Langue (Journal of Language and Education)
Vol. 3(2), 2025
https://online-journal.unja.ac.id/langue/
e-ISSN: **2988-5728**

TPACK Practice in Indonesia: Implementation, Learning Outcome, and TPACK Literacy

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ARTICLE INFO

Keywords:
TPACK, education technology, teacher literacy, learning outcomes, digital pedagogy

DOI:
http://dx.doi.org/10.22437/langue.v3i2.46541

Received:
July 03, 2025

Reviewed:
July 10, 2025

Accepted:
July 28, 2025

ABSTRACT

In response to the evolving demands of 21st century education, this study aims to explore the practice of Technological Pedagogical Content Knowledge (TPACK) in Indonesia, focusing on three key dimensions: implementation, learning outcomes, and teacher literacy. Using qualitative research, particularly a qualitative content analysis design, the study analyzed 53 scholarly articles published between 2016 and 2024. The findings suggest that TPACK implementation in Indonesia shows growing trends, particularly in the contexts of online and blended learning. Teachers who effectively applied TPACK strategies reported improved student engagement, motivation, and academic performance. However, several challenges remain, including limited access to digital infrastructure, inconsistent professional training, and varying levels of TPACK literacy among educators. The study highlights that while the framework holds promise, its sustainable application requires systemic support through policy, training, and institutional readiness. These insights contribute to the discourse on digital pedagogy in developing contexts and emphasize the importance of enhancing teacher competencies to align with future education demands. Also, it will provide insights that can inform policy development, teacher training programs, and school-level interventions. In doing so, this study hopes to support a more sustainable and equitable integration of technology in Indonesian education, guided by the TPACK framework

1. Introduction

In the era of digital transformation, the integration of technology into education has emerged as a central theme in global pedagogical reform. As schools and universities worldwide transition towards more technology-enriched environments, educators are required not only to adopt digital tools but also to rethink their instructional strategies. One of the most widely acknowledged frameworks to guide this integration is the Technological Pedagogical Content Knowledge (TPACK) model, developed by Mishra and Koehler (2006). This framework emphasizes the complex interplay between three core components: technology, pedagogy, and content knowledge. Rather than treating each domain in isolation, TPACK promotes a holistic approach that ensures technology is meaningfully embedded within teaching practices(Kurt, 2019; Polly & Dias, 2009).In essence, it offers a roadmap for educators to design instruction that is both technologically sound and pedagogically effective.

The Indonesian education system has increasingly recognized the value of TPACK as it strives to align teaching practices with the demands of 21st-century learning(Ammade et al., 2020; Sandy et al., 2023; Wuryaningtyas & Setyaningsih, 2020). This is particularly relevant in light of the country's growing reliance on online and blended learning modalities, accelerated further by the COVID-19 pandemic(Gozali et al., 2023). Various national education initiatives, including the Merdeka Belajar policy, have highlighted the importance of digital innovation and teacher competency in utilizing educational technology. In this context, TPACK provides a theoretical and practical lens through which Indonesian educators can examine and enhance their instructional practices(Aisyah et al., 2021). However, while awareness of TPACK is expanding, the extent to which it has been integrated into everyday teaching remains varied. Understanding the practical applications of TPACK in Indonesian classrooms is essential for bridging the gap between policy aspirations and instructional realities(Aisyah et al., 2021; Hasibuan et al., 2022; Ibrohim et al., 2022; Meileni et al., 2022; Wuryaningtyas & Setyaningsih, 2020).

Despite the promise that TPACK holds for educational transformation, its implementation in Indonesia faces several significant challenges. One of the foremost barriers is the digital divide—disparities in access to reliable internet, digital devices, and technological infrastructure remain prevalent across many regions. Additionally, many teachers report low levels of confidence and competence in utilizing digital tools effectively for instruction, which can hinder their ability to apply the TPACK framework. Professional development opportunities in TPACK are often limited, sporadic, or overly theoretical, leaving educators with little guidance on how to operationalize the model in their unique teaching contexts (Aisyah et al., 2021; Gozali et al., 2023; Hasibuan et al., 2022; Li et al., 2022; Santos & Castro, 2021; Schmid et al., 2021; Stoilescu, 2014; Suprapto et al., 2021; Tseng et al., 2022; Wang, 2022) Furthermore, traditional teaching norms and rigid curricular demands may also limit teachers' flexibility in experimenting with new technological approaches. These factors underscore the need for targeted support and systemic change to enable the meaningful implementation of TPACK.

