools often lack stable internet connectivity, sufficient bandwidth, or reliable power supply (Lestari et al., 2024). Even where infrastructure is present, disparities in access to devices (whether school-provided or personally owned) affect both teachers and students. These structural challenges create risk-averse teaching practices, where teachers avoid planning technology-integrated lessons due to fear of disruption or simply not trying ones at all (GEM Report UNESCO, 2023).

Beyond infrastructure, teacher preparedness is a significant barrier. Teacher education in Indonesia has traditionally emphasized subject mastery and conventional pedagogical approaches, with limited focus on digital pedagogy (Silvhiany, 2022). Many in-service teachers, particularly those trained before the widespread adoption of ICT, lack confidence in using technology for teaching purposes, even when they are adept at personal digital use. This generational and experiential divide echoes findings from other developing countries, where professional training lags behind rapid digitalization (Mailizar & Fan, 2019).

Finally, policy to practice disconnects complicate implementation. Research highlights that while schools report improved access to ICT, actual pedagogical integration remains limited (Ali & Baloch, 2025; Kusanagi, 2022). This suggests that infrastructure and mandates alone cannot drive meaningful adoption. Instead, local conditions that include school leadership, institutional culture, and community attitudes, shape how policies are interpreted and enacted. Indonesia's diversity of school types (public, private, religious, community-based) adds complexity, as policies often encounter differing institutional policies that affect technology uptake.

Understanding Implementation Gaps

The notion of an implementation gap has gained traction in broader educational reform literature as a way of conceptualizing the divergence between policy intention and practice (Century & Cassata, 2016). Within the domain of educational technology, this concept can be extended to describe the disconnect between teachers' personal competence with digital tools and their professional integration in classrooms.

Traditional research on technology integration adopts a barrier-focused perspective. Ertmer's (1999) influential framework distinguishes between *first-order barriers* (external constraints such as infrastructure, time, and access) and *second-order barriers* (internal factors such as beliefs, attitudes, and confidence). While useful, this binary framing has been critiqued for oversimplifying the complex interplay of factors influencing teacher practices (Tsai & Chai, 2012). More recent literature highlights the dynamic interactions between individual, institutional, and systemic influences (Abedi, 2024).

Empirical evidence shows that personal competence does not automatically translate into classroom practice. For instance, Mercader and Gairín (2020) found that Spanish secondary teachers were frequent

personal users of ICT but faced difficulties integrating technology pedagogically, largely due to institutional constraints. Similar findings in Southeast Asia indicate that personal use is a necessary but insufficient condition for professional integration (GEM Report UNESCO, 2023). By explicitly conceptualizing this disconnect as an implementation gap, researchers can move beyond cataloguing barriers toward examining the relational conditions that shape technology use in different contexts.

Theoretical Frameworks for Technology Integration

Two theoretical lenses inform this study: the Technological Pedagogical Content Knowledge (TPACK) framework and ecological systems perspectives.

The TPACK framework (Mishra & Koehler, 2006) identifies three core knowledge domains: technological, pedagogical, and content knowledge, as well as their intersections (TCK, TPK, and PCK). Effective integration requires teachers not only to understand each domain but also to synthesize them in context-specific ways. However, empirical studies suggest that knowledge alone is insufficient. Teachers with strong TPACK may still fail to integrate technology if institutional conditions do not support experimentation or if infrastructure is unreliable (Rosenberg & Koehler, 2015). Calls have thus emerged for extending TPACK to explicitly incorporate contextual variables, emphasizing that integration is situated rather than universal (Cherner & Smith, 2017; Ling Koh et al., 2014).

Building on Bronfenbrenner's ecological model (Bronfenbrenner, 1979), ecological perspectives on educational change illuminate the systemic conditions shaping teacher behavior. From this view, classroom practices are nested within multiple interacting systems: classroom environments, school leadership and culture, infrastructure, and national policies. Teachers' decisions about technology use are therefore mediated by organizational norms, accountability mechanisms, and community expectations (Ehrenfeld, 2022; Gu et al., 2019). Importantly, ecological models highlight that personal-professional gaps may reflect differences across system layers rather than deficiencies in teachers themselves.

