**PATHALOGY Journal**
Journal of educational sciences
2025; Vol 1 No. 2
e-ISSN: 3090-4420; p-ISSN: 3090-5184
DOI: https://doi.org/10.64538/pathalogy.v1i2.58

# Transforming Primary Education through Digital Integration: A Case Study from Rural Indonesia

**Jenni Panjaitan [1], Eliut Nina Christantini [2]**

1 SD Kanisius Wonogiri, Indonesia [1]; e-mail: jennipanjaitan2@gmail.com
2 SD Kanisius Wonogiri, Indonesia [2]; e-mail: eliutnina1977@gmail.com

**ARTICLE INFO**

***Keywords:***

Constructivist Pedagogy;
Digital Learning;
Educational Technology;
Gamification;
Primary Education;
Rural Schools;
Teacher Professional Development.

***Article history:***

Accepted: February 26th, 2025
Revised: May 17th, 2025
Published: June 28th, 2025

**ABSTRACT**

The integration of digital technology in primary education holds transformative potential for enhancing student engagement, comprehension, and autonomy. This study investigates the implementation of digital learning tools at SD Kanisius Wonogiri, a rural Indonesian elementary school, using a qualitative case study approach. Data were collected through participatory classroom observations, semi-structured interviews with teachers and students, and document analysis, and analyzed thematically. Findings reveal that gamified platforms and interactive digital content significantly improve students' understanding of abstract concepts and foster active learning. Teachers reported increased student motivation and participation when using tools such as Quizizz and Kahoot!, while students expressed enthusiasm for the interactive nature of lessons. The research also identified critical barriers, including unreliable internet access, limited device availability, and insufficient teacher training factors that hinder the optimal use of educational technology. The study underscores the importance of aligning digital integration with pedagogical frameworks like constructivism and connectivism, as well as the need for systemic support through infrastructure investment and continuous professional development. It concludes that while technology alone cannot transform education, it can serve as a powerful enabler of pedagogical innovation when supported by a sustainable, collaborative ecosystem.

**Corresponding Author:**
Jenni Panjaitan
SD Kanisius Wonogiri, Indonesia 1; e-mail: jennipanjaitan2@gmail.com

## 1. Introduction

The rapid advancement of digital technology has profoundly influenced various sectors, including education. Within primary education, technological integration is increasingly seen as a necessary evolution rather than a mere innovation. Studies have consistently shown that the incorporation of digital tools and platforms significantly impacts student learning, particularly in enhancing academic

performance and intrinsic motivation (Rayan & Watted, 2024; Solehudin, 2024). Digital learning environments, characterized by interactivity and adaptability, cater to diverse learning styles and promote deeper cognitive engagement. Game-based learning applications, for instance, have demonstrated measurable improvements in student outcomes, especially in traditionally challenging subjects such as mathematics (Byun & Joung, 2018). Furthermore, the success of these interventions is contingent upon teachers' digital competencies, which mediate the translation of technology into meaningful pedagogical practice (Kiryakova & Kozhuharova, 2024).

As education systems adapt to the needs of the 21st century, the role of educational technology has expanded beyond classroom tools to become a central pillar of equity and inclusion, particularly in under-resourced or rural schools. These settings often face unique challenges such as limited infrastructure and lower levels of digital literacy among educators and students which can hinder the equitable distribution of learning opportunities (Priawasana, 2024; Solehudin, 2024). Despite these obstacles, digital education holds significant promise in bridging educational gaps. Technologies provide access to high-quality learning materials, enable remote collaboration, and offer personalized learning trajectories. However, this potential is often unrealized in practice due to insufficient policy support, lack of continuous teacher training, and limited access to reliable digital infrastructure (Tezer et al., 2024). Thus, systemic and sustainable strategies are essential to ensure that digital learning does not deepen existing educational disparities but instead becomes a vehicle for empowerment and equity.

Indonesia presents a compelling case for examining the dualities of opportunity and challenge in educational technology implementation. As a nation characterized by significant geographic, infrastructural, and socio-economic diversity, the integration of digital learning tools across its school systems remains uneven. In primary schools, particularly those in rural regions, challenges include inconsistent access to internet services, inadequate provision of digital devices, and significant gaps in teachers' digital competencies (Hamdani et al., 2024; Montilla et al., 2023). These issues collectively contribute to the underutilization of digital tools in pedagogy. Even when devices are available, many teachers report low confidence or lack of training in using them effectively, which in turn affects student motivation and learning engagement (Hamdani et al., 2024; Omar et al., 2023).

Nevertheless, opportunities abound. When implemented with appropriate support, multimedia and digital platforms enhance student interaction and participation, creating learning environments that are both enjoyable and effective (Cuesta & Andrade, 2024; Li et al., 2024). Interactive learning applications, digital games, and collaborative tools such as virtual classrooms or shared documents provide new avenues for communication, creativity, and critical thinking. They enable students to move beyond passive consumption toward active construction of knowledge, while also allowing for differentiated instruction based on students' individual needs (Boon & Abdullah, 2021). Gamification strategies have further been associated with increases in learner autonomy and ownership, fostering motivation and self-regulated learning behaviors (Nacaroğlu et al., 2025). These findings reinforce the argument that technology, when used with pedagogical intent and supported by training and infrastructure, can transform traditional models of instruction and support more inclusive and engaging education (Palandi et al., 2024; Suyu et al., 2024).

The theoretical foundations underpinning the use of technology in education are rooted in constructivist and connectivist paradigms. Constructivism, advanced by theorists such as Jean Piaget and Lev Vygotsky, posits that learners actively construct knowledge through their interactions with the environment. In this view, technology serves as a facilitator of learning experiences, allowing students to explore concepts through simulations, multimedia presentations, and problem-based tasks (Hwang et al., 2022; Li et al., 2024). Through tools such as visual animations, interactive modules, and real-time feedback systems, digital technology enhances engagement and supports the development of higher-order thinking skills (Jeny, 2024). It also aligns with Vygotsky's notion of the "zone of proximal development," in which technology functions as a scaffold, providing the necessary support to bridge gaps between current and potential capabilities.