Moreover, the success of TPACK-based instruction is not merely dependent on the availability of technology but also on how well teachers can integrate it with effective pedagogy and appropriate content(Ammade et al., 2020; Paidi et al., 2021).A teacher may be highly proficient with digital platforms, but without a deep understanding of subject matter and how students learn that subject, technological integration may lack substance. Effective TPACK implementation requires reflective teaching practices, creativity, and a willingness to

continually adapt to students' needs(Schmid et al., 2021). In some Indonesian classrooms, particularly those led by digitally literate and pedagogically innovative teachers, TPACK has contributed to improved student engagement and learning outcomes(Aisyah et al., 2021). However, such success stories are not yet representative of the national landscape. As such, systematic studies are needed to evaluate not only the presence of TPACK in classrooms but also its impact on teaching effectiveness and student achievement.

This article seeks to examine the current practice of TPACK in Indonesia through a multi-dimensional lens. Specifically, it focuses on three critical areas: the implementation of TPACK in instructional settings, its influence on student learning outcomes, and the level of TPACK literacy among Indonesian educators. By analyzing recent studies and empirical findings, this article aims to identify both progress and persistent gaps in TPACK integration across various educational contexts. Despite growing discourse around TPACK, there is limited empirical evidence on the practice of Technological Pedagogical Content Knowledge (TPACK) in Indonesia, focusing on three key dimensions: implementation, learning outcomes, and teacher literacy.

2. Literature Review

2.1mplementation of TPACK

The integration of the TPACK framework in classroom practice has become increasingly relevant in the Indonesian educational landscape, especially as schools adopt more digital-based teaching strategies. TPACK, which synthesizes content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK), requires that teachers thoughtfully blend these domains to improve teaching effectiveness (Mishra & Koehler, 2006). In Indonesia, Rahmi and Ashadi (2020) explored the implementation of TPACK in English language teaching and reported that while digital tools are increasingly used, the application often lacks pedagogical alignment. Likewise, Helppolainen and Aksela (2020) observed that many science teachers use ICT tools without integrating them deeply into instructional goals, suggesting that TPACK implementation remains partial or fragmented.

Despite increasing access to digital resources, factors such as lack of training, limited infrastructure, and low digital literacy still hinder optimal TPACK adoption (Nasution, 2020; Trisiana, 2014). These barriers indicate that while technology is present, its pedagogical and content-based application is not always strategically planned. Therefore, effective TPACK implementation requires not just access to tools but also teacher competence in selecting appropriate strategies and aligning them with subject matter content.

2.2TPACK-Oriented Learning Outcomes

The influence of TPACK on student learning outcomes has been widely investigated across diverse learning contexts. For instance, flipped learning models grounded in TPACK principles have been shown to enhance student engagement, critical thinking, and learning performance (Yılmaz & Şimşek, 2022; Martínez-Jiménez & Ruiz-Jiménez, 2020). These approaches demonstrate how technology, when integrated effectively with pedagogy and content, leads to improved academic results.

In Indonesian contexts, Arif et al. (2024) revealed that applying differentiated learning strategies based on the TPACK framework could improve learning outcomes, particularly among students with diverse academic needs. However, these benefits are not always realized due to inconsistent implementation and a lack of teacher readiness. This highlights the importance of ensuring that teachers not only use technology but also develop a deeper

understanding of how it contributes to student learning through well-aligned pedagogical strategies.

