

EXPLORING TEACHERS' DIGITAL READINESS IN RURAL INDONESIA: A CASE STUDY OF INFRASTRUCTURE AND TECHNOLOGY ACCESS IN A 3T AREA

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ABSTRACT

This study explores teachers' professional digital readiness in facing digital transformation by examining access to infrastructure and technology in a rural senior high school located in a 3T area of Indonesia. Using a qualitative case study design, this research involved seven teachers from a public senior high school in East Kolaka Regency, Southeast Sulawesi. Data were collected through semi-structured interviews and analyzed using thematic analysis to capture teachers' experiences, challenges, and institutional conditions related to digital learning implementation. The findings indicate that teachers generally possess basic digital literacy and positive attitudes toward technology use. However, digital practices remain limited to fundamental tools and are not yet pedagogically integrated. Teacher digital readiness is influenced by internal factors, such as motivation, confidence, and prior experience, as well as external factors, including limited device availability, unstable internet connectivity, insufficient professional development, and unequal student access to technology. The study further demonstrates that inadequate infrastructure constrains the translation of teacher readiness into sustained digital practice. This study contributes a micro-level and contextualized understanding of teacher digital readiness in rural 3T contexts, highlighting the interplay between individual, institutional, and infrastructural factors, and offers implications for developing more inclusive and context-responsive digital education policies.

Keywords: Digital Readiness; Digital Transformation; Rural Education; Qualitative Case Study; 3T Areas

INTRODUCTION

Digital transformation has become a central agenda in contemporary education, reshaping teaching practices, learning environments, and the professional demands placed on teachers. Within this context, teacher digital readiness refers to teachers' capacity to effectively integrate digital technologies into pedagogical practices, encompassing not only technical skills but also attitudes, confidence, pedagogical understanding, and access to supportive infrastructure (Gisbert Cervera & Lázaro Cantabrana, 2015; Hanifah & Nadlifatin, 2024). Accordingly, teacher digital readiness is conceptualized as a multidimensional construct influenced by individual competence, institutional support, and technological conditions.

In Indonesia, efforts to advance educational digitalization have intensified through various national initiatives aimed at strengthening teachers' digital competence and expanding technology-based learning (Ista Maharsi, Muhammad Izam Ghali, 2019). However, empirical evidence indicates that the implementation of digital transformation remains uneven, particularly in underdeveloped, frontier, and outermost (3T) areas (Hamsiah et al., 2024). Schools in rural regions frequently encounter persistent challenges related to limited technological infrastructure, unstable internet connectivity, and restricted access to digital learning resources (Nasir, Kiftiah, et al., 2025; Subroto et al., 2023). These structural constraints significantly affect teachers' opportunities to develop and meaningfully apply digital competencies in classroom practices.

Previous studies consistently identify teacher digital readiness as a key determinant of successful digital transformation in education (Softić, 2022). Research across diverse contexts demonstrates that readiness is shaped by teachers' technological competence, motivation, professional experience, and access to continuous institutional support and professional development (Dewi et al., 2025; GEN Islawati et al., 2025; Nasir & Munawir, 2022). International literature further emphasizes that teacher digital readiness extends beyond device ownership, highlighting the importance of pedagogical adaptation, confidence, and context-responsive training aligned with authentic instructional challenges (Ali et al., 2023; Chigeza et al., 2014).

Despite these insights, prior research also reports that digital training initiatives often fail to produce sustainable outcomes due to inadequate infrastructure and weak managerial or leadership support, particularly in non-urban settings (Anggraini et al., 2025; Saputra et al., 2025). Teachers in rural schools frequently face access barriers that limit consistent technology use, resulting in fragmented and temporary digital practices rather than sustained pedagogical integration. Studies conducted in rural contexts suggest that effective technology adoption requires not only individual readiness but also supportive leadership, adaptive institutional policies, and locally responsive infrastructure (Mustafa, 2025; Panjaitan et al., 2025).

