

Transformation of School Principal Leadership in the Digital Era: Literature Review

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DOI Link: <http://dx.doi.org/10.6007/IJARPED/v14-i4/26690>

Published Online: 06 October 2025

Abstract

The role of school principals is undergoing a significant transformation in response to the demands of the digital era, shaped by rapid technological advancements, the Fourth Industrial Revolution (Industry 4.0), and the emergence of Society 5.0. This study conducts a systematic literature review to explore how school leadership is evolving to meet these challenges, with a particular focus on fostering teacher professionalism and building adaptive, future-ready schools. Drawing from 15 peer-reviewed journal articles published between 2020 and 2024, the review identifies key leadership strategies that enhance educational innovation and institutional resilience. The findings indicate that effective school principals in the digital age exhibit both transformational and digital leadership qualities, including visionary thinking, collaboration, data-informed decision-making, and adaptability. These leaders utilize digital tools not only for administrative efficiency but also to improve pedagogical practices and support continuous professional development for teachers. The study emphasizes the importance of cultivating a school culture that promotes digital literacy, adaptive learning, and collaborative problem-solving. It concludes that successful school leadership in the digital era must integrate technological innovation with human-centered approaches to achieve sustainable improvements in teaching and learning. A conceptual model is proposed to illustrate how principals can drive digital transformation by aligning teacher development with strategic policy innovation, providing a valuable reference for educational stakeholders navigating ongoing technological change.

Keywords: School Leadership, Digital ERA, Transformational Leadership, Teacher Professionalism, Educational Management, Industry 4.0, Society 5.0

Introduction

The rapid development of information technology has revolutionized almost every aspect of life, including the world of education. In facing the digital era and the complexities of the 4.0 industrial revolution and 5.0 society, schools as formal educational institutions are required to undergo a comprehensive transformation—from the learning system, administrative management, to leadership patterns and the professional development of educators. Digitalization not only demands technical changes but also a transformation of work culture, institutional vision, and leadership paradigms.

In this context, the principal plays a strategic role as the driving force of change. They are not only required to adapt to technological developments but also to become agents of transformation who can inspire teachers and educational staff to innovate. The leadership model relevant to this condition is transformational leadership, characterized by a forward-looking vision, innovation capability, and a commitment to the continuous improvement of school quality. Studies by Wulandari (2024), Murni et al. (2024), and Hasanah & Mustofa (2024) reveal that principals who implement transformational leadership are proven to be capable of driving organizational culture change, enhancing team collaboration, and creating a work environment that supports technology-based learning.

Meanwhile, teachers as the frontline in the learning process are also required to enhance their professionalism to stay relevant with the needs of the times. Teacher professionalism in the digital era not only encompasses mastery of pedagogy but also the ability to integrate technology into learning and develop digital literacy. Kurniasari et al. (2025), Taufikurrahman (2021), and Santosa & Wening (2020) show that teachers who are active in continuous professional development based on digital technology have a significant impact on increasing student engagement, learning creativity, and more optimal learning outcomes.

However, various studies that have been conducted tend to discuss separately the leadership of school principals and the professionalism of teachers in the digital context. Previous studies have not extensively analyzed the interconnection and synergy between the two as a strategic unity in the transformation of digital education. Research gaps are also evident in the lack of studies that synergize the role of transformational school leadership with efforts to strengthen teacher professionalism as a holistic strategy in facing the challenges of the 4.0 industrial revolution and society 5.0.

Therefore, this research aims to thoroughly examine the role of school principals' leadership in driving educational transformation, particularly in relation to the development of teacher professionalism in the digital era. The novelty of this research lies in the systematic literature approach that examines the strategic interconnection between two important components in the school ecosystem, as well as formulating a conceptual model that can serve as a foundation for the implementation of educational leadership policies and practices in the future.

Literature Review

The transformation of digital education in the era of the industrial revolution 4.0 and society 5.0 demands profound changes in learning systems, management, and the culture of educational organizations. One of the key aspects of the success of this transformation is the role of school leadership, which must become agents of change to create a learning environment that supports the application of technology. On the other hand, teacher professionalism must also improve in line with the demands of using technology in the learning process. Therefore, this literature aims to examine the relationship between school principal leadership and the development of teacher professionalism in facing the challenges of digital education.