Connectivism, a more recent learning theory developed by Siemens and Downes, emphasizes the role of networks and digital connectivity in knowledge construction. According to this view, learning

occurs through the formation of connections between various information sources across a digital ecosystem (X. Chen & Chan, 2024; Mattar, 2018). Digital platforms, therefore, become integral to the learning process, enabling students to engage with diverse perspectives, update their understanding in real-time, and participate in collaborative knowledge-building activities (Ibrahim et al., 2021; Pramono et al., 2021). By encouraging students to navigate, filter, and evaluate digital content, connectivist approaches develop essential digital literacies and critical thinking capacities that are vital in contemporary education.

In addition to theoretical rationales, institutional frameworks also shape how educational technology is adopted and implemented. Organizations such as UNESCO and the OECD have articulated clear guidelines for leveraging technology to promote inclusive, equitable, and quality education. UNESCO's emphasis on digital inclusion underscores the need for infrastructure investment, teacher professional development, and policies that ensure access for all learners regardless of location or socioeconomic status (Bekele et al., 2023). These recommendations align with the OECD's focus on future-ready skills and digital fluency, which advocate for curricula that foster problem-solving, collaboration, and technological adaptability (Amakhina et al., 2022). The convergence of these international directives reflects a global consensus: educational technology should not only serve instructional purposes but also prepare learners for the demands of a knowledge-based and digitally connected world.

Despite these guiding frameworks, localized implementation remains a critical concern. In rural Indonesian primary schools, including the context of SD Kanisius Wonogiri, technology adoption must contend with cultural, economic, and logistical realities. Teacher readiness is uneven, and infrastructural gaps such as unreliable internet or insufficient digital devices complicate sustained integration. Moreover, existing training models often lack contextual relevance and fail to address the pedagogical integration of technology in early-grade education. These gaps highlight the need for context-sensitive research that explores how digital tools are used, perceived, and sustained in local school settings.

This study, therefore, seeks to investigate the role of digital technology in enhancing educational quality at SD Kanisius Wonogiri, a primary school located in a rural area of Central Java. By examining how digital tools are integrated into teaching practices, how students respond to these tools, and what challenges emerge in their application, the study aims to offer practical insights and policy recommendations. The research further contributes to the literature by highlighting the intersection between global educational frameworks and local implementation realities, with a particular focus on the foundational years of formal education.

The novelty of this research lies in its contextual analysis of digital learning implementation in an Indonesian rural primary school, focusing on both the benefits and the systemic challenges. While prior studies have explored technology in urban or secondary educational settings, limited research has examined how early-grade classrooms in under-resourced areas navigate digital transformation. Additionally, this study adopts a multi-dimensional lens, considering infrastructure, pedagogy, motivation, and institutional support as interconnected elements influencing successful technology integration.

## 2. Methodology

This study employs a qualitative case study approach to explore the integration of digital technology in primary education, focusing on its implementation at SD Kanisius Wonogiri, a rural school in Central Java, Indonesia. The decision to utilize a qualitative case study design is grounded in the need to understand the complex, context-dependent, and socially embedded nature of technology integration in teaching and learning processes. This methodology allows for the investigation of how digital tools are interpreted, utilized, and experienced by educators and students within a real-life educational setting.

The qualitative case study method is particularly suited to educational research aiming to capture the richness of human experiences, institutional practices, and socio-technical interactions (Sumarno, 2023). One of its core strengths lies in its capacity to provide in-depth insights into the everyday practices and perceptions of participants. In the context of this research, it enabled a detailed examination of how

teachers at SD Kanisius integrate digital tools into their pedagogy, how students respond to these tools, and how school infrastructure and policy frameworks facilitate or hinder such integration.

The study was conducted over a period of one month, allowing the researcher to conduct sustained observations and repeated interactions with participants. This extended engagement with the research site contributed to the development of trust and deeper access to the social dynamics of the classroom. It also permitted the observation of routine instructional practices and the identification of patterns in technology use, student engagement, and instructional strategies.

Data were collected using three primary techniques: participatory observation, semi-structured interviews, and document analysis. The use of multiple data sources aligns with the principle of methodological triangulation, which strengthens the validity and credibility of qualitative findings by enabling cross-verification (Dinç, 2019). Triangulation not only enhances robustness but also allows for the identification of inconsistencies or contradictions in the data, which may offer further analytical depth (BOLATLI & Taş, 2023; Masruri et al., 2024).

Participatory observations were carried out in multiple classes and across different subjects to capture a representative picture of technology integration across the school. During these sessions, the researcher assumed the role of a passive participant, observing classroom activities without disrupting the natural flow of instruction. Particular attention was paid to how teachers incorporated digital tools such as multimedia presentations, educational applications, and gamified platforms into their teaching routines. The researcher also observed students' reactions, engagement levels, and peer interactions when digital tools were employed.

To complement the observational data, semi-structured interviews were conducted with a total of 10 teachers and 20 students. Teachers were selected from across different grade levels and subject specializations, ensuring variation in teaching approaches and digital exposure. Interviews with teachers explored their familiarity with digital tools, perceived benefits and challenges, professional development experiences, and attitudes toward educational technology. Student interviews, in turn, focused on their experiences using technology in the classroom, their learning preferences, and their perceived changes in motivation and comprehension.

Semi-structured interviews were chosen for their flexibility, allowing the researcher to follow up on participants' responses while maintaining a consistent thematic structure. This flexibility was critical in eliciting rich, personal narratives and uncovering nuanced perspectives on technology use, particularly from students in early-grade levels who may have limited verbal expressiveness.

Document analysis served as the third data collection method. The documents reviewed included lesson plans (RPP), syllabi, school reports on ICT use, training materials, internal communications related to technology adoption, and visual documentation of classroom activities. These documents provided insights into the formal and informal mechanisms through which technology was institutionalized in the school's curriculum and pedagogical planning. They also served as a means to cross-check claims made by teachers during interviews, thereby reinforcing the validity of the data (Sumarno, 2023).

All data were coded and analyzed thematically using an inductive approach. This process involved reading through transcripts and field notes multiple times to identify recurring patterns, categories, and themes. Initial codes were developed to capture emergent ideas related to technology use, such as "student motivation," "infrastructure barriers," "teacher confidence," and "interactive learning." These codes were then grouped into broader thematic categories that aligned with the research questions and theoretical framework.