However, the majority of existing studies on teacher digital readiness rely on large-scale surveys or macro-level analyses and predominantly focus on urban or semi-urban educational settings with relatively adequate infrastructure (Hidayati et al., 2023; Imaduddin & Firdaus, 2025). Consequently, these studies tend to overlook the micro-level realities of teachers working in rural and 3T regions, where geographical, social, and infrastructural conditions profoundly shape digital practices. Empirical investigations that explore teachers' lived experiences, perceptions, and readiness within such contexts remain limited (khan, 2025; Rachel et al., 2025).

Addressing this gap, the present study adopts a qualitative case study approach to examine teachers' professional digital readiness for educational transformation in a rural senior high school located in a 3T area of East Kolaka Regency, Southeast Sulawesi, Indonesia. Unlike previous large-scale research, this study provides a micro-level and contextualized analysis that captures teachers' lived experiences, challenges, and adaptive strategies under constrained infrastructural conditions. The novelty of this research lies in its in-depth exploration of teacher digital readiness within a rural 3T context, highlighting how individual, institutional, and infrastructural factors interact in shaping digital transformation at the school level.

Accordingly, this study aims to: (1) analyze the level of teachers' professional digital readiness in facing digital transformation in a rural senior high school, (2) identify internal and external factors influencing such readiness, and (3) evaluate the effectiveness of technological infrastructure in supporting digital learning. The findings are expected to contribute theoretically by enriching the literature on teacher digital readiness from a contextual and micro-level perspective, and practically by informing policymakers and educational stakeholders in designing more responsive professional development programs, infrastructure provision, and educational policies tailored to the needs of rural and 3T regions. Thus, this study not only fills the existing empirical gap but also contributes methodologically by employing a qualitative lens to provide a nuanced, micro-level understanding of teacher digital readiness in rural 3T settings.

METHODS

This study employed a qualitative approach using a case study design to explore teachers' professional digital readiness in facing digital transformation within a rural senior high school context. A qualitative case study was considered appropriate because it allows for an in-depth examination of participants' experiences, perceptions, and meanings as situated within their real-life educational environment.

The study was conducted at a public senior high school located in East Kolaka Regency, Southeast Sulawesi, Indonesia, over a one-month period in 2025. The research site was selected purposively as it represents schools in underdeveloped, frontier, and outermost (3T) areas that face persistent challenges related to limited technological infrastructure, unstable internet connectivity, and restricted access to digital learning resources.

The participants consisted of seven educators representing diverse subject areas and institutional roles, including two English teachers, one Indonesian language teacher, one Biology teacher, one Geography teacher, one Hindu religious education teacher, one Christian religious education teacher, and the school principal. This diversity was intentionally designed to capture multiple pedagogical and leadership perspectives on digital transformation within the school context.

Purposive sampling was applied using specific criteria: (1) participants had a minimum of five years of teaching experience at the secondary school level, ensuring adequate professional exposure to curriculum changes and digital initiatives; and (2) participants had attempted to integrate digital technology into their instructional or managerial practices. These criteria ensured that participants possessed relevant experiential knowledge and could provide information-rich data aligned with the research objectives. The inclusion of teachers from different subject areas, as well as the school principal, enabled the study to obtain varied perspectives on teacher digital readiness, institutional support, and infrastructural challenges, thereby enhancing the depth and richness of the data.

The sample size of seven participants was considered sufficient for this qualitative case study, as data saturation was achieved when no new themes or substantive insights emerged during the final interviews. The focus of the study was on depth of understanding rather than statistical representativeness, and the variation in participants' backgrounds contributed to the credibility and robustness of the findings.

Data were collected through semi-structured, face-to-face interviews to allow flexibility in exploring participants' perspectives while maintaining focus on key aspects of the study. The interview guide addressed teachers' digital competencies, experiences in using technology, challenges encountered, and institutional support for digital learning. All interviews were audio-recorded with participants' consent to ensure data accuracy.