Transformational Leadership in Digital Education

Transformational leadership has proven effective in driving organizational culture change, including in the education sector. Bass (1985) stated that transformational leadership can inspire and motivate organizational members to achieve higher goals by providing a clear vision and creating a supportive work environment. In the context of schools, principals who implement transformational leadership not only focus on administrative aspects but also on the development of teachers' capacities and the improvement of learning quality. Innovative and visionary principals have the ability to drive positive change in the school environment by focusing on the utilization of technology.

Wulandari (2024), Murni et al. (2024), and Hasanah & Mustofa (2024) demonstrate that principals with transformational leadership can enhance the overall quality of the school by introducing policies that encourage the use of technology in teaching and administration. They also create an organizational culture that supports collaboration among teachers and educational staff, and motivates them to innovate in integrating technology.

Teacher Professionalism in the Digital Era

The professionalism of teachers is the key to the success of education in the digital era. Kurniasari et al. (2025) explain that teacher professionalism not only involves mastery of pedagogy but also the ability to integrate technology into learning. This includes mastery of digital tools that support the teaching and learning process, such as online learning platforms, interactive learning applications, and relevant hardware. Teacher professionalism also includes the development of digital literacy, which is important for adapting to rapid technological advancements.

Taufikurrahman (2021) and Santosa & Wening (2020) emphasize that the development of teacher professionalism in the digital era is crucial for enhancing student engagement and learning outcomes. Teachers who continuously develop themselves through technology-based training can enhance the quality of learning and provide a more engaging learning experience for students. Additionally, the professionalism of teachers also contributes to their ability to utilize technology in creating a learning environment that is adaptive and responsive to the needs of the times.

The Relationship Between School Leadership and Teacher Professionalism

Although many studies discuss school principal leadership and teacher professionalism separately, very few explore the interconnection between the two in the context of digital transformation. Research by Prasojo et al. (2023) shows that transformational school leadership can provide significant support in the development of teacher professionalism. Principals with a technological vision can create policies and provide resources that enable teachers to continuously develop their digital skills.

A study by Saraswati & Nugroho (2022) also shows that collaboration between school principals and teachers in designing technology-based teaching strategies is crucial for creating an innovative learning environment. Principals who encourage teacher professionalism through technology training programs and digital competency development can enhance the overall quality of learning. This shows the importance of the synergy

between school leadership and efforts to strengthen teacher professionalism in facing the challenges of the industrial revolution.4.0.

Conceptual Model of Teacher Leadership and Professionalism Development

Integrating transformational leadership with the development of teacher professionalism is a strategic approach to addressing the challenges of digital education. The conceptual model proposed by Jannah (2023) underscores the importance of the principal's role in building a shared vision with teachers to achieve educational goals that are adaptive to technological changes. The principal must act as a facilitator and motivator for teachers in the process of developing their professionalism, particularly in the integration of technology into learning. The novelty of this model lies in strengthening the relationship between school leadership and teacher professionalism as a unified entity in creating effective and sustainable educational transformation. With this approach, it is hoped that a more innovative, adaptive, and future-ready school ecosystem can be created.

The existing literature shows that transformational leadership of school principals and teacher professionalism are two complementary elements in facing the digital era. An effective principal in implementing transformational leadership can facilitate the development of teacher professionalism, while teachers who continuously develop their technological skills can play an active role in the implementation of policies initiated by the principal. This research contributes to formulating a conceptual model that can serve as a guideline for the implementation of policies and practices of more effective educational leadership in the future.

It is important for future research to further explore the synergy mechanisms between these two elements in a broader context, including examining external factors that influence the implementation of technology in schools. In the future, this research is expected to provide a stronger foundation for the formulation of educational policies that are more responsive to technological developments and future educational needs.

Methods (Revised for Clarity on Analysis)

This research adopts a Systematic Literature Review (SLR) approach to collect, screen, and synthesize peer-reviewed studies relevant to school leadership and teacher professionalism in the digital era. The goal was to explore the strategic interrelationship between transformational leadership and teacher professionalism in supporting digital transformation in education.