Thematic analysis enabled the researcher to maintain fidelity to participants' voices while also constructing analytical interpretations that reflected the broader socio-educational context. It also facilitated the comparison of findings across data sources. For instance, statements from teacher interviews regarding the effectiveness of multimedia tools were corroborated by classroom observations showing increased student attentiveness and enthusiasm during video-based lessons. Conversely, student complaints about unstable internet connectivity were echoed in school reports documenting frequent disruptions in digital activities.

Despite the strengths of the qualitative case study approach, several limitations must be acknowledged. First, qualitative research is inherently interpretive, and the findings are influenced by the researcher's subjective judgments (Pahmi et al., 2023). Although efforts were made to minimize bias through triangulation and reflexivity, absolute objectivity is not attainable in this form of inquiry. Second, the study's context-specific nature means its findings may not be generalizable to all Indonesian primary schools, especially those in urban or highly digitized environments (Zawawi & Hashim, 2024). Nevertheless, the purpose of qualitative research is not generalizability, but rather the production of deep, context-rich insights that can inform practice and policy in similar settings.

Ethical considerations were rigorously observed throughout the study. Informed consent was obtained from all participants, including parental consent for student participants. Anonymity was assured, and all data were handled with confidentiality. Participants were informed about the purpose of the study and were free to withdraw at any time without consequence. The school's administrative board granted formal approval for the research, and classroom observations were conducted with full awareness and cooperation from teaching staff.

This methodology, grounded in constructivist and connectivist epistemologies, was particularly suitable for exploring how technology is embedded in the social fabric of primary education. By focusing on lived experiences, social interactions, and contextual variables, the study offers insights not only into what technologies are used, but also into how and why they are used in specific ways. It highlights the interdependence between tools, people, and institutional structures in shaping digital learning outcomes.

## 3. Results

### *3.1 Data Collection Process and Research Timeline*

The data collection process was conducted over a period of four consecutive weeks at SD Kanisius Wonogiri, utilizing three complementary techniques: participatory classroom observation, semi-structured interviews with teachers and students, and document analysis. Each technique was selected to yield specific insights into the integration of digital technology in the school's teaching and learning environment.

Structured classroom observations were guided by a predefined framework adapted from (Burke et al., 2021), focusing on indicators such as student engagement, instructional strategies, and the functional integration of technological tools. Observers also maintained a reflective journal to record contextual nuances including environmental factors, classroom layout, and spontaneous teacher-student interactions which contributed to a holistic analysis of digital integration (Suwardika et al., 2024). These reflections were later triangulated with interview data to verify consistency and enrich interpretation. Peer collaboration between multiple observers was also employed to reduce individual bias and strengthen the objectivity of the observational findings (McCauley & McHugh, 2021).

Through participatory observation sessions in Grades 2 through 5, researchers witnessed firsthand how teachers employed educational software, interactive videos, and gamified platforms such as Quizizz and Kahoot! in real-time. Participatory approaches enabled a deeper understanding of teacher-student dynamics and the co-construction of learning through technology (Granger et al., 2018). Observers documented students' affective responses, behavioral engagement, and the extent of their collaborative participation in tech-enhanced lessons. (Evangelou, 2023) emphasizes that such embedded observation yields rich data on learner motivation and social dynamics, which was evident as students displayed heightened enthusiasm during digitally mediated lessons.

Interviews with 10 teachers and 20 students revealed consistent themes. Teachers shared both enthusiasm and hesitations, frequently citing improved engagement but expressing concerns about infrastructure limitations and their own digital literacy. Students, on the other hand, voiced excitement toward interactive media and digital quizzes, often describing such lessons as "fun," "easier to understand," and "less boring."

Document analysis further confirmed that digital technology had been formally integrated into the school's lesson planning. Reviewed documents including RPP (Rencana Pelaksanaan Pembelajaran) and teacher reports demonstrated attempts to embed multimedia, educational platforms, and digital

assessments into daily instruction, although inconsistently across grade levels. These records validated the observational findings and offered additional insight into how digital integration is framed administratively within the school.

### *3.2 Thematic Analysis of Pedagogical Impact*

Analysis of observation logs and interview transcripts identified three dominant themes reflecting the pedagogical impact of digital technology in the classroom: improved comprehension of abstract concepts, heightened student motivation, and increased learner autonomy.

The use of gamified tools such as Quizizz and Kahoot! was particularly effective in enhancing students' understanding of abstract content. As supported by (Mohammed & Özdamlı, 2021), these platforms utilize game mechanics points, levels, feedback loops to contextualize learning in engaging ways (Zeng et al., 2024) found similar outcomes, arguing that game-based platforms can transform complex cognitive tasks into manageable, intuitive experiences. Observations confirmed that when digital quizzes were employed, students were not only more attentive but also more willing to answer challenging questions, even when they previously hesitated in traditional classroom discussions.

Students' perceptions aligned with these observations. In interviews, many described gamified activities as "more exciting than books" and noted that receiving immediate feedback helped them understand why their answers were right or wrong. This corresponds with findings from (Hellberg & Moll, 2023) and (Zourmpakis et al., 2023), who emphasize that instant feedback mechanisms contribute to metacognitive development and sustained engagement. Additionally, the competitive aspects of these tools fostered social learning and peer collaboration, as noted by (Hürsen & Bas, 2019) and (Lester et al., 2023).

The introduction of digital media also nurtured greater learner autonomy. Students demonstrated initiative in exploring supplementary learning resources, asking to replay animations or revisit quiz questions. (Głowacki et al., 2018) assert that such behaviors are indicative of self-regulated learning a critical competency in modern education. These shifts in learning behavior suggest that technology, when aligned with pedagogical goals, does more than deliver content; it reshapes learning dispositions.

### *3.3 Theoretical Relevance of Findings*

The observed instructional shifts and student behaviors strongly aligned with key tenets of constructivist and connectivist learning theories. Constructivism advocates for learning through active engagement and contextual experiences, and digital technologies were found to significantly enhance these aspects in the primary classroom. Interactive simulations, videos, and educational games allowed students to visualize abstract content, manipulate variables, and construct understanding through exploration (Sulindra et al., 2024; Teixeira & Arriel, 2024). (Lathifah, 2024) further supports this, noting that multimedia learning environments encourage the synthesis of prior knowledge with new experiences.

