The Success of Digital Technology Infrastructure in Improving Learning Quality of the Merdeka Curriculum Era at Schools In South Tangerang

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Abstract. This study investigates the role of digital technology infrastructure in improving learning quality under the implementation of the Merdeka Curriculum in South Tangerang schools. The background of this research is the persistent gap in digital readiness among schools, where variations in internet connectivity, ICT device availability, and teacher digital competence result in inconsistent learning outcomes. The study aims to analyze how digital infrastructure supports interactive learning, competency development, and the realization of curriculum principles such as personalization, student-centered learning, and project-based approaches. Using a descriptive qualitative method, data were collected through literature review, field observations, and informal interviews with teachers and school management. The findings reveal that strong infrastructure, including reliable internet, adequate devices, and functional Learning Management Systems, significantly enhances student engagement, facilitates multimedia-based instruction, and supports digital assessment practices. Conversely, schools with limited infrastructure face disruptions that hinder instructional continuity and reduce opportunities for technology-enabled learning. The study concludes that digital infrastructure is a strategic foundation for cultivating adaptive, independent, and future-oriented learning environments. Strengthening digital governance, improving teacher competence, and ensuring equitable technological access across schools are essential to optimizing Merdeka Curriculum implementation.

eywords: Digital technology infrastructure, Merdeka Curriculum, learning quality, schools, South Tangerang.

INTRODUCTION

The rapid development of digital technology in the 21st century has brought substantial changes across various sectors, including education. In the educational context, the integration of digital tools has transformed traditional teaching and learning processes into more modern, flexible, and student-centered approaches. The use of Information and Communication Technology (ICT) has become a key driver in enhancing interactive, collaborative, and technology-supported learning. Digital transformation enables educators and students to access a wider range of learning resources and provides opportunities for innovative pedagogical approaches through

multimedia, learning applications, and virtual learning environments. The Indonesian government introduced the Merdeka Curriculum in 2022 as a strategic educational reform aimed at addressing learning loss, improving student competencies, and supporting a more flexible, contextual, and differentiated learning system. The Merdeka Curriculum emphasizes student-centered learning, project-based activities, and the development of core competencies such as critical thinking, creativity, collaboration, and digital literacy. To ensure effective implementation, schools must be supported by adequate digital technology infrastructure. This includes reliable internet connectivity, appropriate ICT devices (such as laptops, computers, and projectors), digital platforms, e-learning systems, and digital school administration tools that facilitate continuous and structured learning.

The Covid-19 pandemic accelerated the digitalization of education and highlighted the urgency of strengthening digital readiness in schools. During the pandemic, schools across Indonesia—including those in South Tangerang—were required to shift rapidly to online and hybrid learning modalities. This situation revealed significant disparities in digital infrastructure, access to technology, and digital competencies among teachers and students. Although several schools in South Tangerang have made substantial improvements in digital facilities, not all institutions have achieved optimal utilization. Some schools still experience insufficient device availability, unstable internet connectivity, limited teacher training, and inconsistencies in the use of digital learning platforms. A UNESCO report (2023) emphasizes that digital transformation can increase learning quality by up to 30% when sustainable infrastructure development is accompanied by professional development for educators. However, without adequate infrastructure, digital learning may instead widen the gap between schools with high technological readiness and schools with limited access. This digital divide is particularly noticeable in South Tangerang, where the variation in school types—public, private, and community-based—results in uneven levels of digital preparedness.

The role of digital technology infrastructure extends beyond simply providing tools; it supports the creation of dynamic, adaptive, and creative learning ecosystems consistent with the principles of the Merdeka Curriculum. With appropriate digital infrastructure, learning becomes more interactive and engaging, enabling teachers to design varied learning activities and students to explore knowledge independently. Additionally, technology supports personalized learning pathways that adjust to students' abilities, interests, and learning pace. Based on these conditions, this study aims to analyze how digital technology infrastructure contributes to improving learning quality in the context of Merdeka Curriculum implementation in South Tangerang. By examining existing infrastructure, school readiness, and technology utilization, the study seeks to provide comprehensive insights and strategic recommendations for strengthening digital ecosystems in schools. The findings are expected to contribute to academic discourse on digital transformation and support policymakers, educators, and institutions in preparing more effective and technology-integrated learning environments.

