

Teachers' TPACK, Students' Digital Literacy, And Digital Learning Attitudes At SMA Negeri 1 Wamena, Papua

Seti A. Togodli

English Language Education, Graduate Program, Universitas Pendidikan Ganesha, Bali,
Indonesia

I Putu Indra Kusuma

English Language Education, Graduate Program, Universitas Pendidikan Ganesha, Bali,
Indonesia

Dewa Putu Ramendra

English Language Education, Graduate Program, Universitas Pendidikan Ganesha, Bali,
Indonesia

Corresponding Author: togodligwesetia@gmail.com

Abstract

This study investigates how teachers' Technological Pedagogical Content Knowledge (TPACK) competencies shape students' digital literacy and their attitudes toward digital learning within a rural senior high school context. This research was conducted at SMA Negeri 1 Wamena, Papua a region characterized by limited digital infrastructure, restricted access to professional training, and significant socioeconomic constraints among the student population. Data were gathered through semi-structured interviews with English subject teachers and students, non-participant classroom observations, and document analysis. Thematic analysis revealed three overarching themes: the enactment of TPACK competencies in classroom practice was adaptive and context-sensitive, with higher-TPACK teachers employing creative strategies to integrate technology despite infrastructural limitations; students' digital literacy development was significantly shaped by the quality of instructional support received, though constrained by limited device access and unstable internet connectivity; and teachers actively interpreted and navigated contextual challenges, yet systemic barriers including inadequate professional development and insufficient institutional support impeded effective technology integration. The findings contribute contextually grounded insights to the TPACK literature by illustrating how

1229



rural and resource-constrained environments mediate the relationship between teacher competence, student digital literacy, and attitudes toward digital learning. Implications for teacher professional development policy and digital infrastructure investment in remote Indonesian regions are discussed

Keywords: TPACK, digital literacy, attitudes toward digital learning, rural education, qualitative case study

INTRODUCTION

The rapid integration of digital technology into global education systems has fundamentally reshaped pedagogical paradigms, altering not only how content is delivered but how teachers conceptualize their professional roles. This transformation has brought unprecedented opportunities for personalized, interactive, and technology-enriched learning. Yet it has equally exposed persistent disparities in educational access, most acutely in rural and geographically remote settings where digital infrastructure remains underdeveloped. In Indonesia, this challenge is particularly pronounced in the eastern region of Papua, where schools such as SMA Negeri 1 Wamena operate under significant resource constraints that complicate the integration of digital learning into everyday classroom practice. Central to the discourse on technology integration in education is the Technological Pedagogical Content Knowledge (TPACK) framework, first articulated by Mishra and Koehler as an extension of Shulman's foundational Pedagogical Content Knowledge (PCK) model (Mishra & Koehler, 2006). TPACK posits that effective technology-integrated teaching demands more than proficiency in digital tools; it requires the seamless synthesis of three knowledge domains: Content Knowledge (CK), Pedagogical Knowledge (PK), and Technological Knowledge (TK). From their intersections emerge Technological Pedagogical Knowledge (TPK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), and ultimately the holistic TPACK a complex, integrated form of teacher knowledge that enables meaningful technology-enhanced instruction (Tseng et al., 2022). The TPACK framework has evolved considerably since its inception. Contemporary scholarship increasingly foregrounds the role of context in mediating how TPACK is enacted. Petko, Koehler, and Mishra have proposed an updated TPACK-in-context model that positions institutional, infrastructural, and socio-cultural conditions as fundamental determinants of how teachers implement technology in their classrooms (Petko et al., 2024). This contextualist



orientation is especially salient in rural educational environments like Wamena, Papua, where geographic isolation, limited government investment in digital infrastructure, and unequal distribution of professional development opportunities collectively constrain how teachers can enact their TPACK competencies in practice.