Observations revealed that cooperative learning an essential component of constructivist pedagogy was amplified by collaborative platforms and shared digital tasks. During group-based digital activities, students were seen explaining concepts to peers, negotiating answers, and jointly solving problems. These interactions fostered both social learning and academic development.

From the connectivist perspective, the study's findings reinforced the notion that learning is enhanced by digital networks and distributed knowledge systems (M. Z. Chen et al., 2022; Quatbayevich, 2024). Through platforms like Google Classroom and Padlet, students accessed diverse learning resources and participated in asynchronous discussions. This expanded the traditional classroom into a hybrid, networked environment where knowledge was not confined to textbooks or teacher instruction but co-constructed through a web of digital interactions. (Malkawi & Khayrullina, 2021) found similar benefits in elementary settings, arguing that digital collaboration fosters independent inquiry and social connection.

These findings underscore the synergistic relationship between educational technology and contemporary learning theories, demonstrating that digital tools are not merely delivery mechanisms but mediators of cognitive and social engagement.

### *3.4 Support from Existing Literature*

The empirical findings of this study are well-supported by a broad base of existing research on the effectiveness of educational technology. Multiple studies have found that digital platforms significantly increase student motivation and learning outcomes when used effectively (Egüz et al., 2019; Rezer, 2021). For example, the transformation of conventional content into interactive, student-centered activities fosters intrinsic motivation and academic resilience an effect echoed by students and teachers in this study.

Global literature highlights that gamification elements enhance memory retention and engagement by converting learning into dynamic experiences (Zeng et al., 2024). In the context of SD Kanisius Wonogiri, the increase in attentiveness, participation, and content retention aligns with this literature, indicating a replicable pattern of success in integrating game-based learning strategies within primary education.

### *3.5 Constraints and Barriers*

Despite the positive outcomes, several significant barriers were identified that hinder optimal technology use. These findings are consistent with both global and local studies that outline the structural and systemic limitations of technology integration in low-resource settings (Sinaga et al., 2024).

The most prominent constraint was inadequate infrastructure. Teachers cited unstable internet connectivity as a frequent cause of lesson disruptions. This challenge was particularly acute during attempts to stream video content or access cloud-based resources. Similar constraints have been reported in studies by (Kormos & Wisdom, 2021), which underscore the essential need for reliable digital infrastructure in rural schools.

Furthermore, limited access to digital devices often shared between classes or unavailable altogether restricted the breadth of implementation. The reliance on teacher-owned devices or outdated equipment also posed risks to continuity and scalability. Financial limitations, as noted in (Poddubnaya et al., 2020) and (Bala & Mitchell, 2024), further compound these issues by restricting schools' ability to invest in maintenance and upgrades.

Equally critical was the insufficient professional development for teachers. While some educators were able to navigate digital platforms competently, many expressed the need for more hands-on training and continuous support. This mirrors findings by (Al-Zahrani & Alasmari, 2024), who assert that teacher readiness is often the decisive factor in whether technology translates into improved learning outcomes. Moreover, language barriers, cultural considerations, and a lack of localized digital content were noted as additional challenges, particularly in early-grade instruction (Okon & Chukwurah, 2020; Zhang & Leong, 2024).

### *3.6 Infrastructure and Training Recommendations*

To address these barriers, the study highlights several infrastructural and pedagogical recommendations. First, stable internet access and adequate hardware are foundational for successful technology integration (Kormos & Wisdom, 2021). Investments should be directed toward providing each classroom with reliable connectivity and functional digital equipment. Schools must also ensure technical maintenance and support systems are in place (Stenman & Pettersson, 2020).

Second, professional development programs for teachers must be designed with practical, contextual needs in mind. Rather than generic training, workshops should focus on the specific challenges rural educators face, including low bandwidth scenarios, multilingual classrooms, and resource limitations. (Soekamto et al., 2022) advocate for community-based training models that emphasize peer collaboration, which can reduce isolation and promote sustainable pedagogical innovation. (Liu et al., 2018) also emphasize the value of mentoring and teacher learning communities in building long-term digital competencies. Furthermore, (H. Chen & Huang, 2024) suggest that digital literacy programs should integrate curriculum design, assessment planning, and real-time classroom management tools to build both competence and confidence.

## 4. Discussion

The findings from this study affirm that educational technology, when implemented strategically and supported by robust institutional mechanisms, holds transformative potential beyond the role of

instructional supplementation. At SD Kanisius Wonogiri, digital technologies not only enhanced the immediacy and interactivity of learning processes but also catalyzed a pedagogical shift toward student-centered learning. These outcomes underscore the argument that educational technology is not simply a digital replication of traditional content delivery, but rather a medium that fosters innovation, critical thinking, and learner autonomy when aligned with constructivist pedagogical principles (Lee, 2023).

Digital tools such as gamified learning platforms and multimedia resources were observed to create immersive and engaging learning environments, enabling students to interact with content through exploration, experimentation, and collaboration. These findings resonate with Sargent and (Sargent & Calderón, 2021), who argue that technology facilitates the transition from rote learning to more inquiry-based approaches that encourage cognitive engagement and problem-solving. In classrooms observed at SD Kanisius, digital applications transformed abstract concepts into tangible, relatable experiences, allowing learners to construct meaning through contextualized interaction a hallmark of constructivist learning environments.

This shift in instructional practice signifies a broader transformation in the role of teachers. In traditional pedagogy, teachers have often functioned as primary content providers. However, in the digital learning environment at SD Kanisius, educators increasingly adopted the role of facilitators, guiding students through digital content, encouraging dialogue, and scaffolding collaborative learning experiences. This aligns with recent findings by (Çetinkaya, 2024) and (Mashudi & Hilman, 2024), which indicate that teacher agency is strengthened when digital tools are used to support inquiry, reflection, and dialogic learning in early-grade classrooms. Teachers in this study reported designing lessons that moved beyond passive content delivery, instead focusing on designing meaningful tasks, fostering peer interaction, and helping students develop digital navigation skills.

