

SCHOOL PRINCIPALS' DIGITAL LEADERSHIP IN ADVANCING TEACHER PROFESSIONALISM AND LEARNING INNOVATION: A QUALITATIVE LITERATURE-BASED ANALYSIS

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ABSTRACT

Educational transformation in the digital era requires schools to integrate technology systematically into learning practices and institutional management. In this context, school principals' digital leadership plays a pivotal role in fostering teacher professionalism and promoting sustainable learning innovation. This study aims to analyze the role of principals digital leadership in enhancing teacher professionalism and supporting learning innovation within contemporary educational transformation. A qualitative literature-based research design was employed by analyzing peer-reviewed journal articles, research reports, and relevant academic documents. Data were examined using thematic content analysis to identify recurring patterns related to digital leadership practices and their implications for teachers' professional development and instructional innovation. The findings indicate that principals' digital leadership contributes through three key dimensions: strengthening teachers' digital competencies through continuous training and coaching, implementing technology-based academic supervision, and cultivating a collaborative and innovation-oriented school culture. Additionally, principals support learning innovation by articulating a clear digital vision, encouraging professional collaboration, and utilizing data-driven decision-making. Nevertheless, challenges such as teacher resistance, limited digital infrastructure, and disparities in digital literacy remain significant barriers. This study underscores the importance of strengthening principals digital leadership capacity to ensure that educational transformation is effective, inclusive, and sustainable. *This is an open access article under the CC-BY-SA license.*



INTRODUCTIONS

Digital transformation has become a defining feature of the global education ecosystem, compelling schools to integrate technology to enhance both learning quality and institutional governance (Bykovskaia et al., 2020). The

development of the industrial era 4.0 to society 5.0 demands that educational institutions integrate digital technology into all aspects of management and learning (Fukuyama, 2018). In this context, the school principal, as an educational leader, holds a strategic role in directing change, ensuring organizational readiness, and fostering a culture of digital innovation within the school environment (Tanniru & Peral, 2021). Without effective digital leadership, digital transformation efforts often stop at technology procurement without improving learning quality (Tamar et al., 2023).

Teacher professionalism has become a critical factor in responding to the demands of technology-based education, requiring not only pedagogical mastery but also strong digital literacy and adaptability (Levano-Francia et al., 2019). School principals play a role in guiding, mentoring, and facilitating the development of teachers' digital competencies to support the creation of innovative learning processes (Nababan et al., 2021). These competencies include the use of digital platforms, the development of technology-based learning media, and the evaluation of digital learning (Ng et al., 2023). Therefore, principals' digital leadership becomes the primary driver for teachers in enhancing their professionalism in the digital era (Snyder, 2019).

However, field realities show a gap between the need for teachers' digital competency development and the leadership support available in schools (Baracaldo Guzmán, 2019). Many schools still lack a structured digital leadership strategy, resulting in suboptimal use of technology to support teacher professionalism (Suratman et al., 2024). The lack of an innovation culture, limited technology training, and low digital literacy remain obstacles affecting teacher performance in the digital age (Gegenfurtner, 2016). Therefore, the role of school principals in encouraging learning innovation through digital leadership is crucial to ensuring that educational transformation runs effectively (Nowell et al., 2017).

In addition, learning innovation does not rely solely on technology, but also on the ability of school principals to motivate, inspire, and create a culture of continuous learning for teachers (Baumeister & Leary, 1997). Effective digital leadership enables the creation of a collaborative environment that allows teachers to experiment, evaluate, and develop innovative learning practices (Nababan et al., 2021). This is important considering that modern education emphasizes creativity, collaboration, and the use of technology as the core of the learning process (Bykovskaia et al., 2020). Thus, digital leadership becomes the key to transforming schools into modern learning organizations (Bykovskaia et al., 2020).

The urgency of this research lies in the need to understand digital leadership strategies that enable school principals to sustainably foster teacher professionalism and learning innovation in the post-pandemic era, in which technology has become a fundamental pillar of education (Ng et al., 2023). This study is important as a basis for developing policies and educational management practices responsive to digital challenges (Suratman et al., 2024).