Alongside TPACK, digital literacy has emerged as a foundational competency for learners in the 21st century. Gilster was among the first scholars to theorize digital literacy as the ability to understand and evaluate information across multiple digital formats (Gilster, 1997). Eshet-Alkalai expanded this understanding by identifying six cognitive dimensions of digital literacy: photo-visual thinking, real-time thinking, information thinking, branching thinking, reproductive thinking, and social-emotional thinking (Eshet, 2004). More recently, institutional frameworks from UNESCO, the American Library Association, and Jisc have broadened the definition to encompass not only technical skill but critical evaluation, ethical digital citizenship, and creative production of digital content (Rosa, 2017). In the Indonesian national context, the Ministry of Communication and Informatics has operationalized digital literacy through the National Digital Literacy Movement (*Gerakan Literasi Digital Nasional*), emphasizing safe internet use, resistance to misinformation, and responsible digital communication.

Students' attitudes toward digital learning their affective perceptions of and behavioral tendencies toward technology-supported instruction, represent a third critical dimension of this study's inquiry. These attitudes are theorized through two complementary frameworks: the Technology Acceptance Model (TAM) proposed by Davis (1989), which centers on perceived usefulness and perceived ease of use as determinants of technology adoption, and the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003) which extends TAM by incorporating social influence and facilitating conditions as additional predictors. In educational practice, students who perceive digital learning as useful and accessible tend to demonstrate more positive attitudes, greater engagement, and higher persistence in technology-mediated tasks. Teachers play a pivotal role in shaping these perceptions by modelling purposeful technology use and creating digitally enriched learning environments. Empirical research consistently demonstrates that teachers' TPACK competencies are positively associated with students' digital literacy development and more favorable attitudes toward digital learning (Usman et al., 2024). Quraishi et al. (2024) found that structured technology integration facilitated by knowledgeable instructors significantly enhanced students' digital competence and engagement. Similarly, Sánchez-Cruzado et al. (2021) established that



teacher digital literacy is a critical predictor of meaningful technology integration in classroom practice. However, the majority of these studies are situated in urban or relatively resource-adequate contexts. Research examining the interplay of TPACK, digital literacy, and digital learning attitudes within remote, resource-constrained rural schools particularly in Indonesia's eastern provinces, remains notably scarce.

Wamena, as the capital of Jayawijaya Regency in Papua Province, presents a particularly compelling and underexplored case. Government reports indicate that a majority of schools in the regency lack stable internet connectivity, while the availability of personal digital devices among students is severely limited by household socioeconomic conditions (Akbar et al., 2025). Teachers in this environment face compounding challenges: insufficient pre-service preparation in TPACK, infrequent and often decontextualized in-service training, and limited institutional support for technology integration. Sari et al. documented significant TPACK disparities between rural and urban high school teachers in Indonesia, with rural teachers consistently demonstrating lower competency levels (Sari et al., 2025). This disparity has direct implications for students' opportunities to develop digital literacy and positive learning attitudes.

This study addresses the identified research gap by conducting a bounded qualitative case study at SMA Negeri 1 Wamena, Papua. The research is guided by three questions: (1) How are teachers' TPACK competencies enacted in shaping students' digital literacy and attitudes toward digital learning? (2) How do students experience challenges within digital learning practices in this rural setting? (3) How do teachers interpret and navigate the contextual challenges of technology integration in their classroom practice? By attending closely to the lived experiences of both teachers and students, this study aims to produce contextually grounded insights that may inform professional development initiatives and educational policy for remote Indonesian schools.

LITERATURE REVIEW

The TPACK Framework and Its Contextual Dimensions

The TPACK framework identifies seven knowledge domains central to technology-integrated teaching. Technological Knowledge (TK) refers to teachers' understanding of digital tools and their optimal application in educational settings. Pedagogical Knowledge (PK) encompasses instructional strategies and theories that guide effective teaching. Content Knowledge (CK) reflects subject-matter expertise. The intersectional domains TPK, PCK, TCK, and



holistic TPACK represent the integrated competencies required to design and enact technology-enriched learning experiences that are simultaneously content-rich and pedagogically sound (Maskanah, 2025).