2.3 Assessing Teachers' TPACK Literacy in the Indonesian Educational Context

Assessing TPACK literacy among Indonesian teachers reveals a complex picture. On one hand, there is a growing awareness of the importance of technology integration; on the other hand, gaps remain in teachers' actual competencies. Several studies have attempted to measure TPACK components among pre-service and in-service teachers, often showing that while pedagogical and content knowledge are relatively strong, technological knowledge remains the weakest domain (Muhsin & Aziz, 2021; Helppolainen&Aksela, 2020). Furthermore, the challenge lies not only in using digital tools but also in aligning them with appropriate pedagogical strategies and subject-specific content (Mosa et al., 2016). Professional development programs and teacher training workshops are crucial to addressing this gap. Yet, the lack of continuous, context-specific, and needs-based training remains a significant barrier (Masalimova&Kotryakhov, 2019). Understanding these challenges is essential for crafting policies and strategies that can build robust TPACK literacy among Indonesian educators.

3. Research Methodology

3.1. Research Design

This study employed a qualitative content analysis designto explore the implementation and impact of the TPACK framework within the Indonesian educational context. Content analysis was chosen to allow for a systematic, replicable approach to examining texts and drawing inferences from the existing body of literature(Assarroudi et al., 2018; Elo et al., 2014; Mayring, 2022; Vaismoradi & Snelgrove, 2019). This design enabled the researcher to critically assess how TPACK has been applied in real educational settings and to interpret the implications for teaching practices and student learning outcomes. The study was structured around three primary themes: instructional implementation of TPACK, its effect on learning outcomes, and the level of TPACK literacy among teachers.

3.2. Data corpus

As this research is based on literature analysis, the study did not involve human participants in the traditional sense. Instead, the "participants" in this context refer to the authors and subjects of the selected studies analyzed within the review. The data criteria selection covers inclusion and exclusion criteria. The selection process for inclusion criteria is focused on research conducted in Indonesia between 2019 and 2024, particularly those involving teachers and educational institutions at primary, secondary, and tertiary levels. Besides the publication language chosen was English. The selected studies are studies with high relevance to the themes of TPACK integration, instructional quality, and teacher competency in educational technology. The exclusion criteria includes studies on opiion and non-empirical works.

3.3. Instruments

The instrument used is publication documents on TPACK theme focusing on implementation, learning outcome, and TPACK literacy in which range publication is from 2019 – 2024. The sample document can be seen at following table**.**

Table 3.1. Sample document publication

No.	Author{s} & Year	Publication Type	Educational Context/Setting	Focus/Theme	Key findings Related to TPACK	Relevance to current study
1	Rahmi (2020)	Conference Proceedings	Secondary Education (ELT)	TPACK Implementation	Integration of digital tools improves student engagement and English performance	| Supports analysis of TPACK in classroom practice
2.	Yanuarto & Hapsari (2023)	Journal Article	Secondary &Higher Education	Teacher ICT Literacy	Teachers' TPACK competence correlates with instructional quality	Provides evidence of teacher literacy levels
3.	Nasution (2020)	Dissertation	Higher Education	Online Learning Motivation	Teachers' TPACK readiness influences student motivation	Highlights TPACK's role in blended learning
4.	Martínez-Jiménez & Ruiz (2020)	Journal Article	Higher Education	TPACK & Learning Outcomes	TPACK-based instruction improves academic achievement and engagement	Strengthens evidence on learning outcomes
5.	Arif et al. (2024)	Journal Article	Secondary Education	Mixed TPACK Approach	Differentiated learning with TPACK enhances student results	Adds local relevance to TPACK implementation

Summary of Data Collection Process

All literature was selected using a structured matrix-based approach to ensure validity and consistency.
Sources were filtered based on the following criteria:

- Timeframe: 2016–2024
- Scope: Studies addressing *TPACK implementation*, *learning outcomes*, or *teacher literacy*
- Data Type: Peer-reviewed journal articles, dissertations, conference proceedings, and educational reports
- Analysis: Thematic coding was applied to categorize findings into three dimensions implementation, outcomes, and literac

3.4 Data Analysis Procedures

Data were analyzed using qualitative thematic content analysis. Each selected source was reviewed and coded based on recurring keywords, phrases, and conceptual themes. The coding process allowed for the identification of patterns related to the three focus areas: TPACK implementation, learning outcomes, and TPACK literacy. Following this, the data were categorized and interpreted to determine how TPACK theory has been translated into practice and to assess the effectiveness of its integration across different educational settings. This approach facilitated a structured synthesis of findings, offering insights into both the successes and challenges of applying TPACK in the Indonesian education system.