Together, TPACK and ecological perspectives underscore that technology integration involves more than technical skill; it is contingent on the alignment of knowledge, institutional supports, and systemic conditions. This framing is particularly relevant for Indonesia, where national reforms interact with highly diverse local contexts.

Factors Influencing Technology Integration

Existing research identifies multiple, interacting influences on teacher integration of technology, operating at individual, institutional, and systemic levels. Infrastructure and resources are foundational but insufficient. While access to devices and connectivity is necessary, studies consistently show that infrastructure alone does not drive pedagogical change (Ottenbreit-Leftwich et al., 2010). Reliability, technical support, and equitable distribution are equally critical. On individual level, teacher beliefs and self-efficacy strongly shape decisions about technology use. Teachers who perceive technology as beneficial for student learning and feel confident in its use are more likely to integrate it (Alieto et al., 2024). However, self-efficacy is context-specific: confidence in personal use does not guarantee confidence in classroom use.

Further, institutional support and culture influence the sustainability of tech integration. Leadership encouragement, collegial collaboration/ support, and clear policies can foster innovation, whereas restrictive rules or lack of support can stifle it (Gu et al., 2019). Professional learning communities (PLCs) play a mediating role by enabling teachers to share practices, discuss challenges, and develop collective capacity (Liu et al., 2024).

These factors are not isolated but interdependent. For example, inadequate infrastructure can undermine teacher confidence, while strong leadership may mitigate resource limitations by fostering innovative workarounds. Understanding integration therefore requires examining the interaction of factors at individual, institutional, and systemic levels.

Professional Development as a Medium for Change

Professional development (PD) represents a critical mechanism for supporting technology integration. However, the literature emphasizes that not all PD is equally effective. Traditional one-off workshops focusing

on technical skills have limited impact on sustained classroom practice (Lawless & Pellegrino, 2007). Instead, effective PD is characterized by sustained duration, opportunities for practice, contextual relevance, and embedded follow-up support (Borko, 2004; Desimone, 2009; Hennessy et al., 2022).

In Indonesia, PD faces distinct challenges. Geographic dispersion makes sustained, in-person training difficult, while resources limitation constrains program quality. Moreover, research suggests a misalignment between PD content and teachers' contextual realities. Mailizar and Fan (2019) found that many Indonesian teachers struggled to apply training due to infrastructure limitations and school restrictions. Silvhiany (2022) similarly reported that PD often neglects the practical challenges teachers encounter in classrooms.

Teachers frequently express a need for more contextualized and practice-oriented PD. Observing concrete examples of technology integration in comparable contexts, engaging in collaborative learning with peers, and receiving ongoing mentoring are highlighted as strategies for bridging the gap between training and implementation. Without such support, PD risks raising teacher expectations while leaving them unequipped to overcome systemic barriers, inadvertently widening the implementation gap.

Methodology

Research Design

This study employed a convergent mixed-methods design to examine the technology implementation gap among Indonesian secondary school English teachers. The approach combined quantitative survey data to measure the extent and distribution of the implementation gap with qualitative responses to understand underlying factors and contextual influences (Creswell & Creswell, 2018). The convergent design allows for simultaneous collection and analysis of both quantitative and qualitative data that will be used to provide complementary perspectives on the research phenomenon.

Participants

The study involved 69 in-service English teachers recruited through purposive and snowball sampling across multiple Indonesian regions. This sampling approach was selected to ensure representation across diverse geographical and institutional contexts while acknowledging the explorative nature of the research and challenges to resources that precluded probability sampling. The invitation to participate was sent through different messaging platforms and was open for one month in March 2024.

Participants represented diverse educational contexts: 40.6% (n=28) taught in junior high schools and 58.0% (n=40) in senior high schools, with one missing response. The sample was predominantly female (76.8%, n=53), reflecting the gender distribution typical of English teachers in Indonesian secondary schools. Age distribution showed most participants aged 40-49 years (40.6%, n=28) and ≥50 years (37.7%, n=26), with smaller proportions in younger age categories (30-39 years: 13.0%, n=9; <30 years: 8.7%, n=6).

Employment status varied significantly, reflecting the complex employment structures in Indonesian education: 50.7% (n=35) were civil servants with permanent positions, 33.3% (n=23) honorary teachers without permanent status, 11.6% (n=8) contract teachers, and 4.3% (n=3) part-time teachers. This distribution provides insight into the diverse professional contexts that may influence technology integration opportunities and constraints.