Several previous studies have examined digital leadership in educational contexts, such as the effectiveness of digital leadership in supporting online learning (Tamar et al., 2023), the transformation of teachers' digital competencies (Baracaldo Guzmán, 2019), and the role of principals in educational technology innovation (Nababan et al., 2021). However, studies that specifically link principals' digital leadership with the simultaneous enhancement of teacher professionalism and learning innovation within the context of sustainable educational transformation remain limited (Tanniru & Peral, 2021). Therefore, this research fills that gap in the literature (Snyder, 2019).

The purpose of this research is to analyze how principals' digital leadership contributes to improving teacher professionalism and promoting learning innovation in the era of educational transformation. This study provides theoretical contributions to the development of digital leadership literature and offers practical recommendations for school principals, policymakers, and educational stakeholders in optimizing digital transformation in schools (Nowell et al., 2017).

METHOD

Approach and Type of Research

This study employed a qualitative approach using a literature-based research design to synthesize conceptual and empirical evidence on principals' digital leadership. The qualitative approach was chosen because this research focuses on in-depth understanding of social phenomena through the interpretation of texts and scientific data (Creswell & Poth, 2016).. The literature study method was selected to review and analyze concepts, empirical findings, and

theoretical perspectives related to principals' digital leadership, teacher professionalism, and learning innovation in the era of educational transformation (Snyder, 2019).

Data Sources

The data sources used in this research consist of secondary data obtained from journal articles, scholarly books, scientific proceedings, educational policy documents, and relevant research reports published at both national and international levels. References were collected through scientific databases such as Scopus, Google Scholar, ERIC, and DOAJ to ensure the validity and reliability of the information analyzed (Kitchenham et al., 2015).

Data Collection Techniques

Data collection was conducted through the processes of identifying, selecting, evaluating, and synthesizing various academic literature relevant to the research focus. Keywords such as digital leadership, school leadership, teacher professionalism, and innovation in education were used in the literature search, applying inclusion and exclusion criteria to ensure that the selected data were relevant and met the characteristics of valid academic research (Booth et al., 2021).

Data Analysis Method

Data were analyzed using thematic content analysis, involving systematic coding, categorization, and interpretation to generate conceptual insights grounded in existing literature (Nowell et al., 2017). This approach is effective for examining phenomena based on academic documents and allows researchers to develop conceptual frameworks based on evidence validated in previous literature (Bowen, 2009).

Thus, the selection of a qualitative literature study method is considered appropriate because it provides deep understanding and sharp analysis of the role of principals' digital leadership in enhancing teacher professionalism and promoting learning innovation in the era of educational transformation.

RESULT AND DISCUSSION

School Principals' Digital Leadership and Teacher Professionalism

In an era of increasingly digital educational transformation, the role of the school principal as a digital leader beyond that of a traditional administrator has become a key factor in developing teacher professionalism. Principals' digital leadership encompasses visionary orientation, strategic change management, and the systematic cultivation of technology-enhanced professional practices. For instance, a study by Maulana Dhielfitri and Yohamintin reports how a principal initiated a digital pedagogy training program for teachers through a series of workshops, mentoring sessions, and continuous evaluations substantially improving teachers' digital-based pedagogical competence (Dhielfitri, 2025). Through strategic planning, the principal crafted a digital transformation roadmap from identifying teachers' needs to procuring digital facilities and forming a school digital movement team.

Another real case can be found in a study conducted Regency of Bone Bolango. Principals' digital leadership encompasses visionary orientation, strategic change management, and the systematic cultivation of technology-enhanced professional practices. (Kasim & Surya, 2025). This demonstrates that effective digital principals do not simply instruct; they model digital practices and provide ongoing support for teachers to apply technology in instruction and classroom management.