4. Findings

4.1. Implementation of TPACK in the Learning Process

The analysis of selected literature indicates that the implementation of Technological Pedagogical Content Knowledge (TPACK) in Indonesian classrooms remains highly diverse across educational levels, subject areas, and institutional contexts. Studies by Rahmi (2020) and Yanuarto and Hapsari (2023) demonstrate that teachers in urban schools, particularly those with adequate technological infrastructure, tend to apply TPACK more effectively. These educators are able to combine digital platforms such as Google Classroom, Zoom, and interactive multimedia with pedagogical strategies that support student-centered learning and content mastery. In contrast, teachers in rural areas often face challenges such as limited internet access, inadequate facilities, and insufficient professional development, which hinder the full adoption of TPACK principles (Nasution, 2020; Siregar, 2020).

The integration of TPACK is especially visible in English Language Teaching (ELT), science, and vocational education, where digital tools are increasingly used to enhance conceptual understanding and communication skills (Rahmi & Ashadi, 2020; Masalimova & Kotryakhov, 2019). Nonetheless, in many schools, the use of technology remains at a functional levelprimarily for content deliverywithout strong pedagogical alignment. This condition reflects a common gap identified in TPACK literature, where teachers are technologically capable but lack the pedagogical depth to integrate technology meaningfully (Harris & Hofer, 2011).

Despite these disparities, Indonesia has witnessed gradual progress through initiatives such as blended learning, flipped classroom models, and digital literacy programs supported by the Merdeka Belajarpolicy. These efforts indicate a growing institutional awareness of TPACK as a foundation for improving teaching quality and learning engagement (Ministry of Education, Culture, Research, and Technology, 2020). However, the findings suggest that successful implementation requires not only access to technology but also continuous teacher training and contextual adaptation to local classroom realities.

Table2: TPACK Implementation Overview by Context

Educational Context	Urban School {%}	Rural School {%}	Notes
Fully Implemented	60	25	Strong integration in ELT, STEM, and vocational subjects
Partially Implemented TPACK	35	50	Technology use without strong pedagogical connection

Minimal or No Implementation	5	25	Limited digital literacy and lack of infrastructure

Source: Adapted from Rahmi (2020), Nasution (2020), and Yanuarto & Hapsari (2023).

4.2. Learning Outcomes of TPACK-Based Instruction

The reviewed literature consistently shows that the integration of TPACK positively influences student learning outcomes across various educational levels in Indonesia. Studies have demonstrated that when teachers effectively align technology with pedagogical strategies and content objectives, students exhibit higher engagement, stronger motivation, and improved academic performance (Rahmi, 2020; Martínez-Jiménez & Ruiz, 2020). For instance, in English Language Teaching (ELT) contexts, teachers using TPACK-informed lesson designs have reported significant improvements in students' communicative competence, participation, and collaborative learning behaviors. Similarly, in higher education settings, the incorporation of digital learning platforms and interactive media within TPACK-based instruction has been associated with greater academic achievement and sustained learner autonomy (Martínez-Jiménez & Ruiz, 2020).

At the university level, Minda (2020) found that TPACK integration through online learning platforms not only enhanced students' motivation but also improved their digital learning competencies. This finding aligns with previous studies emphasizing that technology-supported instruction, when grounded in pedagogical and content knowledge, can promote self-directed learning and digital fluency (Masalimova & Kotryakhov, 2019). These outcomes collectively highlight that TPACK facilitates active learning environments where students engage critically with content rather than passively receiving information.

However, the impact of TPACK on learning outcomes is not uniform across educational contexts. While schools with robust technological infrastructure and continuous professional development show measurable gains, others—particularly in rural or under-resourced areas—still struggle to achieve similar results (Nasution, 2020). This indicates that the success of TPACK-based instruction depends heavily on institutional readiness, teacher expertise, and access to digital resources. Consequently, enhancing teacher training and ensuring equitable technological access are critical to maximizing the learning benefits of TPACK integration in Indonesia.