Geographically, participants were distributed across rural (43.5%, n=30), urban (40.6%, n=28), and suburban (15.9%, n=11) settings, providing representation across the urban-rural continuum that characterizes Indonesian educational contexts. Geographical diversity enables examination of how implementation gaps manifest across different infrastructure and resource environments.

Teaching experience was distributed as follows: 34.8% (n=24) had 6-10 years of experience, 30.4% (n=21) had 11-15 years, 23.2% (n=16) had 16 or more years, and 10.1% (n=7) had 0-5 years of experience. This distribution captures teachers across different career stages, allowing examination of how experience relates to implementation gap patterns.

Instrument

The survey instrument was adapted from established frameworks, notably the OECD *Teaching and*

Learning International Survey (TALIS) (OECD, 2019), alongside validated technology integration scales. It was structured into four sections:

1. Demographic information (e.g., age, gender, teaching experience, employment status, and school location).
2. Technology access and usage patterns, distinguishing between personal and professional contexts.
3. Professional development (PD) experiences related to technology integration.
4. Perceived barriers and needs, captured through both fixed-response and open-ended items.

Technology use was measured with frequency scales ranging from *"daily or almost daily"* to *"never"* for both personal and classroom settings. The implementation gap was operationalized as the difference in reported daily use between personal and professional contexts.

Validity and Reliability

The instrument was subsequently pilot tested with five Indonesian secondary English teachers who were not included in the main study. Pilot participants completed the survey and provided feedback through follow-up interviews about item clarity, response option adequacy, and cultural sensitivity. Minor adjustments were made to question wording based on this feedback, particularly regarding technology terminology that would be familiar to Indonesian teachers.

Reliability could not be robustly assessed due to the modest sample size (n = 69) and reliance on single-item measures for several constructs. This represents a methodological limitation, as multi-item scales would allow stronger reliability estimation. Nonetheless, response consistency across related items and alignment with established frameworks suggest acceptable measurement quality for exploratory purposes. For qualitative analysis, inter-rater reliability was established through independent coding of 20% of open-ended responses by the researcher and a fellow doctoral student, achieving 92% agreement after discussion and refinement of coding criteria.

Missing data analysis revealed minimal data loss (1.4 - 4.3% across variables). Of the 70 teachers who initially completed the survey, one case was excluded due to incomplete demographic information, resulting in a final analytic sample of 69. No systematic patterns were detected that would bias the results.

Data Analysis

Quantitative data were analyzed using SPSS 28.0, with emphasis on descriptive statistics appropriate for the study's exploratory objectives and small sample size. The analysis focused on frequency distributions, percentages, and confidence intervals to identify implementation gap patterns across demographic categories. Confidence intervals were calculated using the modified Wald method (Agresti & Coull, 1998), which provides more accurate intervals for proportions than the normal approximation method, particularly for moderate sample sizes. All confidence intervals represent 95% confidence levels.

Inferential tests were deliberately avoided as subgroup sizes fell below recommended thresholds (American Psychological Association, 2020). This approach prioritizes methodological caution and provides a foundation for future confirmatory studies with larger samples.

Qualitative data from open-ended responses were analyzed through thematic analysis following Braun & Clarke's (2006) six-step framework. Initial codes were inductively developed to capture recurring concepts across teacher responses. These were then refined into broader themes through iterative comparison. While the analysis was primarily inductive, sensitivity to theoretical insights from literature (e.g., first- and second-order barriers, TPACK constructs) guided interpretation.

Ethical Considerations

The study received institutional approval and adhered to ethical guidelines for educational research involving human participants (BERA, 2024). Participants were provided simultaneously with the survey and informed consent forms outlining research aims, voluntary participation, confidentiality protections, and the right to withdraw at any time without penalty. Responses were anonymized, and data were stored securely in password-protected files.

Results

The Technology Implementation Gap

Analysis revealed a substantial implementation gap between teachers' personal and professional use of technology. While 78.3% (n = 54, 95% CI [67.1%, 86.5%]) reported using technology daily or almost daily in their personal lives, only 26.1% (n = 18, 95% CI [17.1%, 37.6%]) reported the same frequency in classroom teaching. This represents a gap of 52.2 percentage points.

