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IPS Teachers Readiness for Integrating Artificial Intelligence into Instruction in Rural Schools: A Multisite I-TPACK Analysis in Tuban Regency

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Abstract

The integration of artificial intelligence (AI) into Social Studies (IPS) learning in rural schools faces unmapped structural challenges, particularly through an Intelligent-TPACK (I-TPACK) lens. This study analyzes IPS teachers' readiness to integrate AI as a learning medium in rural schools of Tuban Regency using an I-TPACK framework incorporating AI ethics dimensions. A qualitative multi-site case study design was applied across three state junior high schools. Data were collected through semi-structured interviews (n=9 IPS teachers, 3 principals, 6 students), classroom observations (18 sessions), and document analysis. Findings show strong competency in Content Knowledge (CK) and Pedagogical Knowledge (PK) domains, but critical gaps in Intelligent-Technological Knowledge (I-TK) and cross-domain integration. The central finding is the belief-practice gap phenomenon, exacerbated by three inhibitor clusters: inadequate digital infrastructure, restrictive institutional policies, and low AI-related self-efficacy. This study contributes a contextualized I-TPACK model for Indonesian rural schools and evidence-based policy recommendations.

Keywords: IPS, Teacher Readiness, Artificial Intelligence, I-TPACK, Rural Schools, Social Studies Learning, Belief-Practice Gap, Digital Divide

1. INTRODUCTION

The penetration of artificial intelligence (AI) into the global education system has accelerated at an unprecedented pace (Pambudi et al., 2023). Since the release of ChatGPT in late 2022, the adoption of generative AI in classrooms has increased dramatically, compelling education policymakers worldwide, including those in Indonesia, to respond in a more systemic manner (Xie et al., 2024). The Indonesian government has signaled its intention to integrate AI learning into primary and secondary education starting in the 2025-2026 academic year, in line with the implementation of the Merdeka Curriculum, which promotes project-based learning, twenty-first-century competencies, and digital literacy (Langoday et al., 2024). However, behind this policy optimism lies a substantial

implementation gap between national aspirations and local realities, particularly in rural areas (Hidayat & Nuruzzaman, 2024).

Social Studies, as a subject concerned with social interaction, societal values, and contextual issues, offers both significant potential and distinctive complexity for AI integration (Syahrial, 2025). Unlike subjects grounded primarily in calculation and procedural problem-solving, Social Studies learning requires value reflection, historical empathy, and the development of civic awareness, dimensions that demand careful ethical consideration when engaging with AI-based tools (Baihaqi et al., 2024). Therefore, the integration of AI into Social Studies is not merely a technical issue, but also a pedagogical and ethical one (Syahrial & Santoso, 2025).

Research on teachers' readiness to integrate AI in Indonesia remains contextually limited. Existing studies have largely focused on English teachers, biology teachers, or higher education settings. Social Studies teachers at the junior secondary level, particularly those working in rural schools, have not received proportional scholarly attention (Karakaya et al., 2025). This gap becomes even more significant when considering the distinctive characteristics of rural schools in terms of infrastructure, institutional support, and access to professional resources (Kurniati et al., 2020).

From a theoretical perspective, the Technological Pedagogical Content Knowledge (TPACK) framework developed by Koehler and Mishra has served as a foundational lens for analyzing teachers' technological competence (Ali et al., 2023). However, the emergence of generative AI calls for an extension of this framework. Several scholars have proposed AI-oriented expansions of TPACK. Mishra et al. (2023) introduced Intelligent-TPACK (I-TPACK), which incorporates the ethical dimension of AI, while Karaduman and Akman (2024) proposed an I-TPACK framework that emphasizes validation, prompt engineering, and human-AI collaboration. Castro et al. (2025) specifically applied I-TPACK in the context of rural teachers and found that teachers in remote areas tended to prefer offline-based AI tools as an adaptive response to infrastructural limitations, a finding that is highly relevant to the present study.

The research gap underpinning this study is threefold. First, no study has specifically examined the readiness of junior secondary Social Studies teachers to integrate AI through the I-TPACK framework in the context of rural Indonesia. Second, the belief-practice gap, namely the discrepancy between teachers' perceived technological competence and their actual implementation of AI in classroom practice, has not been systematically documented in rural Indonesian schools. Third, the factors that mediate or moderate the relationship between TPACK and AI adoption readiness in rural Indonesian schools have not yet been empirically identified through field-based multisite research. This study addresses these three gaps through a multisite case study conducted in Tuban Regency, East Java.