One of the most noteworthy observations was the increase in learner autonomy. Students not only demonstrated increased engagement but also took initiative in exploring digital content, reviewing materials independently, and collaborating with peers. These behaviors reflect a critical transition from teacher-directed instruction to learner-centered environments facilitated by technology. This transition is consistent with (Zhao et al., 2021), who highlight the role of interactive digital platforms in empowering students to take ownership of their learning trajectories. Moreover, student motivation appeared to be enhanced not solely because of the novelty of technology but due to its capacity to accommodate diverse learning styles and provide immediate, personalized feedback.

For teachers, this pedagogical transition is both an opportunity and a challenge. As they shift into new instructional roles, educators must acquire not only technical proficiency but also pedagogical strategies tailored to digital environments. Teachers who successfully integrated technology in this study expressed a growing sense of professional efficacy, creativity, and satisfaction findings echoed in (Amotz et al., 2022), who argue that technology integration can reinvigorate professional identity and engagement. However, this transformation necessitates structured and ongoing professional development. One-off training sessions were deemed insufficient, particularly in a rural context where access to peer networks and instructional support may be limited. Teachers require continued mentorship and context-specific support that enables them to implement innovative approaches while also addressing local challenges (Sumarno, 2023).

Beyond the classroom, the sustainability and scalability of technology integration hinge on collaborative institutional efforts. In resource-constrained environments like SD Kanisius Wonogiri, the digital divide is a structural barrier that cannot be addressed at the school level alone. To foster equitable and sustained use of technology, collaborative frameworks involving government agencies, local communities, private sector partners, and educational institutions must be established (Ibyimana, 2024). Public-private partnerships offer a promising avenue to mobilize resources, such as providing access to devices, upgrading internet connectivity, and offering localized digital content. Moreover, such collaboration can enable the co-creation of professional development programs tailored to rural contexts, addressing both pedagogical and technological competencies.

This integrated approach aligns with (Ibyimana, 2024) call for multi-sectoral stakeholder engagement as a foundation for sustainable educational innovation. Community involvement, in

particular, was identified in this study as a critical but underutilized resource. While parents expressed general support for digital learning, their limited digital literacy restricted their ability to assist their children or engage meaningfully with digital education initiatives. Encouraging parental engagement through digital literacy campaigns and community-based workshops could strengthen home-school partnerships, further reinforcing learning beyond the classroom.

It is important to acknowledge, however, that despite the positive impacts observed, several barriers remain that constrain the full potential of technology integration. Infrastructural limitations particularly inconsistent internet connectivity and the uneven availability of digital devices continue to disrupt instructional flow and limit equitable access. These challenges echo the findings of (Sinaga et al., 2024), who assert that infrastructure deficits are among the most persistent impediments to digital adoption in rural schools. Similarly, the lack of contextualized content and training impedes the localization of pedagogical strategies, highlighting the need for a more nuanced understanding of cultural, linguistic, and curricular specificities in digital content development (Okon & Chukwurah, 2020; Zhang & Leong, 2024).

These challenges point to a broader tension in educational technology: while digital tools offer pathways to innovation, equity, and engagement, they also risk exacerbating existing inequalities if not implemented within a holistic, inclusive framework. The findings from SD Kanisius Wonogiri reinforce this duality. On one hand, digital tools facilitated transformative learning experiences and pedagogical innovation. On the other hand, systemic constraints including inadequate infrastructure, limited training, and policy gaps threaten the long-term sustainability and inclusivity of these gains.

To mitigate these risks, policy interventions must be aligned with grassroots realities. Top-down mandates for digital transformation, though well-intentioned, may fail without concurrent investment in ground-level capacity building. Flexible funding models that allow schools to determine their own technology needs, coupled with school-based decision-making and community accountability, could enhance responsiveness and effectiveness. Moreover, policies must be designed with an understanding that technology alone cannot drive educational change. As (Mashudi & Hilman, 2024) note, it is the pedagogical vision and human agency behind technology use that determine its impact.

Another critical consideration is the role of monitoring and evaluation systems in ensuring continuous improvement. As this study employed triangulated methods observations, interviews, and document reviews it became evident that a multi-layered evaluation strategy is necessary to capture the evolving dynamics of digital learning environments. Schools must be equipped not only with tools but also with frameworks for reflective practice, allowing teachers to assess the effectiveness of their strategies, adapt to student needs, and share successful models with peers.

Ultimately, the findings suggest that educational technology can act as a catalyst for pedagogical transformation, equity, and engagement but only within a system that supports innovation while addressing structural constraints. The case of SD Kanisius Wonogiri offers valuable insights into how local schools can navigate this balance. By leveraging digital tools to foster learner agency, reconfiguring the teacher's role, and cultivating collaborative support systems, schools can create learning environments that are not only digitally enhanced but also pedagogically progressive and socially responsive

## 5. Conclusion

This study explored the integration of digital technology in a rural primary education context, focusing on SD Kanisius Wonogiri as a representative case. The findings confirm that digital tools significantly enhance learning quality by promoting greater engagement, deeper conceptual understanding, and increased learner autonomy. Gamified platforms and multimedia content were particularly effective in supporting motivation and comprehension, especially when aligned with constructivist and connectivist principles.

However, the research also highlighted systemic barriers, including limited digital infrastructure, inadequate teacher training, and inconsistent access to devices and connectivity. These challenges

underscore the need for a dual approach technological advancement must be matched with institutional capacity building and sustained professional development.

Moreover, the role of the teacher has evolved, transitioning from a knowledge transmitter to a learning facilitator. This transformation demands not only pedagogical innovation but also ongoing support systems that empower educators to integrate digital tools meaningfully and contextually.

In essence, technology serves not as a panacea but as a catalyst its potential to transform learning can only be realized when implemented within a supportive, equitable, and sustainable educational ecosystem. The study offers practical implications for policymakers, educational leaders, and development partners seeking to bridge the digital divide and promote inclusive, technology-enhanced learning in underserved contexts.