This discrepancy indicates that although teachers are generally competent digital users in personal contexts, professional application remains limited. This finding echoes prior research showing that access and personal competence do not automatically translate into pedagogical integration (Mercader & Gairín, 2020).

Classroom technology use was distributed across multiple frequency categories: 26.1% daily users, 39.1% weekly users, 18.8% monthly users, 11.6% less than monthly users, and 4.3% never users. Thus, while technology is not absent from classrooms, consistent integration remains limited for the majority.

Table 1

Technology Use Patterns Comparison

Usage Pattern	Personal Use	Professional Use	Gap
Daily or almost daily	78.3% (n=54)	26.1% (n=18)	+52.2%
Weekly	1.4% (n=1)	39.1% (n=27)	-37.7%
Monthly	2.9% (n=2)	18.8% (n=13)	-15.9%
Less than monthly	17.4% (n=12)	11.6% (n=8)	+5.8%
Never	0% (n=0)	4.3% (n=3)	-4.3%

Implementation Gap Across Demographics

Descriptive analysis was conducted to examine daily classroom technology use across demographic categories. Given the modest sample size, results should be interpreted cautiously as exploratory rather than confirmatory. The implementation gap appeared consistently across all categories, suggesting systemic rather than purely individual factors drive the phenomenon.

Table 2

Daily Professional Technology Use by Demographics

Demographic Category	Daily Professional Use	Total (n)	Implementation Gap*
Location			
Urban	39.3% (11/28)	28	39.0 points
Rural	16.7% (5/30)	30	61.6 points
Suburban	18.2% (2/11)	11	60.1 points
Employment Status			
Civil servant	20.0% (7/35)	35	58.3 points
Contract	37.5% (3/8)	8	40.8 points
Honorary	30.4% (7/23)	23	47.9 points
Part-time	33.3% (1/3)	3	44.9 points
Age Group			
< 30 years	16.7% (1/6)	6	61.6 points
30–39 years	11.1% (1/9)	9	67.2 points
40–49 years	25.0% (7/28)	28	53.3 points
≥ 50 years	34.6% (9/26)	26	43.7 points
Teaching Experience			
0–5 years	14.3% (1/7)	7	64.0 points
6–10 years	20.8% (5/24)	24	57.5 points
11–15 years	28.6% (6/21)	21	49.7 points
≥ 16 years	37.5% (6/16)	16	40.8 points

**Implementation gap calculated as difference between personal daily use rate (78.3%) and demographic group's professional daily use rate.*

Patterns show higher daily professional use among urban teachers (39.3%) compared to rural (16.7%) and suburban (18.2%), reflecting the influence of infrastructure and resource availability. However, all groups showed large gaps, including urban teachers with 39 percentage points, suggesting that infrastructure access is necessary but not sufficient.

Notably, older and more experienced teachers reported higher professional technology use than younger colleagues, contrary to common assumptions. Teachers ≥50 years and those with ≥16 years of experience showed smaller gaps (43.7 and 40.8 points, respectively). This may reflect accumulated professional confidence and familiarity, and greater autonomy in lesson planning rather than inherent technological aptitude.

Technology Access and Comfort Levels

Access to technology was widespread: 95.7% (n=66) reported having access to devices for teaching. However, access did not translate into regular classroom use, reinforcing that availability alone cannot explain the gap.

Teachers described varied pathways to developing technology comfort. About 30.4% became comfortable during high school or earlier, 8.7% during university, 7.2% during their teaching careers, while 20.3% reported they were still not reasonably comfortable. Another 33.3% attributed their learning to self-directed exploration or informal peer support.

The persistence of the implementation gap even among teachers comfortable with technology supports the interpretation that contextual and institutional factors constrain tech use, not just individual readiness.

Professional Development Participation

Among 68 respondents to PD questions, 77.9% (n=53, 95% CI [66.6%, 86.3%]) reported participating in technology-related PD in the past year. Despite this high rate, only 26.1% reported daily classroom use, representing a 51.8 percentage-point gap between training and implementation.

Participants generally rated PD positively, with most reporting that it was relevant (72.1% "very true"), improved their teaching (75.0%), and met expectations (70.6%). Yet this satisfaction did not sufficiently translate into sustained classroom integration, suggesting that PD may not be addressing contextual barriers.