Based on this background, the study is guided by three research questions: (1) What is the profile of Social Studies teachers' readiness in rural schools in Tuban Regency to integrate AI based on the I-TPACK framework? (2) How does the belief-practice gap manifest in AI supported Social Studies teaching practices in rural schools? and (3) What factors hinder and enable Social Studies teachers' readiness to integrate AI in the rural school context?.

2. RESEARCH METHOD

2.1 Research Approach and Design

This study employed a qualitative approach using a multi-site case study design (Astutik et al., 2022). A multi-site case study enables theoretical replication across different contexts, thereby enhancing the transferability of the findings compared with a single-case design (Audet & d'Amboise, 2021). This design was selected because of its suitability for capturing the complexity of teacher readiness as a contextual, holistic phenomenon that cannot be adequately measured through a purely quantitative approach (Kusumaningrum & Abduh, 2022). The study was grounded in an interpretivist paradigm, which conceptualizes teacher readiness as a construct shaped by the interaction of individual agency, institutional structures, and the socio-cultural context of rural schooling.

2.2 Research Sites and Participants

The study was conducted in three public junior secondary schools located in rural areas of Tuban Regency, East Java: (a) SMPN 1 Jenu (Site A), (b) SMPN 2 Grabagan (Site B), and (c) SMPN 1 Merakurak (Site C). These schools were purposively selected based on the following criteria: (1) they are located in subdistricts classified as rural or semi-urban according to data from the Tuban Statistics Agency; (2) they employ active Social Studies teachers with a minimum of three years of teaching experience; and (3) they were willing to participate voluntarily in the study.

The participants consisted of nine Social Studies teachers, three from each school, three principals, and six students. They were selected using purposive sampling, a non-probability sampling technique in which the researcher intentionally selects participants based on specific criteria relevant to the objectives of the study (Yusuf et al., 2021). This sampling strategy was used to ensure variation in age, teaching experience, ranging from 3 to 20 years, and level of digital literacy. Participant identities were coded as G1-G9 for teachers, KS1-KS3 for principals, and S1-S6 for students to maintain confidentiality.

2.3 Data Collection Techniques

Data were collected through three complementary techniques. First, semi-structured interviews were conducted for 45 to 60 minutes with each participant using an interview guide developed from the seven constructs of I-TPACK (Chang et al., 2024), with an additional dimension related to AI ethics. Second, classroom observations were conducted in two sessions for each teacher, resulting in a total of 18 observations, with each session lasting approximately 80 minutes. These observations used a structured observation protocol to document the frequency, types, and quality of AI integration in classroom instruction. Third, document analysis was carried out on lesson plans, teaching modules, records of technology use, and school policies related to educational technology.

2.4 Trustworthiness and Data Validity

The trustworthiness of the data was ensured through four strategies: (1) source triangulation involving teachers, principals, and students; (2) method triangulation involving interviews, observations, and documents; (3) member checking, in which participants verified summaries of the findings; and (4) thick description, which enables

readers to assess the transferability of the findings to similar contexts (Suci & Fathiyah, 2023). Researcher reflexivity was maintained through the use of an audit trail and a research journal.

2.5 Data Analysis

Data analysis followed Braun and Clarke's six-phase thematic analysis procedure, which includes data familiarization, initial coding, theme searching, theme reviewing, theme defining, and report production (Braun & Clarke, 2006). Cross-site analysis was conducted by comparing the I-TPACK profiles across the three schools to identify recurring cross-site patterns as well as contextual variations. The analytical matrix was developed based on the seven domains of I-TPACK to facilitate a comparative visualization of teacher readiness profiles (Chang et al., 2024). NVivo 14 was used to support systematic coding, data organization, and thematic retrieval throughout the analysis process.

3. Result and Discussion

3.1 Profile of Social Studies Teachers' Readiness: Cross-Domain I-TPACK Competence

The cross-site analysis revealed variations in teachers' I-TPACK profiles, while also demonstrating consistent patterns across specific domains. Table 1 summarizes the key findings from the three research sites.