Reference


Al-Zahrani, A. M., & Alasmari, T. (2024). Exploring the Impact of Artificial Intelligence on Higher Education: The Dynamics of Ethical, Social, and Educational Implications. Humanities and Social Sciences Communications, 11(1). https://doi.org/10.1057/s41599-024-03432-4

Amakhina, S. A., Dmitrieva, N., Sazonova, A. V, & Timokhina, E. I. (2022). Digital Eco-Teaching and Eco-Learning in University Education. Вестник Ггнту Гуманитарные И Социально-Экономические Науки, 4(30), 45–54. https://doi.org/10.34708/gstou.2022.93.10.006

Amotz, R. B., Green, G., Joseph, G., Levi, S., Manor, N., Ng, K., Barak, S., Hutzler, Y., & Tesler, R. (2022). Remote Teaching, Self-Resilience, Stress, Professional Efficacy, and Subjective Health Among Israeli PE Teachers During the COVID-19 Pandemic. Education Sciences, 12(6), 405. https://doi.org/10.3390/educsci12060405

Bala, I., & Mitchell, L. (2024). Thematic Exploration of Educational Research After the COVID Pandemic Through Topic Modelling. Journal of Applied Learning & Teaching, 7(1). https://doi.org/10.37074/jalt.2024.7.1.40

Bekele, T. A., Amponsah, S., & Karkouti, I. M. (2023). African Philosophy for Successful Integration of Technology in Higher Education. British Journal of Educational Technology, 54(6), 1520–1538. https://doi.org/10.1111/bjet.13364

BOLATLI, G., & Taş, F. (2023). Student Opinions About the Training Set Consists of Smart Interactive Mockups and Application Program Used in Anatomy and Histology Education. European Journal of Science and Technology. https://doi.org/10.31590/ejosat.1217012

Boon, Q. W., & Abdullah, N. (2021). "E-Learning on the Go": Understanding the Knowledge, Attitudes, and Motivations of Students of the Beauty and Spa Therapy Program. International Journal of Academic Research in Business and Social Sciences, 11(10). https://doi.org/10.6007/ijarbss/v11-i10/10862

Burke, P. F., Kearney, M., Schuck, S., & Aubusson, P. (2021). Improving Mobile Learning in Secondary Mathematics and Science: Listening to Students. Journal of Computer Assisted Learning, 38(1), 137–151. https://doi.org/10.1111/jcal.12596

Byun, J., & Joung, E. (2018). Digital Game-based Learning for K–12 Mathematics Education: A Meta-analysis. School Science and Mathematics, 118(3–4), 113–126. https://doi.org/10.1111/ssm.12271

Çetinkaya, S. (2024). Field Experience and Digital Technology-Based Literacy Instruction. International Journal of Educational Research Review, 9(2), 77–92. https://doi.org/10.24331/ijere.1404019

Chen, H., & Huang, J. (2024). The Appeals, Dilemmas, and Pathways of Enabling Rural Teachers' Professional Development Through Emerging Technologies. Journal of Contemporary Educational Research, 8(5), 240–246. https://doi.org/10.26689/jcer.v8i5.7038

Chen, M. Z., Salama, R., & Hinton, T. (2022). How Technology Enhanced Learning Strategies Affect Healthcare Students' Engagement? A Mixed Methods Study. Ascilite Publications, e22206. https://doi.org/10.14742/apubs.2022.206

Chen, X., & Chan, S. (2024). Implementing Digital Pedagogy in TVET: A Connectivist Perspective. Vocat Tech Edu, 1(2). https://doi.org/10.54844/vte.2024.0595

Cuesta, M. E. G., & Andrade, S. S. N. (2024). The Impact of Digital Platforms on English Learning in

Ecuadorian Public Primary Schools. Religación Revista De Ciencias Sociales Y Humanidades, 9(41), e2401221. https://doi.org/10.46652/rgn.v9i41.1221

Dinç, E. (2019). Prospective Teachers' Perceptions of Barriers to Technology Integration in Education. Contemporary Educational Technology, 10(4), 381–398. https://doi.org/10.30935/cet.634187

Egüz, Ş., Öztürk, C., & Kesten, A. (2019). Technology-Supported Global Education: A Mixed Method Study. Pegem Eğitim Ve Öğretim Dergisi, 9(4), 1209–1244. https://doi.org/10.14527/pegegog.2019.040

Evangelou, F. (2023). Experiential - Participatory Teaching Techniques in Primary Education: Exploring the Views of Greek Teachers. Journal of Education and Training, 10(2), 36. https://doi.org/10.5296/jet.v10i2.21000

Głowacki, J., Kriukova, Y., & Avshenyuk, N. (2018). Gamification in Higher Education: Experience of Poland and Ukraine. Advanced Education, 5(10), 105–110. https://doi.org/10.20535/2410-8286.151143

Granger, E. M., Bevis, T. H., Southerland, S. A., Saka, Y., & Ke, F. (2018). Examining Features of How Professional Development and Enactment of Educative Curricula Influences Elementary Science Teacher Learning. Journal of Research in Science Teaching, 56(3), 348–370. https://doi.org/10.1002/tea.21480

Hamdani, H., Rahman, A., & Haidah, H. (2024). Improving Student Accessibility and Engagement With Applications as Learning Media in the Digital Era. Jimr, 2(10), 24–28. https://doi.org/10.62504/jimr910

Hellberg, A.-S., & Moll, J. (2023). A Point With Pointsification? Clarifying and Separating Pointsification From Gamification in Education. Frontiers in Education, 8. https://doi.org/10.3389/feduc.2023.1212994

Hürsen, Ç., & Bas, C. (2019). Use of Gamification Applications in Science Education. International Journal of Emerging Technologies in Learning (Ijet), 14(01), 4. https://doi.org/10.3991/ijet.v14i01.8894

Hwang, G., Yang, C., Chou, K., & Chang, C. (2022). An MDRE Approach to Promoting Students' Learning Performances in the Era of the Pandemic: A Quasi-experimental Design. British Journal of Educational Technology, 53(6), 1706–1723. https://doi.org/10.1111/bjet.13208

Ibrahim, N. K., Al-Raddadi, R., Aldarmasi, M. A., Ghamdi, A. A. A., Gaddoury, M. A., Albar, H. M. S. A., & Ramadan, I. K. (2021). Medical Students' Acceptance and Perceptions of E-Learning During the Covid-19 Closure Time in King Abdulaziz University, Jeddah. Journal of Infection and Public Health, 14(1), 17–23. https://doi.org/10.1016/j.jiph.2020.11.007