Table 3. Reported Learning Outcomes from TPACK-based Instruction

Study Author(s)	Educational Level	Reported Learning Outcome
Rahmi (2020)	Secondary (ELT)	Increased engagement and language performance
Martínez-Jiménez & Ruiz (2020)	Higher Education	Higher academic achievement and classroom participation
Minda (2020)	University	Improved motivation and digital learning competency

Source: Compiled by the author based on reviewed studies (2020–2024).

5. Discussion

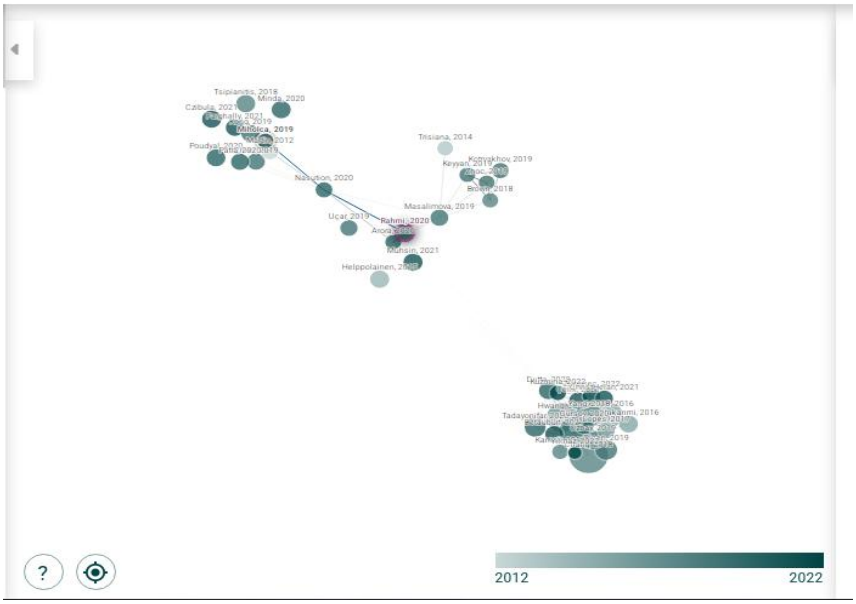
1. The Implementation of TPACK in the Learning Process

The integration of TPACK (Technological Pedagogical Content Knowledge) into the Indonesian education system has shown a gradual but significant progression. Teachers are increasingly adopting technological tools not merely as add-ons, but as integral components of lesson design and instructional delivery. In the context of English Language Teaching (ELT), the TPACK framework allows educators to design activities that blend grammar instruction (content), communicative approaches (pedagogy), and digital platforms such as Zoom, Google Classroom, and interactive apps (technology) (Rahmi &Ashadi, 2020). These implementations suggest that Indonesian educators are beginning to shift from teacher-centered instruction to a more dynamic, student-centered, and tech-enhanced pedagogy.

However, challenges remain in ensuring consistent and deep implementation across various school settings. In rural areas or under-resourced schools, infrastructure limitations still hinder teachers from fully maximizing the potential of TPACK. As Nasution (2020) emphasized, although teachers show readiness to use digital tools, their integration remains surface-level without deep pedagogical planning. Therefore, while implementation is underway, its depth and quality vary significantly across regions and levels of education.