LITERATURE REVIEW

Digital technology infrastructure has increasingly become a central component in supporting educational transformation in the 21st century. A growing body of research highlights that stable internet connectivity, adequate ICT devices, and accessible digital learning platforms constitute the foundational elements that enable meaningful innovation in teaching and learning (Prasojo & Riyanto, 2020). When these infrastructures are well established, learning activities can shift from traditional, teacher-centered practices toward more interactive, student-driven approaches that encourage exploration, collaboration, and creativity. Digital tools facilitate multimedia-based instruction, virtual learning environments, and access to diverse learning resources, thereby strengthening students' engagement and comprehension. Learning Management Systems (LMS) also play an essential role in modern pedagogical practices. LMS platforms support teachers in managing instructional content, organizing learning pathways, monitoring student progress, and administering both formative and summative assessments. Arifin & Setiawan (2022) note that LMS use in the context of the Merdeka Curriculum enables teachers to implement differentiated learning aligned with students' needs, interests, and readiness levels. Through LMS features, teachers can personalize instruction more effectively, offer timely

feedback, and design learning experiences that reflect the principles of flexibility, independence, and competency-based progression.

Mobile learning further contributes to broader accessibility and enhances opportunities for students to learn beyond classroom boundaries. Gikas & Grant (2013) emphasize that mobile technologies support collaborative learning, promote real-time communication, and allow students to engage with digital content at their own pace. This flexibility aligns closely with the Merdeka Curriculum, which encourages self-directed learning and integrates digital literacy as a key competency for 21st-century learners. However, the effectiveness of mobile learning depends heavily on device availability and connectivity, two factors that remain uneven across many Indonesian schools. Several studies also stress that digital transformation cannot be separated from teacher competence. Huda & Yuliani (2022) argue that teacher digital literacy significantly shapes the extent to which digital tools are integrated into classroom instruction. Even when infrastructure is available, teachers may struggle to adopt technology if they lack training or confidence in using digital pedagogical strategies. Rahmawati & Lestari (2021) similarly found that disparities in teacher competence hinder consistent implementation of digital learning and contribute to varied learning outcomes.

Recent Indonesian literature highlights persistent digital inequalities that influence equitable access to learning. Wahyudi & Yusuf (2021) report that variations in infrastructure readiness, particularly between public and private schools, continue to shape differences in students' opportunities to engage with digital resources. This inequality risks limiting the transformative goals of the Merdeka Curriculum, which aspires to cultivate digital literacy, critical thinking, and collaborative skills across diverse student populations. More recent studies add depth to these concerns. Fadilah & Utami (2022) reveal that strengthening digital literacy in primary schools enhances student engagement and supports adaptation to digital learning environments. Nugroho & Rahardian (2022) emphasize that schools with high digital readiness demonstrate more effective post-pandemic instructional recovery and are better prepared to adopt innovative learning models. Lestari & Kurniawan (2023) show that digital platform utilization contributes to students' competency development when teachers integrate technology beyond basic content delivery. Suryani & Maulana (2023) highlight that technological infrastructure strongly correlates with the quality of 21st-century learning, particularly when supported by institutional readiness and leadership commitment. Haryanto & Pratiwi (2023) further discuss that although digitalization presents significant opportunities for innovation, schools must strengthen strategic planning to ensure meaningful and sustainable technology integration. By integrating all previously mentioned, those literatures show that digital technology infrastructure, teacher competence, school readiness, and policy support are interconnected factors that determine the success of digital learning in the Merdeka Curriculum era. These studies consistently affirm that strengthening digital ecosystems is essential not only for improving learning quality but also for ensuring that all students can participate meaningfully in an increasingly digital society.

RESEARCH METHODS

This research utilized a descriptive qualitative approach to examine how digital technology infrastructure contributes to enhancing learning quality within schools implementing the Merdeka Curriculum in South Tangerang. Qualitative inquiry was considered the most appropriate design as it allows educational phenomena to be explored within their natural environments, revealing nuanced practices, contextual variations, and stakeholders' lived experiences that are often overlooked by standardized quantitative measures. The primary analytical focus was directed toward how schools plan, manage, and integrate digital technologies into curriculum delivery and student learning experiences. To obtain rich and comprehensive insights, two major data collection strategies were employed: systematic literature review and field-based observations supported by informal interviews. The literature review examined ten relevant national and international scholarly sources addressing digital infrastructure, technology-enhanced learning, and educational transformation within the Merdeka Curriculum framework. These references served not only as a theoretical foundation but also as a comparative lens to interpret empirical findings and situate them within broader academic discussions.