Furthermore, digital-based academic supervision models developed by principals also contribute significantly to teacher professionalism. For example, in early childhood education institutions (PAUD), research by Danial, Mumu, and Nurjamil shows that principals used Google Drive, Google Classroom, and e-learning platforms to provide instructional feedback, detect teacher weaknesses, and design improvement strategies (Danial et al., 2022). Such digital supervision makes guidance more efficient, flexible, and responsive to teachers' evolving competencies, while reducing the burden of face-to-face administrative tasks that often limit pedagogical reflection.

Psychologically, principals' digital leadership also strengthens teachers' intrinsic motivation. Principals who apply a transformational digital style can foster teachers' sense of trust and inspiration. Rosita & Iskandar found that democratic and transformational leadership in the digital era creates an environment that supports creativity, collaboration, and a sense of professional ownership among teachers (Rosita & Iskandar, 2022). Meanwhile, another study indicates that transformational instructional leadership positively affects teachers' "digital lifestyle" and their

digital-based teaching—meaning teachers do not use technology simply out of pressure, but because they develop digital habits grounded in shared values and vision (Hadi, 2024).

Despite its potential, digital leadership implementation remains uneven, constrained by teacher resistance, infrastructural limitations, and disparities in digital competence. Other studies reveal obstacles such as teacher resistance, technology infrastructure gaps, and limited resources (Andini, 2021). In such situations, digital transformation may stall due to teachers’ fear of failure or lack of competence, hindering the growth of digital professionalism. This underscores that digital leadership is not only about having a vision but also about managing resistance, providing structural support, and building trust. Overall, digital leadership enhances teacher professionalism through three main mechanisms:

- technology-based training and mentoring;
- systematic digital academic supervision; and
- the creation of motivational and collaborative cultures grounded in transformational leadership.

When principals act as digital coaches, facilitators, and inspirers, teachers feel more confident in developing digital competencies, more open to experimenting with new teaching methods, and more committed to continuous improvement. At the same time, real challenges—such as resistance, infrastructure limitations, and skill gaps—highlight the need for supportive policies, infrastructure investments, and capacity building for principals to ensure sustainable teacher professionalism.

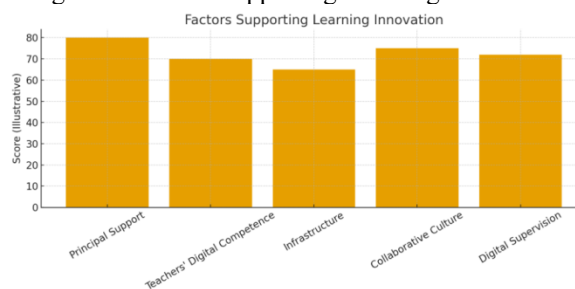
School Principals’ Digital Leadership and Learning Innovation

Amid the rapid educational transformation driven by technological advancement, digital leadership by school principals emerges as a central pillar in promoting learning innovation. Principals who embrace digital leadership view technology not merely as an administrative tool, but as a strategic element to revitalize teaching and learning. A study found that transformational principals can formulate inspiring digital visions that motivate teachers to explore technology-enhanced teaching methods, fostering a collective innovation-oriented school culture (Al Faruq & Supriyanto, 2020).

In practice, digital principals act as learning facilitators organizing training, workshops, and webinars to improve teachers’ digital literacy and disseminate technology-based pedagogical knowledge. For example, a post-pandemic study at SD Negeri 1 Manggung shows that the principal played dual roles as educator and manager by providing digital infrastructure such as a Learning Management System (LMS) and supervising online learning. Through digital supervision and guidance, principals provided constructive feedback, enabling continuous development of innovative practices (Nurrochman et al., 2023).

Digital leadership also fosters teacher collaboration as an integral part of learning innovation. Principals encourage the formation of technology-based Professional Learning Communities (PLC), where teachers share experiences, design new learning modules, and try models such as flipped classrooms or blended learning. Dyan’s research confirms that transformational principals successfully build strong teacher collaboration that drives innovation even under resource limitations (DYAN, 2024).