Ibyimana, J. C. (2024). The Contribution of Rwandaequip to Technology Integration in Rwandan Public Primary Schools: Impacts on Teacher Practices and Student Engagement. International Journal of Research Publication and Reviews, 5(10), 904–911. https://doi.org/10.55248/gengpi.5.1024.2723

Jeny, D. P. (2024). Classrooms to Networks: Applying Connectivism Principles in Pedagogy ```. Nawala Education, 1(5), 63–73. https://doi.org/10.62872/0ypqjy52

Kiryakova, G., & Kozhuharova, D. (2024). The Digital Competences Necessary for the Successful Pedagogical Practice of Teachers in the Digital Age. Education Sciences, 14(5), 507. https://doi.org/10.3390/educsci14050507

Kormos, E., & Wisdom, K. (2021). Rural Schools and the Digital Divide. Theory & Practice in Rural Education, 11(1). https://doi.org/10.3776/tpre.2021.v11n1p25-39

Lathifah, A. S. (2024). Pemanfaatan Teknologi Digital Dalam Pembelajaran Konstruktivisme: Meningkatkan Kualitas Pendidikan Di Era Digital. Jurnal Pendidikan Dan Kebudayaan (Jurdikbud), 4(1), 69–76. https://doi.org/10.55606/jurdikbud.v4i1.2838

Lee, B. n. (2023). Adapting History Education for the 21st Century: Integrating Technology and Critical Thinking Skills. Spekta (Jurnal Pengabdian Kepada Masyarakat Teknologi Dan Aplikasi), 4(2), 216–224. https://doi.org/10.12928/spekta.v4i2.8572

Lester, D., Skulmoski, G. J., Fisher, D. P., Mehrotra, V., Lim, I., Lang, A., & Keogh, J. (2023). Drivers and Barriers to the Utilisation of Gamification and Game-based Learning in Universities: A Systematic

Review of Educators' Perspectives. British Journal of Educational Technology, 54(6), 1748–1770. https://doi.org/10.1111/bjet.13311

Li, Y., Chen, D., & Deng, X. (2024). The Impact of Digital Educational Games on Student's Motivation for Learning: The Mediating Effect of Learning Engagement and the Moderating Effect of the Digital Environment. Plos One, 19(1), e0294350. https://doi.org/10.1371/journal.pone.0294350

Liu, K., Miller, R. I., Dickmann, E. M., & Monday, K. (2018). Virtual Supervision of Student Teachers as a Catalyst of Change for Educational Equity in Rural Areas. Journal of Formative Design in Learning, 2(1), 8–19. https://doi.org/10.1007/s41686-018-0016-6

Malkawi, E., & Khayrullina, M. V. (2021). Digital Learning Environment in Higher Education: New Global Issues. SHS Web of Conferences, 92, 5019. https://doi.org/10.1051/shsconf/20219205019

Mashudi, M., & Hilman, C. (2024). Digital-Based Islamic Religious Education: A New Orientation in Enhancing Student Engagement and Spiritual Understanding. Global, 2(10), 2488–2501. https://doi.org/10.59613/global.v2i10.342

Masruri, M., Zakaria, N., Sobirin, S., Irwan, I., & Faisal, M. (2024). Cyber Learning as a Transformation of Learning in the Digital Era. Jurnal Konseling Pendidikan Islam, 5(1), 188–195. https://doi.org/10.32806/jkpi.v5i1.142

Mattar, J. (2018). Constructivism and Connectivism in Education Technology: Active, Situated, Authentic, Experiential, and Anchored Learning. Ried Revista Iberoamericana De Educación a Distancia, 21(2), 201. https://doi.org/10.5944/ried.21.2.20055

McCauley, V., & McHugh, M. (2021). An Observational Narrative of Student Reaction to Video Hooks. Education Sciences, 11(6), 286. https://doi.org/10.3390/educsci11060286

Mohammed, Y. B., & Özdamlı, F. (2021). Motivational Effects of Gamification Apps in Education: A Systematic Literature Review. Brain Broad Research in Artificial Intelligence and Neuroscience, 12(2). https://doi.org/10.18662/brain/12.2/196

Montilla, V. R., Rodriguez, R. M., Aliazas, J. V, & Gimpaya, R. (2023). Teachers' Pedagogical Digital Competence as Relevant Factors on Academic Motivation and Performance in Physical Education. International Journal of Scientific and Management Research, 06(06), 45–58. https://doi.org/10.37502/ijsmr.2023.6604

Nacaroğlu, O., KIZKAPAN, O., & Demir, H. (2025). Middle School Students' Motivations and Learning Competencies in Science: Mediating Role of Digital Literacy. Psychology in the Schools, 62(5), 1475–1487. https://doi.org/10.1002/pits.23400

Okon, E. E., & Chukwurah, C. C. (2020). Technology-Driven Teaching Skills'need of Business Education Lecturers and Content Delivery in a Globalised Economy. Journal of Education and Learning (Edulearn), 14(3), 393–401. https://doi.org/10.11591/edulearn.v14i3.14539

Omar, M. K., Ruzaidi, D. U. A., Puad, M. H. M., & Jusoh, R. (2023). How Digitalized Are School Students? Determining Digital Competencies and Motivation Factors in Using Technology for Learning. International Journal of Academic Research in Progressive Education and Development, 12(2). https://doi.org/10.6007/ijarped/v12-i2/17382

Pahmi, S., Junfithrana, A. P., & Supriyadi, E. (2023). Exploring Metaverse Integration in Education: A Case Study on Vocational School Teachers. Jurnal Belaindika (Pembelajaran Dan Inovasi Pendidikan), 5(3), 104–109. https://doi.org/10.52005/belaindika.v5i3.125

Palandi, J. F., Pudyastuti, Z. E., & Molewe, K. (2024). Enhancing English Vocabulary Through Game-Based Learning: A Case Study of the Scramword Application. International Journal in Information Technology in Governance Education and Business, 6(1), 109–121. https://doi.org/10.32664/ijitgeb.v6i1.141