What distinguishes the contemporary understanding of TPACK from its original formulation is the growing recognition that TPACK is not a static, decontextualized form of knowledge but is inherently situated and enacted within specific educational environments. Petko et al.'s updated model explicitly positions context, including institutional support structures, available infrastructure, policy environments, and community socio-cultural factors as integral to understanding how TPACK operates in practice (Petko et al., 2024). This contextual sensitivity is especially critical in rural settings, where environmental constraints can severely limit the range of technologies available to teachers and the types of technology-supported activities that are feasible. Empirical studies from diverse international contexts confirm that TPACK competency levels are positively correlated with the quality of technology integration, student engagement, and learning outcomes in digital environments (Valtonen et al., 2017). However, research from rural South and Southeast Asian educational contexts reveals that even motivated teachers with moderate TPACK competencies may struggle to enact these competencies effectively when systemic supports are absent. Shambare and Simuja demonstrated this in their study of rural secondary schools in South Africa, where structural constraints directly undermined teachers' capacity to deploy their technological knowledge in classroom practice (Shambare & Simuja, 2024).

Digital Literacy: Definitions, Dimensions, and Educational Significance

Digital literacy has been conceptualized variously across scholarly and institutional traditions. Gilster's foundational definition emphasized cognitive engagement with digital information, while Eshet-Alkalai's multi-dimensional framework highlighted the interplay of visual, cognitive, social, and ethical competencies required for effective digital participation (Gilster, 1997). The American Library Association foregrounded the technical and evaluative dimensions of digital literacy, while Jisc extended the concept to encompass professional and social participation in digital environments (Thompson et al., 2014). In the context of formal education, digital literacy is increasingly positioned not merely as a technical skill set but as a critical pedagogical outcome shaped by instructional practice. Research by Murtadho et al. (2023) and Quraishi et al. (2024) affirms that students' digital literacy is significantly influenced by the



quality and consistency of technology-integrated instruction they receive. This finding has important implications for rural schools, where uneven instructional quality driven by disparities in teacher TPACK competencies and access to digital tools may produce significant variation in students' digital literacy development across classrooms and schools.

Students' Attitudes toward Digital Learning

Students' attitudes toward digital learning are multi-dimensional, encompassing affective responses (feelings of enjoyment or anxiety), cognitive appraisals (perceptions of usefulness), and behavioral intentions (willingness to engage with digital tasks). Davis (1989) TAM and Venkatesh et al. (2003) UTAUT provide complementary theoretical lenses for understanding how these dimensions interact. In rural school contexts, students who have limited prior exposure to digital technology may initially exhibit technology anxiety or resistance, which can be mitigated through structured, supportive digital learning experiences facilitated by competent teachers. Empirical evidence suggests that teachers' attitudes and modelling behaviors significantly influence students' technology acceptance and engagement. Konrad and Stemberger found that teachers who demonstrated positive attitudes toward digital learning created classroom environments more conducive to student technology adoption (Čotar & Štemberger, 2023). Pan et al. (2024) further documented that students' digital competence was positively associated with their behavioral engagement and confidence in digital learning tasks. These findings reinforce the centrality of teacher competency and particularly TPACK in shaping the attitudinal dimension of students' digital learning experience.

METHOD

Research Design

This study employs a single qualitative case study design, following Yin's conceptualization of the case study as the most appropriate methodology for investigating complex, contextual phenomena within real-life bounded settings, particularly when the boundaries between the phenomenon and its context are indistinct (Yin, 2018). A qualitative orientation was adopted because the research seeks to explore how and why phenomena occur, specifically, how TPACK is enacted and experienced rather than to quantify or predict outcomes. This approach aligns with Creswell's criteria for selecting qualitative inquiry: the need to understand meanings,



explore processes, and honor participant perspectives within their natural settings (Creswell, 2017).

The single case study design was deemed most appropriate for several reasons. First, SMA Negeri 1 Wamena represents a bounded and distinct educational context with specific socio-cultural, infrastructural, and institutional characteristics that warrant in-depth examination in their own right. Second, the research questions require exploration of nuanced, context-dependent processes that cannot be adequately captured through survey instruments or statistical measurement. Third, a case study approach enables methodological triangulation across multiple data sources, thereby strengthening the credibility of findings.

Research Setting and Participants

The research was conducted at SMA Negeri 1 Wamena, a state senior high school situated in Wamena, the capital city of Jayawijaya Regency, Papua Province. The school was selected purposively as a representative bounded case of rural secondary education in eastern Indonesia, characterized by limited digital infrastructure, geographic remoteness, and a student population drawn largely from economically constrained households. These characteristics make the school a particularly rich and informative site for examining how contextual conditions shape technology integration in classroom practice.