Article Identification and Selection Process The literature search was conducted using databases such as Google Scholar, SpringerLink, and JSTOR, targeting peer-reviewed journal articles published from 2020 to 2025. Using tools such as Publish or Perish, an initial dataset of 200 articles was generated based on predefined keywords including:

1. "transformational leadership in schools"
2. "digital leadership and teacher development"
3. "school leadership in Industry 4.0 and Society 5.0"
4. "teacher professionalism in digital education"

Following the PRISMA flow, the stages of the review included:

1. Identification: 200 articles retrieved from databases using the search terms.
2. Screening: Titles and abstracts were screened for relevance and duplication, resulting in 82 studies.
3. Eligibility: Full-text reviews were conducted to assess alignment with inclusion criteria:
 - Empirical or conceptual focus on school leadership and/or teacher professionalism
 - Relevance to digital transformation and technology integration in education
 - Published in English or Indonesian between 2020–2025
4. Inclusion: Final selection of 15 studies that provided rich insights into the evolving role of school principals and teacher development in digital contexts.

Thematic Analysis Approach

This study used Braun & Clarke's (2006) six-phase Thematic Analysis to analyze the selected literature:

1. Familiarization with Data: Reading and re-reading each selected article to identify meaningful segments.
2. Generating Initial Codes: Coding recurring concepts related to leadership, digital integration, professionalism, and school transformation.
3. Searching for Themes: Grouping codes into potential themes such as "transformational leadership attributes," "professional development support," and "policy-driven digital change."
4. Reviewing Themes: Refining and merging overlapping themes to ensure coherence across studies.
5. Defining and Naming Themes: Finalizing major themes that capture the synergy between leadership and professionalism.
6. Producing the Report: Synthesizing findings to generate a conceptual model of leadership-professionalism alignment in digital transformation.

Three overarching themes were identified:

1. Visionary and collaborative digital leadership
2. Teacher professionalism through digital capacity-building
3. Systemic support via policies and culture of innovation

Data Credibility

To ensure validity and reliability, the study employed source triangulation comparing patterns across different literature types (empirical, conceptual, and policy-based) and consulted domain experts to validate the emerging framework. This rigorous, transparent process ensures that the conclusions drawn reflect the most relevant and credible knowledge on school leadership and teacher professionalism in the context of Industry 4.0 and Society 5.0.

Data Analysis

After the data is collected, the researchers use content analysis to delve deeper into the content and themes contained in the literature. Content analysis allows researchers to identify similarities, differences, and patterns that emerge in previous studies. The researchers also conduct a qualitative synthesis, which means combining findings from various studies to build a more comprehensive understanding of the relationship between school principal leadership and teacher professionalism in the digital context.

To ensure the validity and reliability of the research findings, the researchers use source triangulation. This process is carried out by comparing findings from various different literature sources to verify the consistency of the obtained results. In addition, the researchers also verify the findings by discussing them with experts in the fields of educational leadership and educational technology to ensure that the literature synthesis and the proposed conceptual model are relevant and acceptable to the academic community.

Findings and Discussions

The Role of the Principal in Digital Transformation

In the conducted study, most of the literature shows that school principals play a very important role in directing digital transformation in schools. The principal is not only responsible for the administration of the school but also acts as a change agent leading the adoption of technology in learning.

According to Wulandari (2024), an effective principal in leading digital transformation in schools must have a clear and long-term vision. This vision includes a strategic plan for technology integration, training for teachers, and infrastructure that supports digital learning. Principals with a strong vision can motivate teachers to adapt to technology and plan structured technology implementation.

For example, Hasanah & Mustofa (2024) show that principals who understand the importance of technology in education are able to develop policies that encourage the integration of technology into the curriculum. They facilitate the use of digital learning tools, which not only enhance the quality of teaching but also enrich the students' learning experience.

However, the main challenge found is that many school principals are not yet fully prepared to lead digital transformation. Principals in several regions still struggle to plan and implement technology optimally due to limited resources and inadequate training (Siti & Nurul, 2021).

Transformational Leadership in the Digital Era

Most of the reviewed studies indicate that transformational leadership is a relevant and effective approach in addressing the challenges of digital education. Principals who apply transformational leadership styles not only lead with an administrative approach but also inspire teachers and staff to innovate and adapt to changing times.