Factors Contributing to the Implementation Gap

Thematic analysis of open-ended responses identified four interconnected themes explaining why teachers' personal competence did not translate into classroom use:

Theme 1: Challenges related to infrastructure and accessibility

Teachers described unreliable internet, insufficient devices, and unstable electricity. These limitations often led to risk-averse teaching, with teachers avoiding technology to prevent classroom disruption. Connectivity issues represented a primary concern, with teachers describing unreliable internet access that made technology integration unpredictable. One teacher explained: ″Internet connection is unstable, even for attending online training".

This instability creates risk-averse approaches where teachers avoid technology-dependent activities due to fear of classroom disruption. Device availability emerged as another critical constraint, with teachers describing insufficient numbers of computers, tablets, or projectors to support regular classroom technology integration. One teacher noted: "Technology facilities at my school are not easily accessible because there are not enough for teachers' needs".

Power supply issues, particularly in rural areas, created additional constraints that made consistent technology use unreliable. Teachers described situations where equipment was available, but power outages or electrical problems prevented sustained use. These infrastructure challenges create environments where technological integration becomes unpredictable and risky for lesson planning, hence constraining teachers'

efforts in trying to adopt or integrate meaningful technology in their classes.

Theme 2: School policy and lack of support as challenges

Some schools restricted device use or blocked platforms, while others lacked administrative encouragement. One teacher described: *"*Technology-based learning in our institution is extremely limited because students are not allowed to bring electronic devices." This example illustrates how school policies can directly contradict technology integration goals, creating impossible situations for teachers who may possess both competence and motivation.

Administrative support levels varied significantly among schools, with teachers in less supportive environments struggling to access necessary resources or approval for technology integration activities. Another teacher explained: "School management has not fully supported the use of technology in learning". This lack of support manifested in limited resource allocation, restrictive policies, and the absence of encouragement for innovation. Some teachers reported that despite personal readiness to integrate technology, school policies or cultural expectations created barriers to implementation. These barriers included restrictions on internet access, prohibitions on certain applications or platforms, and scheduling constraints that limited technology use opportunities. The institutional theme demonstrates how organizational factors can override individual competence and motivation.

Theme 3: Gaps in teachers' pedagogical confidence and competence

Many teachers expressed uncertainty about how to use technology for effective teaching, despite confidence in personal use. As one explained: *"*I can use smartphones for WhatsApp, Facebook, and YouTube. But if I have to use them for teaching, I am confused about where to start." This quote illustrates the gap between consumer technology competence and educational technology application skills.

Another teacher noted: "[I] haven't fully mastered how to use technology for effective teaching". Teachers frequently describe feelings of inadequacy when attempting to use technology for teaching purposes, even when comfortable using the same technologies personally. Professional anxiety about technology use in classroom contexts emerged as a significant barrier, suggesting that pedagogical technology integration requires distinct competence beyond general digital literacy. Teachers expressed concerns about managing classroom technology activities where they can ensure all students can participate, or where they can troubleshoot technical problems while maintaining instructional flow in the class.

Theme 4: Disparities in urban-rural resources

Rural teachers reported multiple disadvantages: unstable internet, frequent power cuts, and fewer PD opportunities. By contrast, urban teachers faced resource competition but not total absence. One teacher explained: "In remote areas, internet access is still difficult, and electricity often goes out." This quote illustrates how geographical location creates complex challenges that affect the possibilities for technology integration, regardless of individual teacher competence or motivation. Another teacher noted: ″The number of rooms and technology tools at my school is still very insufficient."

Rural-urban disparities were consistently mentioned, with rural teachers describing multiple varieties of challenges, which include limited internet bandwidth, reduced access to technical support, and fewer PD opportunities. Urban teachers, although generally having better access to infrastructure, also faced resource constraints that limited their ability to integrate technology. However, their challenges typically involved competition for shared resources rather than a complete absence of technological access. These contextual differences suggest that uniform technology integration policies may be insufficient to address diverse implementation challenges across Indonesia's complex educational landscape.

Together, these findings demonstrate that the implementation gap is shaped by the intersection of technical, institutional, pedagogical, and contextual factors rather than by individual deficits alone.