Participants were selected purposively to ensure that they could provide information-rich data relevant to the research questions. Teacher participants included English subject teachers who were directly involved in technology-mediated instruction. Student participants comprised senior high school students across different grade levels who had experience with digital learning activities facilitated by these teachers. The number of participants was determined by the principle of data saturation rather than statistical representativeness, consistent with qualitative case study conventions.

Data Collection

Three complementary data collection methods were employed to ensure methodological triangulation and enhance the trustworthiness of findings:

- 1) Semi-structured interviews: In-depth interviews were conducted individually with teacher participants and in small groups with students. Interview guides were developed based on the research questions and theoretical framework, covering TPACK competency dimensions,



digital learning practices, perceived challenges, and attitudes toward technology use. Interviews were audio-recorded and transcribed verbatim for analysis.

- 2) Classroom observations: Non-participant structured observations were conducted across multiple class sessions to document how teachers enacted technology integration in real time, including the types of digital tools used, the pedagogical strategies employed, and how students responded to digital learning activities. Field notes were recorded using an observation protocol aligned with TPACK dimensions.
- 3) Document analysis: Supplementary documents, including lesson plans, school digital resource inventories, student digital learning portfolios, and institutional technology policy documents, were collected and analyzed to corroborate and contextualize data from interviews and observations.

Data Analysis

Data were analyzed using reflexive thematic analysis following the six-phase approach outlined by Braun and Clarke, adapted for case study research. Analysis proceeded inductively from initial familiarization with the data through iterative rounds of open coding, axial coding, and theme construction. The researcher maintained a reflective journal throughout the analytical process to document interpretive decisions and enhance analytical transparency (Braun & Clarke, 2006).

To establish trustworthiness, multiple strategies were employed: member-checking (sharing preliminary findings with participants for verification), peer debriefing (discussing emerging themes with a critical colleague), thick description (providing detailed contextual accounts to support transferability), and negative case analysis (actively seeking data that challenged or complicated emergent themes). These procedures reflect Lincoln and Guba (2014) criteria for credibility, transferability, dependability, and confirmability in qualitative inquiry.

RESULT AND DISCUSSION

Thematic analysis of interview transcripts, observation field notes, and documents yielded three overarching themes, each corresponding to one of the research questions guiding this study. The themes are presented below with illustrative evidence drawn from the data.



Theme 1: Adaptive Enactment of TPACK Competencies in a Resource-Constrained Environment

The first theme addresses how teachers' TPACK competencies were enacted in classroom practice at SMA Negeri 1 Wamena. Findings revealed considerable variation in TPACK enactment across participating teachers, with the most consistent differentiator being the degree to which teachers possessed and could deploy integrated TPK and TCK competencies. Teachers with stronger TPACK profiles demonstrated a distinctive capacity for contextual adaptation the ability to design technology-integrated lessons that leveraged available resources creatively while remaining pedagogically purposeful.

Classroom observations documented a range of adaptive strategies employed by higher-TPACK teachers. These included: the use of mobile applications that could function without internet connectivity (offline dictionary apps and grammar tools); the preparation of pre-downloaded multimedia content to circumvent unstable network conditions; the incorporation of peer device-sharing protocols to address the limited number of available smartphones; and the design of offline collaborative digital tasks in which students produced digital content (voice recordings, text documents) using shared devices during scheduled lab sessions.

These adaptive strategies are consistent with Shambare and Simuja's concept of "contextual technology competence" the capacity to creatively enact TPACK within resource-constrained conditions rather than abandoning technology integration when ideal conditions are absent. Similarly, findings from Frontiers in Education confirm that rural teachers with stronger TPACK foundations are better positioned to develop contextually responsive digital teaching strategies even under significant infrastructural constraints.

By contrast, teachers with weaker TPACK competencies particularly in the TK and TPK dimensions demonstrated a tendency to revert to conventional chalk-and-talk instruction when digital tools presented difficulties. Interview data revealed that these teachers often perceived technology as an add-on rather than an integral component of their pedagogical approach, and felt insufficiently equipped to troubleshoot technical problems in real time. This pattern reflects broader findings on the relationship between TPACK self-efficacy and technology integration behavior, where lower confidence in technological competence is associated with avoidance of digital tools in instruction. Observation data further revealed that the physical arrangement of the classroom, the availability of a functioning projector or shared screen, and the proximity of teacher supervision all moderated how effectively students could engage with technology-



integrated activities. Higher-TPACK teachers were observed anticipating and managing these environmental variables more proactively, further illustrating the contextually embedded nature of TPACK enactment as theorized by Petko.