Table 1. Profile of Social Studies Teachers' Readiness Across I-TPACK Domains (A Multisite Study, Tuban, 2025)

I-TPACK Domain	Site A (SMPN 1 Jenu)	Site B (SMPN 2 Grabagan)	Site C (SMPN 1 Merakurak)	Analytical Notes
Content Knowledge (CK)	High	High	High	Strongly supported by teaching experience
Pedagogical Knowledge (PK)	Moderate to High	Moderate	Moderate	Fairly strong, but not yet integrated with AI
Technological Knowledge (TK)	Low	Very Low	Low to Moderate	Main barrier to AI integration
Pedagogical Content Knowledge (PCK)	High	Moderate to High	High	Strong in contextualized instruction
Technological Content Knowledge (TCK)	Low	Very Low	Low	Critical gap
Technological Pedagogical Knowledge (TPK)	Low	Very Low	Low	Critical gap
TPACK (Holistic Integration)	Low to Moderate	Low	Moderate	Clear cross-site disparity

All Social Studies teachers demonstrated strong Content Knowledge (CK), particularly in topics such as social interaction, population dynamics in Tuban, local history, and contemporary social issues. Their extensive teaching experience, with an average of 11.3 years, contributed significantly to the depth of this content mastery. This finding is consistent with the study by Sepadi et al. (2025), which identified teaching experience as a strong predictor of both CK and PCK. As one teacher explained:

> *"I have been teaching Social Studies for more than 15 years. I already master the subject matter, and I know exactly which concepts are difficult for students to understand and which strategies are effective. What I still do not know is how AI can help me teach those concepts more effectively." (G3, Site A)*

The Pedagogical Knowledge (PK) domain was found to be at a moderate to high level. Teachers were able to design contextual learning strategies grounded in local phenomena by employing group discussions, case studies, and field visits. However, when asked to integrate AI into these pedagogical strategies, almost all teachers struggled to articulate how such integration could be meaningfully achieved. This finding reinforces the argument of Wijanarko et al. (2025) that many Indonesian teachers still lack a cross-domain understanding of how TPACK is implemented in classroom practice.

The most consistent finding across the three sites was the weakness of the I-TK domain. Most teachers were only superficially familiar with AI. They were able to use ChatGPT to generate test items or summarize learning materials, yet they did not understand how large language models (LLMs) work, the risks of AI hallucinations, or the implications of student data privacy. This finding parallels the study by Sepadi et al. (2025), which showed that even when technology is available, rural teachers still lack the competence to use it pedagogically. The issue, therefore, is not merely one of accessibility, but of the depth of understanding required for meaningful integration.

This gap in I-TK carries cascading implications. Low I-TK directly constrains the development of composite domains, particularly I-TCK and I-TPK, as well as the holistic integration of I-TPACK. In a comparative study, Zhang et al. (2024) demonstrated that I-TK functions as a structural prerequisite for all composite TPACK domains. Without an adequate I-TK foundation, efforts to develop I-TCK and I-TPK cannot proceed organically.

One finding that distinguishes this study from previous research is the identification of a gap in the AI ethics dimension, a distinctive component of I-TPACK that is absent from the classical TPACK framework. Nearly all teachers had never received any information about algorithmic bias, student data privacy, or the ethical considerations surrounding the use of AI in children's education. This creates a specific risk: teachers who use AI without ethical understanding may inadvertently expose student data or adopt AI-generated outputs that contain cultural bias. This finding confirms the need to incorporate an ethical dimension into the I-TPACK framework (Celik, 2023).

3.2 *The Belief-Practice Gap: Between Perceived Readiness and Actual Implementation*

A central finding of this study is the empirical confirmation of a belief-practice gap in the context of AI integration in rural schools. The majority of teachers, seven out of nine, identified themselves in the pre-observation questionnaire as fairly confident AI users. However, classroom observation data from 18 sessions showed that only three teachers had ever mentioned or demonstrated AI to students, and none used AI as a core instructional medium within a deliberately planned lesson design.

The AI use that was identified remained largely instrumental and administrative in nature, including generating multiple-choice questions, reported by six teachers, searching for images or illustrations, reported by four teachers, and producing summaries of learning materials to be transferred to the whiteboard, reported by two teachers. No evidence was found of pedagogically transformative uses of AI, such as employing AI as a student discussion partner, providing adaptive scaffolding, or conducting AI-assisted analysis of learning outcomes. This gap appears more pronounced than that reported by Suryanto and Ulya (2025) for Indonesian language teachers, suggesting that AI, as a relatively new technology, generates a deeper gap than general digital technologies.