Field observations were conducted in a purposive selection of public and private schools across urban and peri-urban areas of South Tangerang. This variation in school characteristics enabled the capture of differing resource levels, policy responses, and pedagogical technology practices. The observations focused on several indicators of digital readiness: availability and reliability of internet connection, adequacy and functionality of ICT devices, readiness of digital classroom environments, utilization of Learning Management Systems (LMS), and teacher capability in leveraging digital tools for pedagogical purposes. Classroom observations were supplemented with informal semi-structured interviews involving teachers and school staff to gain deeper understanding of benefits, challenges, and day-to-day operational realities of technology integration. Data analysis was carried out through a systematic thematic procedure, involving, first, data reduction, where observation field notes and interview transcripts were coded and categorized based on themes derived from literature. Second, data display, where thematic patterns were organized and compared between schools with varying technological conditions; and Third, Conclusion drawing, where synthesized insights were aligned with the theoretical framework to interpret implications for digital transformation within the Merdeka Curriculum.

To strengthen the credibility and trustworthiness of findings, multiple validation strategies were employed including source triangulation, comparison with empirical literature, and reflexive interpretation of divergent cases particularly in schools where technology infrastructure existed yet remained underutilized. These strategies ensured that conclusions were grounded in both theoretical evidence and real-world educational practices. Through this methodological approach, the study generates a holistic, contextually grounded portrayal of how digital infrastructure supports while at times constrains the successful implementation of technology-enhanced learning in the era of the Merdeka Curriculum in South Tangerang.

RESULTS AND DISCUSSION

The findings of this study reveal that digital technology infrastructure plays a pivotal role in shaping the quality of Merdeka Curriculum implementation in schools across South Tangerang. The availability of digital facilities, internet performance, and the depth of pedagogical integration into digital platforms collectively determine whether learning processes align with the curriculum's principles of flexibility, personalization, and project-based engagement. These findings reinforce earlier views articulated by Prasojo and Riyanto (2020) who emphasize that digital infrastructure functions as an essential backbone for enabling interactive and innovative learning processes. The empirical observations from this study affirm that digitalization in schools is not merely a trend but a structural requirement for achieving education transformation.

A major finding of this study underscores that the stability and bandwidth capacity of school internet connectivity serve as core enablers of technology-enhanced learning. Schools with reliable broadband access demonstrated frequent utilization of learning applications such as Google Classroom, Canva, Kahoot, Quizziz, and institution-specific LMS platforms. Smooth access facilitates synchronous and asynchronous collaboration, online assessments, and retrieval of multimedia-rich learning content, thereby fostering more interactive and student-centered environments. These conditions are consistent with UNESCO's (2023) global evidence which states that stable connectivity can increase learning effectiveness by up to 30 percent when accompanied by competent instructional design. In contrast, schools with inconsistent connectivity faced disruptions such as platform loading failures, unstable video connections, and time-consuming attempts to upload assignments. These disruptions reduce instructional time, undermine student engagement, and limit meaningful implementation of curriculum innovations. Teachers in low-connectivity environments reported increased stress, reduced instructional confidence, and difficulty maintaining continuity between planned and delivered lessons, demonstrating that digital readiness directly influences teacher performance.

Another prominent theme relates to the quantity and quality of ICT devices. Schools equipped with projectors in every classroom, functional laptop units, digital laboratories, and student tablets showed clear pedagogical advantages. Teachers in these contexts were able to diversify learning materials through visual, auditory, and kinesthetic stimuli, including simulations and interactive demonstrations aligned with student competency development. This aligns with

findings from Gikas and Grant (2013) who highlight that the integration of mobile and digital devices enhances multimodal learning and supports higher student engagement. Conversely, schools with limited or obsolete equipment such as shared projectors or outdated computers struggled to incorporate digital learning consistently. This disparity leads to inequitable learning experiences within the same institution and challenges the curriculum's intention to promote equal access to creative and independent learning opportunities. Nugroho and Rahardian (2022) further support this observation by stating that uneven device distribution remains one of the primary causes of digital inequality in Indonesian schools, particularly in urban areas with varying socioeconomic conditions.