Theme 2: Students' Experiences of Digital Literacy Development and Learning Challenges

The second theme addresses students' lived experiences of digital literacy development within the constrained digital learning environment of SMA Negeri 1 Wamena. Overall, findings indicated that students' digital literacy trajectories were closely tied to the instructional practices of their teachers, with students taught by higher-TPACK educators demonstrating notably greater digital confidence, information literacy skills, and willingness to engage with digital learning tasks. This aligns with Kusuma's findings from rural Indonesian secondary schools, where structured instructional support was identified as the primary mediator of students' digital skill development (Kusuma, 2022).

Students consistently described their digital learning experiences in terms of three interrelated challenges:

1. Device Access Limitations

The majority of students did not possess personal smartphones or laptops. Those who did reported that family economic pressures sometimes necessitated sharing devices with siblings or parents, limiting their available time for academic digital tasks outside school hours. Within school, the limited number of functioning computers in the school's ICT laboratory created bottlenecks that restricted how frequently classes could engage in hands-on digital activities.

2. Internet Connectivity Instability

Students and teachers uniformly described internet connectivity as the most significant and pervasive challenge to digital learning. Network access was characterized by frequent disruptions, low bandwidth, and complete unavailability during adverse weather conditions. This instability made real-time internet-dependent tasks such as online research, video streaming, or cloud-based collaboration highly unreliable, constraining digital learning to offline alternatives.



3. Uneven Prior Digital Experience

Students entered senior high school with highly variable prior exposure to digital technology, shaped largely by their elementary and junior high school backgrounds and household economic circumstances. This heterogeneity created pedagogical challenges for teachers, who needed to scaffold digital literacy development for beginners while simultaneously providing more complex tasks for students with stronger prior experience.

Despite these obstacles, students who received consistent structured digital learning experiences even with limited tools demonstrated meaningful development across several digital literacy dimensions over the course of the study period. Specifically, gains were observed in students' information-searching strategies, their ability to evaluate digital sources, their competence in producing basic digital content (e.g., typed reports and voice recordings), and their confidence in digital communication. These findings align with Ling et al.'s observation that even modest and consistent exposure to structured digital learning can produce measurable improvements in students' digital competence and learning engagement.

Attitudinally, students taught by higher-TPACK teachers reported more positive orientations toward digital learning, characterized by greater enthusiasm for technology-supported tasks, reduced anxiety about using unfamiliar digital tools, and a stronger sense of self-efficacy in navigating digital environments. Students in these classrooms also more frequently described digital learning as personally relevant and enjoyable affective responses that TAM and UTAUT frameworks associate with higher technology acceptance and continued engagement. In contrast, students whose teachers employed technology only incidentally or inconsistently expressed more ambivalent or negative attitudes, describing digital learning as confusing, inaccessible, or disconnected from their academic needs.

Theme 3: Teachers' Interpretation and Navigation of Contextual Challenges

The third theme examines how teachers interpreted and responded to the structural and contextual challenges of technology integration at SMA Negeri 1 Wamena. Contrary to a deficit framing that might characterize rural teachers as passive recipients of inadequate conditions, the findings reveal that participating teachers were active agents who exercised significant professional judgment in navigating their constrained environment. This finding resonates with Ndoen et al.'s documentation of adaptive teaching strategies among rural Indonesian educators



and with Deng et al.'s emphasis on contextual responsiveness as a dimension of teacher professional growth (Boymau & Hidayati, 2025).

Across interview and observation data, teachers described three primary categories of challenge that shaped their technology integration decisions:

1. Professional Development Insufficiency

Teachers reported that in-service training on technology integration was infrequent, often delivered through one-time workshops disconnected from the realities of their classroom context. Several teachers noted that training programs were designed with urban school infrastructure in mind and did not address the specific constraints of teaching in Wamena. This disconnect left teachers feeling underprepared to troubleshoot practical problems that arose during digital lessons.