Murni et al. (2024) emphasize that principals who adopt transformational leadership are able to create a work climate that supports collaboration and innovation, which is very important in the digital context. They also play a role in shaping an organizational culture that is open to change and new technologies. Transformational leadership enables school principals to motivate teachers to develop their digital skills and integrate technology into learning.

Additionally, Jannah (2023) revealed that principals who implement transformational leadership can encourage the creation of collaboration among teachers in using technology for teaching. In other words, the principal not only acts as a leader who provides direction but also as a facilitator who creates space for teachers to share experiences and learn from one another in the use of technology.

However, this research also shows a gap between principals who possess transformational leadership skills and the field reality that does not always support them. In some cases, principals face difficulties in managing resistance to change from teachers who are less accustomed to technology (Pratiwi, 2023).

Development of Teacher Professionalism in the Digital Context

The development of teacher professionalism has become one of the key elements in the transformation of digital education. In the conducted research, much literature shows that school principals play an important role in supporting the development of teachers' digital skills through ongoing training and mentoring.

According to Kurniasari et al. (2025), school principals who provide support in the form of technology training can help teachers improve the quality of their teaching, as well as introduce various digital learning tools and platforms. This study also emphasizes that training focused on developing technological skills can enhance teachers' motivation and engagement in implementing technology in their classrooms.

However, Taufikurrahman's (2021) results show that although many school principals encourage the development of teacher professionalism through technology, there are significant barriers related to the lack of resources and time for training. In many cases, budget constraints and limited time for training become obstacles in accelerating the adoption of technology in schools.

Digital Leadership Policies in Schools

One of the important findings of this research is the significance of policy roles in supporting digital transformation. Principals are not only responsible for implementing technology but also for designing policies that support the effective use of technology within the school. This policy includes access to technology, teacher training, and supporting infrastructure.

Rizal & Kurniawan (2022) emphasize that clear and structured policies are crucial to ensure that digital transformation occurs not only at the individual level but also at the systemic level throughout the school. Policies that include budget allocation for technology, improved internet access, and the provision of adequate technological tools greatly support the successful implementation of technology in schools.

Challenges in Digital Leadership Transformation

The transformation of digital leadership is not without challenges, both at the principal level and the teacher level. Some of the challenges identified in this study include the lack of readiness among school principals to use technology, resistance to change, and limited resources.

Siti & Nurul (2021) noted that principals in many schools in remote areas face difficulties in accessing the technology needed for digital transformation. In addition, the limited availability of digital leadership training for school principals also poses a challenge in leading technology-based changes.

Furthermore, Taufikurrahman (2021) also revealed that resistance to the use of technology often comes from teachers who feel they do not have sufficient digital skills. Therefore, it is important for school principals to create a work environment that supports technology-based learning and professional development.

Conclusions

The transformation of school leadership in the digital era is an important aspect in realizing relevant and adaptive education in response to rapid technological development. Based on the results of a systematic literature review (SLR) conducted on 15 related studies, several key conclusions can be drawn regarding the role of school principals in leading digital transformation in schools and the challenges faced in its implementation.

The Key Role of School Principals in Digital Transformation

The principal acts as a change agent facilitating the adoption of technology in the school. The principal is not only responsible for administrative aspects but also must have a clear long-term vision to guide the school towards digital transformation. Most studies show that principals with a strong vision and commitment to technology can motivate teachers to adapt to digital technology and plan systematic implementation. A clear vision from the principal also enables them to develop policies that support the use of technology in teaching and school management.

However, there are still several challenges, particularly related to the lack of technical understanding among school principals, which affects their ability to lead technological transformation effectively. Some school principals, especially in areas with limited access to technology, struggle to plan and implement policies focused on digital transformation.

Transformational Leadership as an Effective Model

Transformational leadership has proven to be an effective model in driving technology-based change in schools. Principals who implement transformational leadership not only focus on daily management but also on inspiring and motivating teachers to innovate and adapt to technology. Research shows that principals with a transformational leadership style can create a collaborative climate, where teachers feel encouraged to share knowledge and experiences in using technology in the classroom.