Across the observed schools, the adoption of LMS platforms emerged as a critical factor in instructional organization, assessment management, and transparency of learning processes. Active LMS utilization enabled teachers to design structured learning sequences, disseminate differentiated content, provide immediate feedback, and track student learning progress. These features, when fully utilized, support the Merdeka Curriculum's emphasis on personalization and self-paced learning. This aligns with Arifin and Setiawan (2022) who explain that LMS platforms can serve as powerful tools for differentiated learning when teachers possess adequate digital pedagogical skills. However, a notable portion of teachers used digital platforms only in basic forms such as projecting slides or uploading static files, reducing digital learning to a substitute for traditional methods rather than enabling a transformative shift. Lestari and Kurniawan (2023) also emphasize that digital platforms have significant potential to advance student competencies only when used interactively rather than as passive content repositories.

Teacher digital competence surfaced as one of the most influential determinants of effective infrastructure utilization. Educators with strong digital literacy demonstrated advanced practices such as integrating interactive technologies into Pancasila Student Profile projects, developing digital lesson modules, and facilitating reflective online learning communities. Teachers with lower competence tended to restrict technology use to superficial functions which limited the benefits students could gain. These findings reinforce the argument by Huda and Yuliani (2022) that digital transformation requires parallel growth in teacher competence; without adequate support for teachers, digital tools cannot achieve their intended impact. In several schools, teachers expressed feeling overwhelmed by rapid technology developments and noted the lack of structured professional development opportunities. This reveals a gap between technological availability and teacher readiness, suggesting that investment in human capability is as crucial as investment in devices.

The digital ecosystem also directly influenced students' engagement with inquiry-based and collaborative learning models central to the Merdeka Curriculum. When digital devices were readily accessible, students were able to conduct online research, co-author documents in real time, and produce creative digital outputs such as videos, infographics, and digital posters. These learning activities supported the development of creativity, critical thinking, and collaboration which are core elements of the Pancasila Student Profile. Consistent with findings by Fadilah and Utami (2022), schools that incorporate digital literacy into everyday learning show higher levels of student motivation, more active participation in class discussions, and stronger problem-solving abilities. Observations further revealed that such environments nurtured greater autonomy and creativity among students, reflecting a shift toward more dynamic and participatory learning experiences aligned with curriculum goals. Students also expressed greater satisfaction with digital project-based assignments because these tasks allowed for creative expression through multimedia tools.

Despite these strengths, several systemic constraints were identified. Resource disparities between public and private schools remain pronounced and continue to produce uneven access to digital learning opportunities. Schools with limited budgets struggle to maintain or upgrade ICT devices, while private schools generally enjoy more advanced technology ecosystems. This aligns with Wahyudi and Yusuf's (2021) analysis which identifies digital inequality as a persistent structural challenge within Indonesian education. Professional development for teachers also remains fragmented, with most training focusing on the introduction of digital tools rather than fostering pedagogical transformation. Teachers reported that many workshops merely demonstrate software features without offering guidance on how to design meaningful digital learning strategies. Technical maintenance systems are also limited, leaving schools vulnerable to

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equipment malfunctions and prolonged disruptions. In some institutions, digital practices have not yet become a normalized part of school culture, causing technology use to remain optional and inconsistent. Haryanto and Pratiwi (2023) confirm that digitalization efforts cannot succeed unless school culture actively supports continuous innovation.

A significant insight also emerged regarding digital governance and long-term sustainability. Schools that implemented clear digital policies, systematic maintenance routines, and ICT support personnel demonstrated more consistent integration of digital tools. In contrast, schools without such structures experienced frequent platform breakdowns, slow responses to issues, and irregular digital adoption. Suryani and Maulana (2023) argue that successful digital infrastructure must be complemented by institutional readiness, strong leadership commitment, and sustainable planning to ensure long-term educational benefits. Leadership support was particularly influential, as principals who encouraged experimentation, allocated budgets for innovation, and provided constructive feedback helped create an environment where teachers felt confident exploring digital resources.