2. Institutional Support Gaps

Teachers perceived limited active support from school administration for technology integration initiatives. While the school's formal policy acknowledged the importance of digital learning, practical support such as maintenance of ICT equipment, provision of supplementary materials, or timetabled access to computer facilities was inconsistent and often insufficient.

3. Infrastructural Constraints Gaps

Beyond internet connectivity and device availability, teachers described challenges related to unreliable electrical supply, limited technical maintenance capacity for existing equipment, and the absence of a dedicated ICT coordinator to provide classroom-level support.

In response to these challenges, teachers developed a range of coping and adaptive strategies, including peer consultation networks informal communities of practice among colleagues who shared digital teaching ideas and troubleshooting knowledge and the deliberate selection of low-bandwidth or offline-compatible digital tools. Higher-TPACK teachers demonstrated a notably stronger capacity for this adaptive problem-solving, suggesting that TPACK competency serves not only as a predictor of technology integration quality but also as a buffer against the demoralizing effects of infrastructural constraints. This finding corroborates Hidayat et al.'s observation that professional development that strengthens TPACK enhances

teachers' capacity to sustain technology integration even in challenging conditions (Hidayat et al., 2024).

Teachers who maintained positive attitudes toward technology integration regardless of resource limitations were observed to persevere in incorporating digital elements into their instruction and to communicate enthusiasm for digital learning to their students more effectively. This attitudinal dimension of teacher TPACK enactment represents an important but underexplored mediating variable between structural conditions and student outcomes in rural digital learning environments.

DISCUSSION

The findings of this study yield several theoretically significant insights that extend and nuance the existing TPACK and digital literacy literature, particularly with respect to rural and resource-constrained educational contexts.

First, the study affirms and elaborates the TPACK-in-context perspective advanced by Petko et al demonstrating empirically that TPACK enactment is deeply mediated by local contextual conditions. The contrast between higher-TPACK and lower-TPACK teachers at SMA Negeri 1 Wamena was not reducible to individual competency differences alone; it was also shaped by differential access to supportive institutional structures, professional learning communities, and contextually relevant professional development. This finding calls for a reconceptualization of TPACK not as a fixed individual attribute but as a dynamic and contextually enacted form of professional knowledge that must be supported systemically.

Second, the relationship between teachers' TPACK competencies and students' digital literacy development documented in this study is consistent with findings from Voogt et al. (2013) landmark review and with more recent evidence from Aslan et al who established that TPACK exerts both direct and digitally-mediated indirect effects on instructional quality. In the Wamena context, this relationship operated through specific instructional mechanisms: the selection of offline-compatible tools, the scaffolding of digital tasks to accommodate heterogeneous prior experience, and the deliberate cultivation of a classroom climate in which digital exploration was encouraged despite anxiety-inducing resource limitations. These mechanisms represent pedagogically important dimensions of TPACK enactment that are often obscured in quantitative studies of teacher competency.



Third, the attitudinal dimension of students' digital learning experience as theorized through TAM and UTAUT, was clearly traceable to the quality of instructional mediation provided by teachers. Students whose teachers modelled positive, purposeful engagement with digital tools and created structured opportunities for digital practice developed more favorable and confident attitudes toward digital learning. This finding reinforces Konrad and Stemberger's observation that teacher attitudes are among the most powerful contextual predictors of student technology acceptance. It also extends this insight to a rural Papuan context, suggesting that the relationship between teacher modelling and student attitude formation operates across diverse socio-economic and infrastructural conditions.

Fourth, the systemic challenges documented in this study particularly the persistent gaps in infrastructure and professional development point to important implications for educational policy in remote Indonesian regions. Government reports confirm that the digital divide between Papuan schools and their urban counterparts remains substantial, yet policy responses have not consistently addressed the contextually specific needs of teachers and students in settings like Wamena. Professional development initiatives that are co-designed with rural teachers, delivered in contextually relevant formats (e.g., peer learning networks, mobile-based microlearning), and explicitly attentive to the infrastructural realities of rural classrooms are urgently needed.