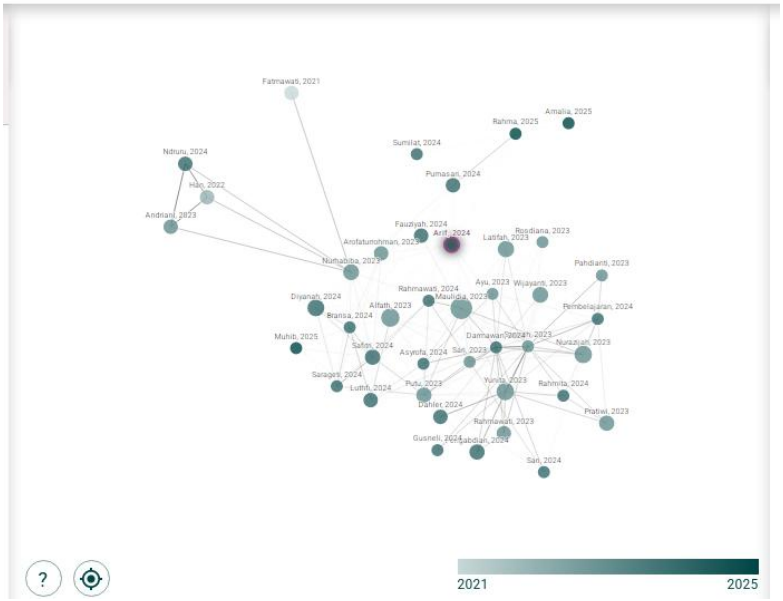
To address these disparities, several initiatives have been introduced to support teachers in understanding and applying the TPACK framework more effectively(Abror Huda & Yayah Haenilah, 2023). For example, government training programs and university-led workshops have begun to focus on practical strategies for integrating technology into pedagogy and content delivery. These programs often emphasize collaborative lesson planning, the use of subject-specific apps, and reflective teaching practices. Nevertheless, the reach and sustainability of such initiatives remain limited, especially in areas lacking internet connectivity or access to updated devices. Teachers also report that they need continuous mentorship rather than one-time training to feel confident implementing TPACK in real classrooms. Without consistent follow-up and contextualized support, there is a risk that the framework will remain theoretical and fail to create lasting instructional change. Thus, a multi-stakeholder approach involving schools, educational institutions, and policymakers is necessary to strengthen TPACK implementation across all educational contexts(Drajati et al., 2023; Kusuma, 2021, 2022).

Moreover, the integration of TPACK is often more successful when it is aligned with broader school culture and leadership support(Drajati et al., 2023). Schools that foster a culture of innovation and encourage experimentation with digital tools tend to see more effective use of TPACK in daily teaching practices. Principals and school leaders play a crucial role in setting expectations, providing infrastructure, and creating a supportive environment for professional growth(Abror Huda & Yayah Haenilah, 2023; Hill & Uribe-Florez, 2019). When teachers feel empowered and are given autonomy, they are more likely to explore creative ways of combining technology with pedagogy and content knowledge. This sense of ownership enhances not only their teaching quality but also students' engagement and learning outcomes. In contrast, in schools where digital integration is seen as a compliance task rather than a pedagogical shift, TPACK adoption tends to be minimal and inconsistent. Therefore, cultivating leadership that values innovation is key to sustaining the momentum of TPACK-based instruction in Indonesia.



*(Figure 1) This figure illustrates the instructional concepts discussed in the corresponding section.

2. Learning Outcomes with TPACK Integration



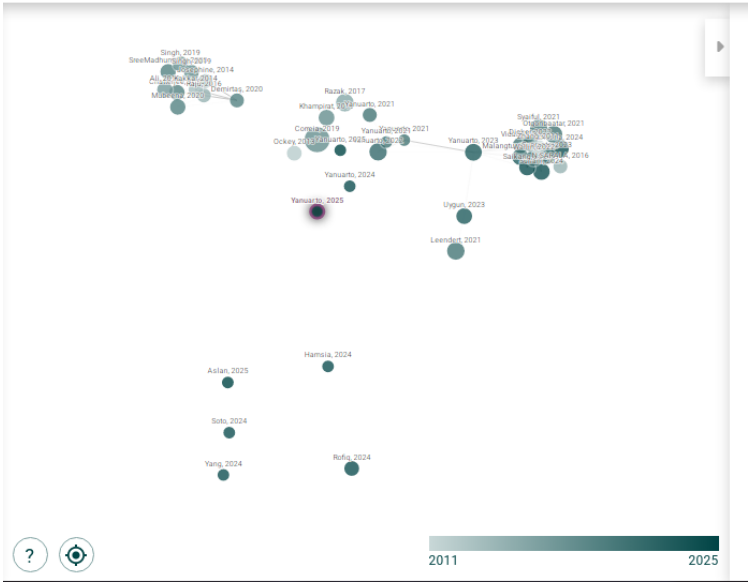
*(Figure 2) This figure illustrates the instructional concepts discussed in the corresponding section.