Figure 1: Factors Supporting Learning Innovation

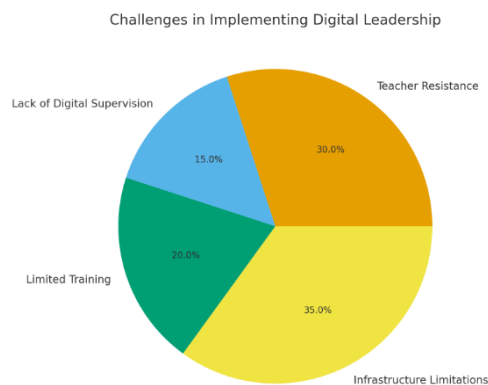


The learning innovation process that is developed does not stop at the stage of launching ideas; it continues to be evaluated through digital monitoring and data analysis. As digital leaders, principals use data from learning platforms to assess the extent to which new methods are applied and effective. This strategy enables them to make evidence-based decisions, identify obstacles, and adjust actions responsively. Findings from the study by Wijaya and Nuraini show that effective principals implement digital-based monitoring and evaluation systems as part of their innovation management strategy (Wijaya & Nuraini, 2025).

Another concrete example of the contribution of digital leadership to learning innovation can be seen at SD Angkasa Lanud Silas Papare through a literacy project called “*Si Pesawat Literasi (SiPeLi)*.” Sembiring, Simanungkalit, and Ramadhan (2025) explain in their study that the principal applied an instructional-participatory leadership style adapted to teacher readiness. The principal not only encouraged the use of social media as a literacy tool but also built a literacy innovation culture through the SiPeLi model, which increased students’ enthusiasm for digital reading and writing. The success of this model demonstrates that visionary and supportive digital leadership can transform the school’s literacy culture into one that is more modern and relevant (Sembiring et al., 2025).

However, the journey of learning innovation under digital leadership is not always smooth. Principals face challenges such as teacher resistance, especially from those who are unfamiliar with or anxious about technological changes. One study revealed that although some principals manage digital change through participatory strategies, they still encounter limitations in infrastructure and resources (Andini, 2021). Furthermore, on online learning in schools highlights the weaknesses in principals’ digital coaching capacity, the lack of formal integration of online supervision, and disparities in teachers’ mastery of learning management systems (Kurniawan & Lazwardi, 2025).

Figure 2: Challenges in Implementing Digital Leadership



On the other hand, digital leadership has also proven its role in strengthening teachers’ digital literacy. For example, at SD Alkhairaat 1 Palu, Rifad, Alhabsyi, and Nadirah (2023) found that a transformative principal improved teachers’ digital literacy through workshops, training programs, and routine supervision. As a result, teachers became more technologically literate and capable of integrating digital practices into daily instruction (Rifad et al., 2023).

Another equally important aspect is the external collaboration fostered by principals as digital leaders. In several cases, principals partner with outside institutions such as educational technology providers to strengthen the innovation ecosystem. In a study at a senior high school, found that principals established strategic partnerships to develop technology-based curricula, conduct digital training for teachers, and enhance students’ digital literacy. Such partnerships accelerate the innovation process and ensure the sustainability of digital transformation (Silalahi et al., 2025).

Culturally, principals who lead digitally cultivate an innovative school culture in which minor failures are viewed as part of experimentation and collective learning. Principals initiate regular meetings, best-practice sharing sessions, and collaborative reflections, which foster shared ownership of innovation. Other research emphasizes that

visionary leaders not only set the vision but also internalize the value of innovation in every aspect of school management (Al Faruq & Supriyanto, 2020).

Thus, this narrative illustrates that principals' digital leadership is essential in promoting learning innovation through a clear vision, professional development facilitation, teacher collaboration, data-driven monitoring and evaluation, and ecosystem partnerships. Digital principals are not merely administrative managers but change agents who drive a culture of innovation and digital literacy in schools, despite facing challenges such as infrastructure limitations, resistance, and capacity gaps.