Teachers' interview narratives provide a multi-layered explanation for this gap. As one teacher explained:

> *"I know that AI is important and useful. I have tried using ChatGPT to create test questions, and the results were indeed good. However, I am still confused about how to use it with students in the classroom. Should I ask students to open their laptops? Not all of them have one. On top of that, the internet signal at school often goes down, so I cannot realistically plan to use AI in class." (G5, Site B)*

This quotation reveals three interrelated layers of the belief-practice gap. First, there is a competency gap, as knowledge about AI does not automatically translate into AI-based pedagogical strategies. Second, there is an infrastructure gap, as unpredictable technical conditions constrain teachers' ability to design AI-supported instruction. Third, there is a device ownership gap, as unequal access to digital devices among students creates a dilemma of equity that discourages collective classroom use.

Ismaniati et al. (2025) provide a theoretical explanation for this phenomenon by arguing that self-efficacy mediates the relationship between TPACK and teachers' intention to adopt AI. Even teachers with sufficient TPACK are unlikely to integrate AI if their AI-related self-efficacy remains low. In rural contexts, this low self-efficacy is further exacerbated by the absence of peer learning networks, as teachers often lack colleagues who can serve as role models for effective AI integration.

3.3 *Mapping the Barriers: A Three-Cluster Analysis*

Drawing on interview, observation, and document analysis, this study identified three interrelated clusters of barriers. Table 2 summarizes the findings alongside triangulated evidence from previous studies.

Table 2. Clusters of Factors Hindering IPS Teachers' Readiness for AI Integration

Category of Factors	Empirical Indicators	References
Infrastructure	Unstable internet access, low bandwidth, and classrooms without signal coverage	Erita et al. (2025); Sepadi et al. (2025); Joseph & Uzondu (2024)
Institusional	Restrictive Policies on Digital Devices: Varying Principal Support	Purnama et al. (2025); Castro et al. (2025); Sepadi et al. (2025)
Individual	Low Self-Efficacy, Generational Gap, and Discomfort with Generative AI	Harahap & Siregar (2025); Triandro et al. (2025); Ismaniati et al. (2025)

Limited internet access emerged as the most dominant and consistent barrier across the three sites. At Site B (SMPN 2 Grabagan), several classrooms did not even receive adequate cellular signal, making the use of cloud-based AI practically impossible. In their study on AI integration in Social Studies learning in Indonesia, Erita et al. (2025) identified limited digital infrastructure as a significant cross-regional barrier. The principal of Site B explained:

> *"We have tried to provide WiFi, but the bandwidth is extremely limited, only 10 Mbps for the entire school with 400 students. When used simultaneously, it is practically impossible to support streaming or AI applications. During the rainy season, the signal often disappears completely." (KS2, Site B)*

Castro et al. (2025), in their study of rural teachers, found that teachers' preference for offline-based AI reflected an adaptive response to connectivity constraints, an important practical implication that is often overlooked in policies designed on the basis of urban assumptions. Joseph and Uzondu (2024) similarly emphasized that educational leaders in remote areas need to consider offline-first solutions in AI implementation, an approach that was not evident in any of the three schools examined in this study.

A particularly noteworthy finding of this study is the significant difference in readiness between Site C (SMPN 1 Merakurak) and the other two sites. Site C demonstrated a relatively better I-TPACK profile, although it still remained within the overall low category. This difference can be directly linked to the principal's technology-oriented leadership. The principal of Site C regularly organized knowledge-sharing sessions on AI, permitted the use of personal mobile phones for learning purposes, and advocated for a more flexible interpretation of national policies regarding gadget use in schools. A teacher from Site C stated:

> *"Our principal is very supportive. He often organizes small AI training sessions, even though the equipment is quite limited. That has really helped us gain a clearer picture of what can actually be done." (G8, Site C)*

This finding confirms the argument of Purnama et al. (2025) that institutional support is a determining factor in teachers' readiness for AI. Sepadi et al. (2025) also showed that, in rural contexts, principal support has a greater multiplier effect than in urban settings because alternative sources of support are far more limited.