In this study, the researcher served as the primary instrument for data collection and interpretation. To ensure confidentiality and ethical integrity, pseudonyms were assigned to all participants, namely Alya, Armin, Gani, Ridwan, Wawan, Miswar, and Edo.

Data analysis was conducted using thematic analysis following a systematic and transparent coding procedure. First, interview recordings were transcribed verbatim and read repeatedly to achieve data familiarization. Second, open coding was applied to identify meaningful units related to teachers' digital readiness, challenges, and supporting factors. Third, similar codes were grouped into broader categories through axial coding. Finally, these categories were refined into overarching themes that reflected patterns across participants' responses. The identified themes were then interpreted in relation to the research objectives to provide a comprehensive understanding of teachers' professional digital readiness for digital transformation.

To ensure trustworthiness, data credibility was enhanced through triangulation and member checking. Triangulation was conducted by comparing responses across participants to identify consistent patterns, while member checking involved validating preliminary interpretations with selected participants. Ethical considerations were addressed by informing participants of the research purpose, obtaining voluntary informed consent, and ensuring that all data were used solely for academic purposes.

RESULTS

This study involved seven teachers from a public senior high school in East Kolaka Regency, Southeast Sulawesi. Data were generated through in-depth interviews to explore teachers' professional digital readiness in facing digital transformation under limited infrastructural conditions. The analysis resulted in three main themes that directly address the research objectives: (1) teachers' professional digital readiness, (2) internal and external factors influencing readiness, and (3) the effectiveness of technological infrastructure in supporting digital learning.

Teacher Professional Digital Readiness toward Digital Transformation

The findings reveal that teachers' digital readiness was generally at a basic level, with most participants relying on fundamental digital tools such as presentation software, projectors, and instructional videos. Although teachers demonstrated positive attitudes and openness toward digital technology, this readiness was not consistently translated into advanced or pedagogically integrated digital practices. This contrast highlights a gap between teachers' willingness to engage with technology and their capacity to implement it in more complex instructional contexts. As one teacher explained, "I usually use PowerPoint and videos; that's what I'm familiar with" (Alya).

Teachers also reported difficulties when adapting to new digital platforms, particularly those requiring unfamiliar technical skills or pedagogical adjustments. These

challenges suggest that teachers' readiness was constrained not by resistance to technological change, but by limited exposure, insufficient hands-on practice, and the absence of structured professional guidance. This condition was reflected in a participant's statement: "If there is a new application, I need a lot of time to learn it" (Gani). Overall, the findings indicate that teacher digital readiness in the research context was characterized by basic competence and strong motivation, yet lacked depth in terms of instructional innovation and sustained digital integration.

Internal and External Factors Affecting Teachers' Digital Readiness

The analysis indicates that teachers' digital readiness was shaped by an interaction of internal and external factors. Internally, confidence, motivation, and prior experience influenced teachers' engagement with digital tools. Participants who felt confident using basic technologies were more willing to experiment with digital materials, whereas those with limited experience tended to hesitate when encountering unfamiliar platforms. One participant noted, "I'm confident with basic tools, but beyond that, I still hesitate" (Alya).

Externally, infrastructural and institutional conditions exerted a strong influence on teachers' readiness. Limited availability of devices required teachers to share equipment, reducing flexibility in lesson planning and digital implementation. Unstable internet connectivity further restricted access to online resources and often compelled teachers to abandon planned digital activities. As one teacher stated, "The Wi-Fi is often slow, so digital activities don't run smoothly" (Wawan). These internal and external constraints collectively limited teachers' capacity to maintain consistent technology integration.

Effectiveness of Technological Infrastructure in Supporting Digital Learning

The findings demonstrate that the existing technological infrastructure was not yet effective in supporting sustained digital learning. Limited access to devices, unstable internet connectivity, and hardware performance issues were consistently identified as major barriers. These infrastructural limitations reduced teachers' confidence in planning technology-based instruction and reinforced a reliance on conventional teaching approaches. One participant explained, "Sometimes I want to use the projector, but it is already being used by another class" (Armin).