Finally, the adaptive agency demonstrated by participating teachers their creative navigation of constraints rather than passive acceptance of limitations represents an important but undervalued dimension of rural teacher professionalism. Supporting and scaling these adaptive strategies through targeted institutional recognition and structured peer learning communities could represent a cost-effective pathway to improving technology integration quality in resource-constrained schools.

These findings carry important implications for policy and practice. At the institutional level, schools in remote Papua need structured peer learning communities, contextually adapted professional development programs, and consistent administrative support for technology integration initiatives. At the policy level, sustained investment in digital infrastructure including reliable internet connectivity, device provision, and technical maintenance capacity is a prerequisite for equitable digital learning opportunities for students in remote Indonesian schools.



CONCLUSION

This study has examined how teachers' TPACK competencies shape students' digital literacy and attitudes toward digital learning in a rural senior high school in Wamena, Papua, through the lens of a single qualitative case study. The findings demonstrate that while TPACK competency is a significant enabler of meaningful technology integration, its enactment is profoundly shaped by the contextual conditions of the local educational environment including digital infrastructure availability, institutional support, and access to relevant professional development.

Higher-TPACK teachers at SMA Negeri 1 Wamena demonstrated contextually adaptive instructional strategies that contributed positively to students' digital literacy development and fostered more favorable attitudes toward digital learning, even within significant resource constraints. Conversely, systemic barriers particularly the inadequacy of professional development and institutional support impeded the ability of lower-TPACK teachers to enact technology integration effectively, with downstream consequences for students' digital learning opportunities.

Future research should build on these findings through longitudinal studies that trace the development of teachers' TPACK over time in response to targeted professional interventions, as well as comparative multi-site qualitative studies across rural schools in Papua and other eastern Indonesian provinces. Such research would contribute valuable evidence to support the development of equity-focused digital education policies for Indonesia's most geographically marginalized communities.

ACKNOWLEDGEMENT

The author would like to express sincere gratitude to the supervisors for their invaluable guidance, constructive feedback, and continuous support throughout this study. The author also extends sincere appreciation to the principal, English teacher and the students of SMA Negeri 1 Wamena, Papua for their willingness to participate and for their valuable cooperation during the research process.

REFERENCES

Akbar, I. A., Handoyo, E., & Rokhman, F. (2025). *Kebijakan Pengembangan Mutu Pendidikan Akademi Kepolisian dalam Rangka Meningkatkan Daya Saing Bangsa*. Crossroad Research



- Journal*, 2(6), 62–69. <https://doi.org/10.61402/crj.v2i6.511>
- Boymau, L. T., & Hidayati, S. (2025). Unpacking Rural English Teachers' Perspectives on Digital Learning Tools. *JPI (Jurnal Pendidikan Indonesia)*, 14(1), 101–110. <https://doi.org/10.23887/jpiundiksha.v14i1.84506>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Čotar, K., & Štemberger, T. (2023). Teacher Educators' Attitudes Towards Using Digital Technologies for Learning and Teaching: The Case of Slovenia. *International Journal of Emerging Technologies in Learning (iJET)*, 18(17), 45–55. <https://doi.org/10.3991/ijet.v18i17.41095>
- Creswell, J. W. (2017). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. SAGE Publications.
- Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
- Eshet, Y. (2004). Digital Literacy: A Conceptual Framework for Survival Skills in the Digital Era. *Journal of Educational Multimedia and Hypermedia*, 13(1), 93–106.
- Gilster, P. (1997). *Digital Literacy*. Wiley & Sons, Inc.
- Hidayat, T., Rafadewi A. Putri, A., & Purwaningsih, W. (2024). TPACK Profile of Biology Teachers During Their Learning Process After Participating in Numerical Taxonomy and its Training Program. *KnE Social Sciences: International Conference on Mathematics and Science Education*, 74–84. <https://doi.org/10.18502/kss.v9i13.15909>
- Kusuma, I. P. I. (2022). EFL teachers' online teaching in rural schools during the COVID-19 pandemic: Stories from Indonesia. *Studies in English Language and Education*, 9(1), 203–221. <https://doi.org/10.24815/siele.v9i1.21239>
- Lincoln, Y. S., & Guba, E. G. (2014). *Naturalistic Inquiry*. Sage Publication.
- Maskanah, U. (2025). Integration of TPACK in PAI Learning in the Digital Age: A Literature Review. *Ar-Raudhah: Journal of Islamic Religious Education*, 1(1), 9–21.
- Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, 108(6), 1017–1054. <https://doi.org/10.1111/j.1467-9620.2006.00684.x>
- Murtadho, M. I., Rohmah, R. Y., Jamilah, Z., & Furqon, M. (2023). The Role Of Digital Literacy In Improving Students' Competence In Digital Era. *AL-WIJDĀN Journal of Islamic Education*