Individual factors operated differently across age groups. Teachers under the age of 35 demonstrated a higher level of independent exploration of AI, even though they had not yet integrated it into classroom instruction. By contrast, senior teachers, those over 45 years old, tended to have lower AI-related self-efficacy and were generally more skeptical about the relevance of AI for IPS. Ismaniati et al. (2025) empirically demonstrated that self-efficacy mediates the relationship between TPACK and AI adoption intention, reinforcing the interpretation that interventions aimed at strengthening self-efficacy should form an integral part of AI training programs for teachers.

However, it is important to note that Triandro et al. (2025) found that psychological inhibitory factors were no longer significant among teachers who were already digitally mature, suggesting that the main challenges are structural rather than merely individual. The implication is that intervention programs cannot focus solely on building individual confidence without simultaneously addressing structural and infrastructural barriers.

3.4 *Theoretical* Implications: Toward a Contextualized I-TPACK Model

The findings of this study offer several theoretical contributions that enrich and extend the existing I-TPACK literature. First, this study confirms that I-TK, rather than CK or PK, is the most critical domain in determining the level of holistic I-TPACK integration in the context of AI. This finding updates the classical view of Koehler and Mishra (2006), in which TK was often treated as a minimal prerequisite rather than a key differentiating factor. In the context of AI, I-TK should instead be regarded as an architectural foundation that cannot be substituted.

Second, this study identifies institutional factors, particularly principal support, as a stronger moderating variable than individual factors in explaining variations in I-TPACK levels across rural schools. This finding extends the self-efficacy mediation model proposed by Ismaniati et al. (2025) by introducing institutional enablement as a necessary condition for individual self-efficacy to function effectively as a mediator.

Third, this study proposes a Rural Contextual I-TPACK (RCI-TPACK) model that integrates four contextual dimensions into the standard I-TPACK framework: (a) Infrastructure Sensitivity, referring to responsiveness to connectivity limitations; (b) Institutional Climate, referring to the degree of institutional support; (c) Subject-Specific Ethical Reasoning, referring to ethical considerations specific to IPS as a value-laden subject; and (d) Community Embeddedness, referring to alignment with the socio-cultural context of rural communities. This model responds to the limitations of standard I-TPACK frameworks, which have largely been developed on the basis of urban or developed-country contexts.

3.5 *Practical* Implications: Evidence-Based Recommendations

Based on the empirical findings, this study proposes three evidence-based recommendations. First, digital infrastructure policies should meet the minimum operational requirements for AI implementation, including internet speeds of at least 25 Mbps with reliable uptime, device availability at a 1:3 ratio or one device for every three students, and the exploration of offline-based AI solutions as a complement to cloud-based systems. Erita et al. (2025) and Castro et al. (2025) both emphasize that without these minimum infrastructure conditions, AI training programs are unlikely to translate into meaningful classroom practice.

Second, the design of professional development programs should shift from a one-size-fits-all model toward a rural-contextualized model. Such programs should: (a) strengthen I-TK through structured and sustained hands-on experience rather than one-off workshops; (b) build peer learning networks among IPS teachers across rural schools; and (c) explicitly integrate the AI ethics dimension as a core component rather than a supplementary addition.

Third, the capacity of school principals as innovation champions needs to be strengthened systematically. The positive variation observed at Site C indicates that principals with a technology-oriented leadership style can partially compensate for structural barriers through adaptive leadership. Principal certification and leadership development programs should therefore include AI leadership competence as a mandatory component.

4. Conclusion

This study shows that the readiness of IPS teachers in rural schools in Tuban Regency to integrate artificial intelligence into classroom instruction remains generally limited. While teachers demonstrated relatively strong content and pedagogical knowledge, weaknesses in intelligent technological knowledge constrained the development of functional I-TPACK. The findings also confirm a clear belief-practice gap, in which teachers' perceived readiness to use AI was not reflected in actual classroom implementation.

The study further reveals that AI integration in rural schools is shaped by the interaction of infrastructural, institutional, and individual barriers, with principal support emerging as a critical enabling factor. By documenting this gap and proposing a Rural Contextual I-TPACK model, this study contributes to the growing literature on AI integration by showing that teacher readiness in rural contexts cannot be understood apart from local infrastructure, institutional climate, ethical awareness, and community conditions.

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