Furthermore, disparities in students' access to digital devices and internet connectivity intensified these challenges. Even when teachers were prepared to implement digital tools, inconsistent student access hindered continuous application in classroom settings. As a result, digital learning practices tended to be sporadic and situational rather than systematically integrated into instructional routines. Taken together, these findings indicate that technological infrastructure in the research site functioned more as a constraining factor than as an enabling condition for digital transformation.

DISCUSSION

Teacher Professional Digital Readiness in Facing Digital Transformation

The findings of this study indicate that teachers' professional digital readiness in the research context remains at a developing stage. Although teachers demonstrated

basic digital literacy and positive attitudes toward technology use, their instructional practices were largely confined to fundamental tools such as presentation slides and videos. This finding is consistent with previous studies conducted in both Indonesian and international contexts, which report that basic digital competence alone is insufficient to support meaningful and transformative digital pedagogy (Chigeza et al., 2014; Dewi et al., 2025).

Importantly, this study extends existing research by demonstrating that the teachers' limited digital integration was not primarily driven by resistance to technological change. Instead, teachers exhibited strong motivation and willingness to learn, indicating that affective readiness was already present. This finding aligns with (Kartika Chrysti Suryandari, Rokhmaniyah, 2021; Pendidikan et al., 2022), who identify willingness to change as a crucial foundation for digital adaptation. However, similar to the findings of (Nasir & Munawir, 2022), the present study shows that motivation alone does not automatically translate into advanced digital practices in the absence of structured guidance and sustained institutional support.

From a theoretical perspective, these findings position teacher digital readiness as a layered and developmental process rather than a binary condition. Teachers in rural and 3T contexts may demonstrate readiness at the attitudinal level while remaining constrained at the pedagogical and technological levels. This distinction contributes to digital transformation theory by emphasizing that readiness comprises interrelated dimensions willingness, basic competence, and advanced pedagogical integration each of which may evolve at different paces depending on contextual conditions.

Internal and External Factors Influencing Teacher Digital Readiness

The findings further reveal that teacher digital readiness is shaped through the interaction of internal and external factors. Internally, teachers' confidence, motivation, and prior experience influenced their engagement with digital tools. While confidence in basic technology use encouraged experimentation, hesitation emerged when teachers encountered unfamiliar platforms or instructional demands. This pattern supports the argument of (Macwan & Barot, 2025), who note that teachers often experience uncertainty when progressing beyond foundational technological skills without adequate instructional scaffolding.

Externally, infrastructural and institutional constraints played a decisive role in shaping teachers' readiness. Limited access to digital devices, unstable internet connectivity, and insufficient institutional support significantly restricted teachers' capacity to integrate technology consistently (Omigie et al., 2023; Sunartiningsih et al., 2025). These findings corroborate prior studies in rural and non-urban contexts, which emphasize that weak infrastructure and managerial support undermine the sustainability of digital learning initiatives (Anggraini et al., 2025; Saputra et al., 2025). However, this study advances existing literature by illustrating how these constraints operate simultaneously across classroom practices, school-level support, and student access within a rural 3T setting.

Student-related factors further intensified these challenges. Unequal access to devices and internet connectivity among students constrained teachers' ability to apply digital strategies consistently, reinforcing the view that digital readiness should be

understood as a systemic condition rather than an individual teacher attribute. In contrast to urban-focused studies that often assume adequate student access, the present findings underscore the centrality of student-related constraints in shaping digital transformation in rural education (Zhang, 2025).

Effectiveness of Technological Infrastructure in Supporting Digital Learning

The findings indicate that the technological infrastructure in the research site was insufficient to support sustained digital learning. Limited device availability, unstable internet connectivity, and inadequate hardware performance discouraged teachers from planning and maintaining technology-based instruction. These findings align with (Bhuana & Apriliyanti, 2021), who identify reliable infrastructure as a prerequisite for effective digital learning.