Taken together, the findings emphasize that digital infrastructure is not merely an optional support mechanism but a foundational prerequisite for achieving the pedagogical aspirations of the Merdeka Curriculum. Strong infrastructure, combined with competent educators, supportive policies, and effective school governance, enables learning that is more meaningful, efficient, future-oriented, and equitable. Conversely, insufficient digital readiness risks widening learning gaps, slowing curriculum innovation, and limiting the development of students' digital-age competencies. This study ultimately affirms that digital transformation in education is a multidimensional process that requires alignment among technology, human capability, organizational culture, and government support.

CONCLUSION AND RECOMMENDATION

This study concludes that the presence and effective use of digital technology infrastructure have become central to the successful implementation of the Merdeka Curriculum in schools across South Tangerang. The results consistently show that learning environments supported by stable internet networks, adequate ICT devices, and well-functioning digital platforms are more capable of fostering interactive, flexible, and student-centered instruction. In such schools, teachers are better positioned to design varied learning experiences that incorporate multimedia content, facilitate virtual collaboration, and accommodate individual learning needs. Students, in turn, demonstrate stronger engagement, greater independence in exploring learning resources, and more enthusiasm in completing project-based and creative digital assignments. These advantages highlight that digital infrastructure is not merely an additional facility; it has become an essential driver that shapes instructional quality and helps schools achieve the broader aims of the Merdeka Curriculum. Nevertheless, the study also reveals that differences in digital readiness among schools can create widening learning gaps. Schools with limited devices, unstable connectivity, or minimal digital support experience frequent disruptions that impede the flow of teaching and learning. Teachers in these settings often struggle to integrate digital tools meaningfully and therefore rely on more traditional approaches. This situation restricts students' opportunities to develop digital literacy and limits their ability to experience the full benefits of technology-enhanced learning. Such disparities show that the success of curriculum implementation is not determined by pedagogical vision alone but is closely tied to the availability of reliable technological support and conducive learning conditions.

The findings also emphasize the importance of teacher competence in shaping the effectiveness of digital infrastructure. Teachers with strong digital literacy and pedagogical insight are more capable of leveraging technology to enrich instruction, create structured digital learning pathways, and evaluate student progress more accurately. They are also more open to experimenting with new approaches and facilitating reflective learning experiences that align with the goals of the Merdeka Curriculum. Meanwhile, teachers who feel less confident in using digital tools tend to use technology in a limited or superficial way, which reduces its potential impact. This demonstrates that digital transformation in education cannot rely solely on infrastructure investment; it must be accompanied by continuous capacity building that empowers teachers to

adopt technology with purpose and confidence. In addition to teacher competence, strong school governance also plays a decisive role. Schools that have established clear digital policies, maintenance routines, and support systems are generally better prepared to sustain digital learning practices. Leadership commitment helps create a culture that values innovation and encourages teachers to use digital tools as part of their daily instructional routines. Without such support, technology use tends to become optional, irregular, or dependent on individual teacher initiative. Long-term planning is therefore essential to ensure that digital infrastructure remains functional and that learning continuity is not compromised by technical issues.

Based on these insights, it can be concluded that strengthening digital ecosystems in schools is a strategic priority for enhancing learning quality under the Merdeka Curriculum. Schools need to ensure that digital facilities are available, accessible, and properly maintained. Continuous professional development for teachers must remain a central agenda, accompanied by opportunities for peer collaboration and mentoring that encourage reflective and innovative teaching practices. School leaders should foster supportive environments where teachers feel encouraged to explore new methods and integrate technology in ways that genuinely benefit students. To support long-term sustainability, schools also need to plan for regular device upgrades, allocate budgets for maintenance, and establish partnerships with government, industry, and community organizations. Broader collaboration is essential to ensure that all students regardless of their background have equal access to digital learning opportunities both at school and at home. By pursuing these directions, schools in South Tangerang can move toward becoming more inclusive, adaptive, and future-ready learning institutions that embody the spirit of the Merdeka Curriculum. Ultimately, digital technology should not be viewed merely as a tool but as an integral part of a transformative learning environment that prepares students to thrive in an increasingly digital world.pp

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