- Studies*, 8(2), 253–260. <https://doi.org/10.58788/alwijdn.v8i2.2328>
- Pan, L., Haq, S. ul, Shi, X., & Nadeem, M. (2024). *The Impact of Digital Competence and Personal Innovativeness on the Learning Behavior of Students: Exploring the Moderating Role of Digitalization in Higher Education Quality*. *Sage Open*, 14(3). <https://doi.org/10.1177/21582440241265919>
- Petko, D., Koehler, M. J., & Mishra, P. (2024). *Placing TPACK in context: Looking at the big picture*. *Computers and Education Open*, 7, 100236. <https://doi.org/10.1016/j.caeo.2024.100236>
- Quraishi, T., Ulusi, H., Muhid, A., Hakimi, M., & Olusi, M. (2024). *Empowering Students Through Digital Literacy: A Case Study of Successful Integration in a Higher Education Curriculum*. *Journal of Digital Learning and Distance Education*, 2(8), 667–681. <https://doi.org/10.56778/jdlde.v2i8.208>
- Rosa, K. S. (2017). *The State of America's Libraries 2017: A Report from the American Library Association*. American Libraries.
- Sánchez-Cruzado, C., Santiago Campión, R., & Sánchez-Compañía, M. T. (2021). *Teacher Digital Literacy: The Indisputable Challenge after COVID-19*. *Sustainability*, 13(4), 1858. <https://doi.org/10.3390/su13041858>
- Sari, R. M., Urfan, F., Sahudra, T. M., & Ridhwan, R. (2025). *Disparity Mapping of Rural-Urban High School Teachers' TPACK Level*. *Indonesian Journal of Geography*, 57(2), 262–271. <https://doi.org/10.22146/ijg.97110>
- Shambare, B., & Simuja, C. (2024). *Mapping TPACK Competency among Life Sciences Teachers in Rural and Marginalised Secondary Schools: A Descriptive Analysis*. *International Journal of Technology in Education and Science*, 8(4), 522–541. <https://doi.org/10.46328/ijtes.573>
- Thompson, K. M., Jaeger, P., Taylor, N., Subramaniam, M., & Bertot, J. (2014). *Digital Literacy and Digital Inclusion: Information Policy and the Public Library*. New York.
- Tseng, J.-J., Chai, C. S., Tan, L., & Park, M. (2022). *A critical review of research on technological pedagogical and content knowledge (TPACK) in language teaching*. *Computer Assisted Language Learning*, 35(4), 948–971. <https://doi.org/10.1080/09588221.2020.1868531>
- Usman, S., Arafah, B., Marhum, M., Munir, S., Budi, & Tadeko, N. (2024). *The Effect of Technological Pedagogical Content Knowledge (TPACK) on Rural Area Students' English Writing*. *Journal of Language Teaching and Research*, 15(3), 884–892. <https://doi.org/10.17507/jltr.1503.21>
- Valtonen, T., Sointu, E., Kukkonen, J., Kontkanen, S., Lambert, M. C., & Mäkitalo-Siegl, K. (2017).



- TPACK updated to measure pre-service teachers' twenty-first century skills. Australasian Journal of Educational Technology, 33(3), 15–31. <https://doi.org/10.14742/ajet.3518>*
- Venkatesh, V., Morris, M., Davis, G., & Davis, F. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27(3), 425–478. <https://doi.org/10.2307/30036540>*
- Voogt, J., Fisser, P., Pareja Roblin, N., Tondeur, J., & van Braak, J. (2013). Technological pedagogical content knowledge – a review of the literature. *Journal of Computer Assisted Learning, 29(2), 109–121. <https://doi.org/10.1111/j.1365-2729.2012.00487.x>*
- Yin, R. (2018). *Case study research and applications*. SAGE Publications.