Beyond confirming existing research, this study demonstrates that infrastructural limitations actively shape teachers' instructional decision-making. Teachers frequently reverted to conventional teaching methods as a pragmatic response to infrastructural uncertainty (Derder et al., 2023). While similar observations have been reported by (Nasir, Susanto, et al., 2025; Tupag & Ubayubay, 2025), the present study provides micro-level evidence showing how infrastructural instability gradually diminishes teachers' confidence, limits pedagogical experimentation, and discourages long-term digital planning.

Theoretically, these findings suggest that technological infrastructure functions as a mediating and regulatory condition in digital transformation rather than a neutral background factor. In rural and 3T contexts, infrastructure may operate as a constraining force that restricts the translation of teacher readiness into sustained digital practice. This challenges technology-centric perspectives that emphasize teacher competence while underestimating the structural conditions necessary for digital transformation.

Implications for Theory, Policy, and Practice

The findings of this study carry important implications for theory, policy, and practice. Theoretically, this study contributes to digital transformation literature by reinforcing the multidimensional and context-sensitive nature of teacher digital readiness. By providing empirical evidence from a rural 3T context, the study extends readiness frameworks that have largely been developed in urban or well-resourced settings and highlights the necessity of integrating infrastructural and institutional dimensions into models of digital readiness.

From a policy perspective, the findings suggest that digital transformation initiatives in rural and 3T areas should move beyond training-centered approaches. While professional development remains essential, it must be accompanied by sustained investment in technological infrastructure, stable internet connectivity, and equitable access to digital resources for both teachers and students. Policies that prioritize skills acquisition without addressing structural constraints risk producing short-term gains without long-term sustainability.

Practically, this study underscores the importance of context-based professional development programs that emphasize continuous, hands-on digital practice aligned with existing infrastructural realities. School leaders and policymakers should also

strengthen institutional support systems, including leadership commitment and technical assistance, to enable teachers to progress from basic digital use toward meaningful and pedagogically integrated digital practices.

CONCLUSION

This study contributes to the growing body of research on digital transformation in education by providing a contextualized understanding of teacher digital readiness in a rural senior high school located in a 3T area. Rather than framing readiness solely as an individual attribute, the findings demonstrate that teacher digital readiness is a multidimensional and context-dependent process shaped by the interaction of personal motivation, institutional support, and technological infrastructure. In this regard, the study highlights that positive attitudes and basic digital literacy, while necessary, are insufficient to ensure meaningful and sustained digital integration in rural educational settings.

The findings further emphasize that digital transformation in education cannot rely exclusively on teacher willingness or skill development. Internal factors such as motivation and confidence must be supported by external conditions, including adequate technological infrastructure, stable internet connectivity, continuous professional development, and equitable student access to digital resources. This reinforces the argument that digital readiness should be understood as a systemic condition rather than an individual teacher attribute, particularly in underdeveloped and resource-constrained contexts.

From a policy and practical perspective, this study suggests that digital transformation initiatives in rural and 3T regions should adopt a holistic and sustainable approach. Professional development programs need to move beyond short-term training and focus on continuous, hands-on, and context-based support aligned with existing infrastructural realities. At the same time, policymakers and school leaders should prioritize long-term investment in technological infrastructure and institutional support mechanisms to enable teachers to translate readiness into consistent and pedagogically meaningful digital practices.

Although this study was limited to a single research site and relied primarily on self-reported interview data, it offers valuable micro-level insights into teachers' lived experiences in navigating digital transformation within rural contexts. Future research is encouraged to involve multiple research sites, larger and more diverse samples, and mixed-method approaches, including classroom observations and longitudinal designs, to capture the dynamic nature of teacher digital readiness over time.

Overall, this study underscores that achieving equitable and sustainable digital transformation in education particularly in rural and 3T areas requires integrated efforts that address not only teacher competence but also infrastructural adequacy, institutional commitment, and policy responsiveness. By foregrounding the realities of rural schools, this research provides evidence-based insights to inform more inclusive and context-sensitive digital education policies.

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