Synergy Between Teacher Professionalism and Learning Innovation in Digital Leadership

In the context of educational transformation driven by technological development and the demands of 21st-century competencies, teacher professionalism and learning innovation cannot be viewed as two separate concerns, but rather as two mutually reinforcing dimensions under the direction of a school principal's digital leadership (Dyan, 2024). Teacher professionalism which includes mastery of pedagogical and technological competencies, the ability for professional collaboration, and an ethical commitment to instructional quality serves as the foundation that enables teachers to design and implement meaningful and sustainable learning innovations. Meanwhile, learning innovation provides concrete avenues for teachers to practice and validate these competencies in real classroom and online learning environments (Ardhi et al., 2024).

School principals who adopt digital leadership act as the bridge aligning these two dimensions through integrated actions: providing continuous training and coaching that sharpen teachers' digital literacy, facilitating professional learning communities for exchanging best practices, and establishing data-based monitoring and evaluation mechanisms for collective reflection and improvement within the learning cycle (Riski et al., 2023). In this way, digital leadership is not merely about providing platforms and devices but managing a professional learning process that allows teachers to grow while simultaneously testing pedagogical innovations both scientifically and practically (DYAN, 2024).

This synergy becomes tangible when principals implement an intensive digital PLC (Professional Learning Community) model: teachers routinely meet in online and offline forums to design learning units, conduct video-based microteaching, analyze student performance data from the LMS, and provide measurable feedback to one another. This process accelerates the adoption of innovative practices because teachers are no longer working in isolation but within a supportive professional network (Ardhi et al., 2024). When this collaborative culture is combined with digital supervision that emphasizes individual attention and intellectual stimulation key features of transformational leadership teachers demonstrate increased confidence in experimenting with pedagogical approaches such as adapting flipped-classroom models, integrating interactive media, or applying data-driven formative assessments, all of which represent direct forms of learning innovation (Anggraeni, 2017).

The use of digital learning data becomes another binding element that strengthens the synergy between professionalism and innovation. Principals who utilize analytics from the LMS, online quiz results, and student activity reports can facilitate concrete teacher reflection: such evidence is used to demonstrate the effectiveness of new teaching strategies, determine professional development needs, and design follow-up actions based on evidence-based decision-making, ensuring that innovation does not stop at trial-and-error but moves toward measurable improvement (Riski et al., 2023). This mechanism also enhances teachers' professional accountability, as data-based monitoring simplifies the identification of strengths and weaknesses in actual teaching practices (Kurniawan & Lazwardi, 2025).

Table 1: Integration of Teacher Professionalism & Learning Innovation

| School / Study | Form of Practice | Measurable Impact |
|----------------------------------|--|--|
| SD Angkasa Lanud Silas Papare | SiPeLi digital literacy program using digital-based multimedia modules | Improved teacher digital literacy skills & increased student literacy outcomes |

| School / Study | Form of Practice | Measurable Impact |
|--|--|---|
| Schools with Digital PLC | Video microteaching, data analysis from LMS, regular collaboration | Teachers become more confident in innovating & adopting new methods |
| Schools Implementing Digital Supervision | Teaching monitoring through the LMS, data-based feedback | Improved teaching methods & more directed learning innovation |
| Schools with Intensive Digital Training | Digital literacy workshops, structured coaching | Increased ability to create digital media & conduct evaluation |

Even so, this synergy does not automatically occur in all schools; structural and cultural barriers often become the main obstacles.

Table 2: Barriers and Solutions in Professionalism Innovation Synergy

| Key Barrier | Impact | Recommended Solutions |
|----------------------------------|--|--|
| Teacher Resistance to Technology | Slow adoption of learning innovation | Coaching approaches, continuous training |
| Infrastructure Gaps | Uneven innovation across schools | Priority procurement, external collaboration |
| Limited Digital Literacy | Teachers struggle to design innovation | Intensive digital literacy programs |
| Traditional Supervision | Minimal data-based evaluation | Academic supervision using digital platforms |

Therefore, effective digital leadership must be accompanied by strategies to address these barriers: equitable resource allocation, capacity-building programs for school principals themselves, and cultural change approaches that emphasize participation and appreciation for innovative practices (Mardiana et al., 2025).