Discussion

The Implementation Gap

This study reveals a 52.2 percentage-point gap in the technology use between Indonesian secondary English teachers' personal and professional use. This finding contributes to ongoing discussions about the relationship between teachers' digital competence and classroom integration, highlighting that personal technological proficiency does not automatically translate into professional practice (Ottenbreit-Leftwich et al., 2010). Instead, the results demonstrate that personal and professional technology practices must be understood as distinct contexts shaped by different barriers, expectations, and forms of support.

By quantifying this divergence, the study examines the concept of a *technology implementation gap* as an analytical lens. While previous research has catalogued barriers to ICT use through frameworks distinguishing between external and internal obstacles (Ertmer, 1999; Hew & Brush, 2007). The implementation gap framework shifts focus from listing obstacles to examining the *distance between contexts of use*. This perspective recognizes that teachers' digital competence is not deficient but often constrained by institutional or systemic conditions. In doing so, it provides a more nuanced account of why integration remains limited despite substantial investment in infrastructure and training.

Contextual Factors Shaping the Implementation Gap

The qualitative findings highlight how the implementation gap is produced by the interaction of multiple contextual factors. Infrastructure challenges were the most frequently cited barrier, with unreliable internet, device shortages, and unstable electricity limiting teachers' willingness to plan technology-dependent lessons. Importantly, these technical constraints had psychological consequences: teachers described avoiding technology to minimize classroom risk which reinforces teachers' avoidance behaviors even when infrastructure improved. This finding suggests that infrastructure policy must prioritize reliability rather than simple availability, echoing UNESCO's (2023a) emphasis on equitable, dependable access.

Institutional factors also emerged as significant. Restrictions on student device use, limited administrative and leadership support, and cultural expectations often curtailed integration. These findings resonate with ecological perspectives (Gu et al., 2019), which stresses the influence of organizational culture and policy environments on teacher practice. The study extends this perspective by showing how even motivated, competent teachers may be unable to implement technology use when institutional norms conflict with policy mandates.

Pedagogical confidence gaps further clarify why personal competence does not automatically transfer to classrooms. Teachers distinguished between consumer use of smartphones and the ability to design and manage technology-supported lessons. This reflects the core challenge captured in the TPACK framework (Mishra & Koehler, 2006): integrating technology requires synthesizing technical skills with pedagogical and content knowledge. While TPACK has often been framed in terms of teacher knowledge, the present findings suggest that confidence and anxiety around classroom management are equally critical to enabling pedagogical applications.

Finally, contextual disparities between urban and rural schools highlight equity issues. Rural teachers faced multilayered disadvantages, including unstable infrastructure and fewer PD opportunities, while urban teachers reported competition for limited resources rather than outright absence. These findings align with earlier work on the digital divide in Indonesia (Lestari et al., 2024; Rahayu & Day, 2015), while adding detail about how disparities intersect with pedagogical confidence and institutional support.

Professional Development: Opportunities and Limitations

Despite high participation rates in PD (77.9%), the persistence of implementation gaps points to shortcomings in current training models. Teachers' accounts emphasized the need for practical, contextualized, and sustained support, rather than short workshops emphasizing technical skills. The 51.8 percentage-point gap between PD participation and daily integration reflects the mismatch between PD content and classroom realities.

This echoes broader findings that effective PD requires active learning, relevance, and ongoing follow-up (D'Angelo et al., 2022; Desimone, 2009; Hennessy et al., 2022). In Indonesia, logistical challenges, such

as geographic dispersion and varied institutional support, further limit PD effectiveness (Mailizar & Fan, 2019; Silvhiany, 2022). The present findings add nuance by showing how teachers perceive this mismatch: PD raised expectations but did not equip them to overcome infrastructure, policy, and equity constraints, potentially contributing to frustration and disengagement.

Implications

Theoretical Implications

The findings contribute to theoretical debates in two ways. First, they suggest that the dichotomy of first-order and second-order barriers (Ertmer, 1999) may be insufficient. Teachers' experiences show how external constraints (e.g., unreliable internet) interact with internal factors (e.g., reduced confidence) to create complex, compounding effects. The implementation gap concept, therefore, complements existing models by emphasizing relational dynamics across contexts rather than discrete categories of barriers.