Poddubnaya, T. N., Zadneprovskaya, E. L., Dzhum, T. A., & Khatit, F. R. (2020). Using the Electronic Information and Educational Environment of the University in the Training of Tourism Industry Workers. Revista Amazonia Investiga, 9(28), 249–259. https://doi.org/10.34069/ai/2020.28.04.28

Pramono, S. E., Wijaya, A., Melati, I. S., Sahudin, Z., & Abdullah, H. (2021). COVID-Driven Innovation in Higher Education: Analysing the Collaboration of Leadership and Digital Technology During the Pandemic in UiTM Malaysia and UNNES Indonesia. Asian Journal of University Education,

17(2), 1. https://doi.org/10.24191/ajue.v17i2.13393
Priawasana, E. (2024). The Digital Paradox: Increased Connectivity and the Decline in Student Attitudes. Indonesian Journal of Instructional Media and Model, 6(1), 26–33. https://doi.org/10.32585/ijimm.v6i1.5234
Quatbayevich, U. S. (2024). Learning Outcomes in Mathematics Education. International Journal of Advance Scientific Research, 4(3), 160–163. https://doi.org/10.37547/ijasr-04-03-29
Rayan, B., & Watted, A. (2024). Enhancing Education in Elementary Schools Through Gamified Learning: Exploring the Impact of Kahoot! On the Learning Process. Education Sciences, 14(3), 277. https://doi.org/10.3390/educsci14030277
Rezer, T. (2021). Historical and Pedagogical Analysis of the Process of Global Digitalization of Education. E3s Web of Conferences, 273, 12036. https://doi.org/10.1051/e3sconf/202127312036
Sargent, J., & Calderón, A. (2021). Technology-Enhanced Learning Physical Education? A Critical Review of the Literature. Journal of Teaching in Physical Education, 41(4), 689–709. https://doi.org/10.1123/jtpe.2021-0136
Sinaga, W. R., Putri, Kinkin Y. S., & Anindhita, W. (2024). Digital Communications and Culture: Navigating Challenges in Education and Business. Journal of Media Culture and Communication, 46, 22–29. https://doi.org/10.55529/jmcc.46.22.29
Soekamto, H., Николаева, И. Г., Abbood, A. A. A., Grachev, D., Косов, M. E., Yumashev, A., Kostyrin, E. V, Лазарева, H. B., Kvitkovskaja, A., & Nikitina, N. I. (2022). Professional Development of Rural Teachers Based on Digital Literacy. Emerging Science Journal, 6(6), 1525–1540. https://doi.org/10.28991/esj-2022-06-06-019
Solehudin, R. H. (2024). The Problematic of Digital Inequality in an Educational Political Policy Perspective. Edukasia, 5(1), 531–540. https://doi.org/10.62775/edukasia.v5i1.763
Stenman, S., & Pettersson, F. (2020). Remote Teaching for Equal and Inclusive Education in Rural Areas? An Analysis of Teachers' Perspectives on Remote Teaching. International Journal of Information and Learning Technology, 37(3), 87–98. https://doi.org/10.1108/ijilt-10-2019-0096
Sulindra, E., Cendra, A. N., & Hartani, T. (2024). Utilization of Instructional Technology in English Language Teaching (ELT) Based on Constructivism: A Literature Review. English Education and Literature Journal (E-Jou), 4(02), 141–153. https://doi.org/10.53863/ejou.v4i02.1150
Sumarno, S. (2023). Integration of Digital Technology in Public Management Transformation: International Journal of Asian Education, 4(2), 115–120. https://doi.org/10.46966/ijae.v4i2.348
Suwardika, G., Sopandi, A. T., Indrawan, I. P. O., & Masakazu, K. (2024). A Flipped Classroom With Whiteboard Animation and Modules to Enhance Students' Self-Regulation, Critical Thinking and Communication Skills: A Conceptual Framework and Its Implementation. Asian Association of Open Universities Journal, 19(2), 135–152. https://doi.org/10.1108/aaouj-10-2023-0115
Suyu, H., Xiaoqi, J., Xixi, S., Yike, L., & Shounan, L. (2024). The Impacts of Technology on Learning Motivation of Primary and Secondary School Students — A Systematic Review. SSRF. https://doi.org/10.57237/j.ssrf.2024.05.002
Teixeira, A. Z. A., & Arriel, W. F. (2024). Critical Analysis of Educational Theories and Their Pedagogical Practices: The Applicability and the Impact in the School Context. Revista Caderno Pedagógico, 21(10), e8768. https://doi.org/10.54033/cadpedv21n10-073
Tezer, M., Malatyalı, K. A., Sönmez, C. N., Abiş, C. K., Işıktaş, S., & Marangoz, S. B. (2024). Exploring Digital Literacy Impact: Unveiling the Dynamics of Student Success in Primary School Environments. Futurity Education, 110–125. https://doi.org/10.57125/fed.2024.03.25.07
Zawawi, N. A. W. A., & Hashim, H. (2024). Special Education Integration Program: Teacher's Insights on Utilizing Technology in ESL Classroom. SHS Web of Conferences, 182, 1013. https://doi.org/10.1051/shsconf/202418201013
Zeng, J., Sun, D., Looi, C., & Fan, A. C. W. (2024). Exploring the Impact of Gamification on Students' Academic Performance: A Comprehensive Meta-analysis of Studies From the Year 2008 to 2023. British Journal of Educational Technology, 55(6), 2478–2502. https://doi.org/10.1111/bjet.13471
Zhang, H., & Leong, W. Y. (2024). AI Solutions for Accessible Education in Underserved Communities.

Joit, 2024(1). https://doi.org/10.61453/joit.v2024no11
Zhao, Y., Llorente, A. M. P., & Gómez, M. C. S. (2021). Digital Competence in Higher Education Research: A Systematic Literature Review. Computers & Education, 168, 104212. https://doi.org/10.1016/j.compedu.2021.104212
Zourmpakis, A.-I., Kalogiannakis, M., & Papadakis, S. (2023). Adaptive Gamification in Science Education: An Analysis of the Impact of Implementation and Adapted Game Elements on Students' Motivation. Computers, 12(7), 143. https://doi.org/10.3390/computers12070143