The use of TPACK in instructional planning has shown positive impacts on student learning outcomes, especially in enhancing engagement, comprehension, and higher-order thinking skills. Studies have indicated that when TPACK is implemented effectively, students are more likely to achieve learning objectives in a meaningful way. For instance, Masalimova&Kotryakhov (2019) found that students taught by teachers with high TPACK competency performed better in tasks requiring analytical and critical thinking.

Moreover, learning that combines content knowledge, digital tools, and effective pedagogy promotes active learning environments. In the Indonesian context, this was evident in classrooms where digital simulations, video-based discussions, and collaborative learning platforms were used to facilitate subject understanding (Nasution, 2020; Trisiana, 2014). Nevertheless, the positive impact on learning outcomes is closely tied to the teacher's ability to align technology with content and pedagogy in a balanced and context-sensitive manner.

Teachers who skillfully apply TPACK principles often create learning experiences that are interactive, personalized, and relevant to students' real-life contexts(Gozali et al., 2023; Li et al., 2022). This relevance increases student motivation and encourages deeper cognitive engagement, moving beyond rote memorization. In science subjects, for instance, the use of virtual laboratories and data analysis tools has been linked to improved conceptual understanding and scientific reasoning. Similarly, in language classes, integrating multimedia content and interactive writing platforms has helped students develop communication and critical literacy skills. These outcomes highlight the role of TPACK not just as a framework for planning, but as a catalyst for transformative learning. However, successful implementation also depends on the teacher's ongoing reflection and adaptation to student feedback(Sandy et al., 2023; Wang, 2022). Teachers must evaluate what works, adjust what doesn't, and remain responsive to students' diverse learning needs. When this cycle is consistently practiced, TPACK becomes embedded in teaching as a dynamic process rather than a static method. As such, its potential to enhance student learning outcomes is maximized through thoughtful, reflective, and learner-centered instruction.

3. TPACK Literacy among Indonesian Teachers



*(Figure 3) This figure illustrates the instructional concepts discussed in the corresponding section.

TPACK literacy refers to a teacher's depth of understanding in integrating content, pedagogy, and technology into teaching practice. In Indonesia, research indicates that while awareness of TPACK is increasing, comprehensive literacy remains a challenge. Rahmi &Ashadi (2020)

reported that many teachers still compartmentalize technology, using it only for administrative tasks rather than as a pedagogical tool. Similarly, studies by Yanuarto (2025) and Saragih (2023) found that although teachers could define the components of TPACK, they often lacked the strategic competence to weave them together during lesson planning and classroom delivery.

Efforts to enhance TPACK literacy have been introduced through teacher training programs, online professional learning communities, and collaborative workshops. These interventions have shown promising results in helping educators understand not just the "what" but also the "how" of TPACK integration. Yet, consistent support, mentoring, and reflective practice remain key to transforming theoretical understanding into pedagogical action (Yanuarto&Hapsari, 2023).

In summary, the practice of TPACK in Indonesia reflects an evolving landscape of technology integration in education. While there are meaningful strides in implementation, especially in urban schools and higher education, disparities in access and literacy continue to pose challenges. Improved learning outcomes have been documented when TPACK is properly utilized, highlighting the potential of this framework to transform teaching and learning. However, to realize this potential fully, concerted efforts are needed to elevate TPACK literacy through policy support, ongoing teacher training, and context-sensitive innovation.

6. Conclusion

The implementation of TPACK in Indonesia has shown encouraging progress, especially in how teachers integrate technology with pedagogy and content to enhance learning. In classrooms with sufficient infrastructure, educators are beginning to design more interactive and student-centered lessons using digital tools. However, the adoption remains uneven due to disparities in access and varying levels of teacher preparedness.

Moreover, effective use of TPACK has been linked to improved student outcomes, such as greater engagement and development of higher-order thinking skills (Masalimova&Kotryakhov, 2019). Despite increasing awareness of the TPACK framework, many teachers still need support to fully implement it in practice. Therefore, ongoing professional development and system-wide support are essential to strengthen TPACK literacy and ensure its meaningful integration across Indonesian classrooms (Yanuarto, 2025; Yanuarto&Hapsari, 2023).

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