Theoretically and practically, the synergy between teacher professionalism and learning innovation under digital leadership requires school principals to assume multi-dimensional roles: as visionaries who set the direction of transformation, as coaches who facilitate competency development, as facilitators of professional networks, and as managers who use data for decision-making. When these roles are carried out consistently and supported by school policies and ecosystem support (such as partnerships with platform providers and universities), educational transformation becomes systemically and sustainably achievable, rather than merely an ad hoc project (DYAN, 2024).

Teacher professionalism and learning innovation are two sides of the same coin in educational transformation. When aligned through the school principal's digital leadership, they can generate adaptive, high-quality, and relevant learning practices suited to students' contemporary needs. However, realizing this synergy requires serious attention to leadership capacity development, infrastructure investment, and the cultivation of a collaborative culture within schools (Ardhi et al., 2024).

Based on the analysis above, several practical implications can be drawn:

School principals must be equipped with digital and transformational leadership training to strengthen their capacity in managing digital educational transformation.

School policies should support the formation of digital teams, allocate budgets for infrastructure, and utilize LMS data for monitoring and evaluation.

Teacher professional development programs must be continuous not limited to one-time training, but extended through coaching, mentoring, and digital communities of practice.

School principals should cultivate a culture of innovation, for example by giving teachers space to experiment, reflect, collaborate, and receive recognition for creativity.

Schools need to establish external partnerships (with technology institutions, research organizations, platform providers) to support more holistic digital innovation and transformation.

The analysis shows that the digital leadership of school principals plays a strategic and multi-dimensional role in promoting teacher professionalism and learning innovation in the era of educational transformation. Principals who are visionary, who train and digitally support teachers, who monitor through data, and who foster a collaborative culture have created adaptive and innovative school ecosystems. Although challenges remain—such as limited digital capacity and resources—this model of digital leadership holds strong potential as a foundation for sustainable educational transformation in the twenty-first century.

CONCLUSION

Reviewer

This study concludes that school principals' digital leadership plays a strategic and multidimensional role in advancing teacher professionalism and fostering learning innovation in the era of educational transformation. Digital leadership enables principals to articulate a clear technological vision, facilitate continuous professional development, implement technology-based academic supervision, and cultivate collaborative cultures that support innovation. Teacher professionalism and learning innovation emerge as interdependent dimensions that are effectively aligned through strong digital leadership. Although challenges related to infrastructure, resistance, and digital literacy persist, strengthening principals' digital leadership capacity offers a viable pathway toward sustainable educational transformation. Future research should employ empirical approaches to further examine the implementation and impact of digital leadership across diverse school contexts.

To optimize digital transformation, principals need to strengthen their digital leadership capacity through formal training, educational technology workshops, and coaching programs. Schools should allocate dedicated budgets for enhancing digital infrastructure and developing Learning Management Systems (LMS) as part of modern academic supervision. Teachers need support through digital Professional Learning Communities (PLCs) as spaces for sharing innovative practices, engaging in pedagogical reflection, and developing technology-based learning materials. Government and policy makers should provide policy support that reinforces school digitalization, including improving educators' digital literacy and implementing continuous professional development programs for principals. In addition, collaboration with external partners such as universities, technology industries, and training institutions is essential to sustain ongoing innovation.

This study has limitations because it relies entirely on literature review, and therefore does not directly measure empirical conditions in schools. The analyzed data depend on the quality and availability of the scientific sources used, which may result in findings that do not fully represent the diverse contexts of digital leadership practices across regions. Furthermore, differences in school characteristics, work culture, and technological readiness cannot be examined in depth through literature-based research.

Future studies need to employ empirical approaches such as case studies, surveys, or mixed methods to explore digital leadership practices more concretely in different school contexts. Evaluating the effectiveness of digital leadership interventions by measuring teacher performance, learning quality, and student learning outcomes is also strongly recommended. Longitudinal research can be conducted to observe the dynamics of changes in teacher competence and learning innovation over time. Moreover, developing contextual digital leadership models suited to the characteristics of schools in Indonesia should be a key focus of future research.

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