With this approach, the principal not only acts as a director but also as a facilitator of change, providing space for teachers to develop and experiment with technology-based learning tools and methods. However, the challenge that arises is the lack of readiness of the principal in managing resistance to change from some teachers, especially those who are less familiar with technology.

Development of Teacher Professionalism in the Digital Era

The leadership of the principal also greatly influences the development of teacher professionalism in facing the digital era. Through policies that support training and the enhancement of teachers' digital skills, school principals can help teachers improve the quality of their teaching with technology. Findings from several studies indicate that continuous training is crucial in introducing and developing digital skills for teachers.

However, the development of teacher professionalism is often hindered by a lack of budget and limited time for training. In addition, the lack of supporting facilities also poses a problem, especially in areas with inadequate technological infrastructure. This shows that to maximize the development of teacher professionalism, school principals must ensure that support in terms of time, budget, and technological resources is sufficiently available.

Challenges in Digital Leadership Transformation

Although school principals play a crucial role in driving digital transformation, there are several significant challenges they face. The main challenge found is resistance to change, both from teachers who feel unprepared to use technology and from the school system, which lacks policies or facilities to support digital transformation. Many teachers feel incompetent in using technology and tend to be reluctant to change their traditional teaching methods.

Moreover, resource limitations are the main obstacle in accelerating the transformation process. Many schools, especially in remote areas, do not have adequate access to technology, such as computers, the internet, and the necessary educational software. Principals who want to lead digital transformation must work hard to find the necessary resources and ensure that the infrastructure supporting technology is available in schools.

The Importance of Policies Supporting Digital Transformation

Clear and structured policies are an important factor in the success of digital transformation. The principal not only acts as the implementer of policies but also as the designer of policies that support the use of technology in various aspects of the school. This policy encompasses various aspects, such as the provision of technological devices, the development of technology-based curricula, training for teachers, and the enhancement of technological infrastructure. Without clear and consistent policies, digital transformation in schools can be hindered or even fail.

Research results show that principals who have policies supporting digital innovation can create an environment that allows teachers and students to learn and grow through technology. This policy should also include the provision of sufficient budget to support the purchase of necessary hardware and software.

Limitation and Future Studies

This research has several limitations that need to be considered so that the results can be interpreted accurately. First, the scope of the literature reviewed is limited to scientific articles published within the last five years (2020–2025), so it may not include relevant earlier studies that are not included in the selected database. Second, this research only examines literature available in Indonesian and English, so there may be studies in other languages that are overlooked.

Third, although the systematic literature review approach provides a comprehensive overview, this approach does not allow researchers to conduct direct observations or field interviews, so the findings obtained are a synthesis of secondary data and do not yet deeply represent specific empirical contexts, such as geographical conditions, school culture, or the

level of digital readiness in each region. Lastly, this research places more emphasis on conceptual and policy aspects without directly testing the implementation of the transformational leadership model in specific educational units.

Based on these limitations, it is recommended that further research can expand and deepen the understanding of the transformation of school principals' leadership in the digital era through a more empirical and contextual approach. Some recommendations that can be considered include:

Field qualitative research, such as case studies or ethnography, to explore the actual practices of school principals' leadership in managing digital change, including challenges, strategies, and teachers' responses in a more in-depth and specific manner across various regions.

The use of a quantitative approach, such as through surveys or experiments, to measure the direct impact of the principal's leadership style on teachers' digital readiness and the effectiveness of technology-based learning.

Comparative research between regions or types of schools, such as comparing public and private schools, or urban and rural schools, to understand the variations and determining factors of successful digital transformation in different educational environments.

The development and validation of a conceptual model or digital leadership evaluation instrument that can be widely used by policymakers and education practitioners to measure the readiness and effectiveness of school principals in the era of technological transformation.

Exploration of the perspectives of teachers, students, and other stakeholders, so that the understanding of school leadership is not only viewed from the managerial side but also from the perspective of those affected and policy implementers at the classroom level.

By expanding the approach and scope, it is hoped that subsequent research can provide more concrete contributions in designing adaptive, contextual, and transformative educational leadership policies in the digital era.

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