Second, the study highlights the value of combining TPACK and ecological systems perspectives. While TPACK emphasizes the knowledge required for integration, ecological approaches account for systemic influences on teacher practice. Together, they provide a more comprehensive understanding of why personal competence does not necessarily translate into professional integration: teachers may possess the knowledge but lack the institutional or systemic conditions necessary to apply it effectively.

Practical Implications for Indonesian Education

The findings have implications for policy and practice in Indonesia, particularly under the *Merdeka Belajar* reforms. Expanding access to digital resources alone does not ensure classroom integration. Persistent implementation gaps suggest that current strategies require refinement.

First, infrastructure must prioritize reliability and equity. Nearly all teachers reported having access to technology, yet fewer than one in four used it daily for instructional purposes. Provision without stable connectivity, maintenance, and technical support does not guarantee use. Policies should target dependable access, particularly in rural and remote schools.

Second, professional development (PD) needs rethinking. High participation, alongside limited integration, suggests that current programs are not effectively bridging the gap between competence and practice. Effective PD should move beyond technical skills to include contextually grounded applications, collaborative learning, and structured follow-up. Tailoring PD to local conditions rather than uniform formats may enhance relevance.

Third, institutional alignment is essential. School policies or cultural expectations often contradicted national reforms. Restrictions on device use or limited leadership support prevented teachers from applying new practices. Alignment between national and local policies is critical. Supportive school cultures, where leadership encourages the integration of ICT, can help mitigate these contradictions.

Finally, equity must remain central. Rural teachers faced greater barriers, including unstable power, weaker connectivity, and fewer PD opportunities. Addressing these disparities requires targeted investments, locally adapted PD, and stronger technical support. Reform must account for regional diversity rather than assuming uniform conditions.

Overall, bridging the implementation gap requires a shift from provision-focused policy to strategies that foster reliability, contextual adaptation, and institutional coherence. These refinements will help ensure that *Merdeka Belajar* translates into meaningful classroom practices across Indonesia.

Limitations and Future Research

This study has limitations. The modest sample size (n = 69) and purposive sampling approach reduce the generalizability of the findings. Larger and more representative samples are needed to confirm the scope of the implementation gap in Indonesian schools. Self-reported survey data may introduce bias. Teachers could have under- or over-reported technology use. Future studies incorporating classroom observations, usage logs, or student perspectives would provide richer evidence of integration practices. The cross-sectional design

limits insights into changes over time. Longitudinal research could examine whether improvements in infrastructure, PD, or school culture reduce the gap, and whether observed patterns reflect stable trends or context-specific variation.

Future research should use larger, multi-regional samples, mixed-method designs, and comparative studies with other developing countries. Such work would validate the implementation gap concept and clarify which interventions most effectively reduce it.

Conclusion

This study examined the technology implementation gap among 69 Indonesian secondary school English teachers, revealing a substantial 52.2 percentage-point difference between personal and professional technology use. The findings demonstrate that personal digital competence does not automatically translate into classroom practice, underscoring the need to understand technology integration as a situated process shaped by contextual, institutional, and systemic factors.

The research contributes to educational technology literature in two ways. Conceptually, it introduces *the implementation gap* as a lens that shifts attention from cataloguing barriers to examining the distance between personal and professional contexts. Empirically, the study provides exploratory evidence from Indonesia, showing that the gap persists across demographic categories and is reinforced by unreliable infrastructure, restrictive policies, low confidence, and rural-urban disparities.

These findings carry policy implications. Infrastructure must be reliable and equitable, PD must be contextual and sustained, and national policies should align with school practices. Addressing technology integration requires systemic approaches that combine infrastructure, supportive institutions, and context-sensitive professional learning.

The implementation gap framework helps explain why technology use remains uneven despite competence and investment. Future research, including larger, more representative, and longitudinal studies, can refine this framework and test strategies for reducing the gap. Ultimately, achieving meaningful integration will depend not only on what teachers know or can do, but also on the systems that enable or constrain their capacity to translate competence into practice.

Acknowledgement

This paper presents preliminary findings from an ongoing doctoral project on the integration of technology in Indonesian education. Although based on a modest sample, the results provide insights that inform broader research directions. AI tools assisted with language refinement and editorial revisions but did not alter data collection, analysis, or findings.

This ongoing doctoral project, on which this article is based, was funded by the Indonesia Endowment Fund for Education (LPDP).

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