

Systematic Literature Review: The Transformation of Principalship: Digital Leadership in Improving Teachers' ICT Literacy

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Abstract: In the digital era, educational leadership must evolve beyond traditional management toward a digital leadership paradigm. This study aims to analyze how school principals transform their roles into digital leaders and how this influences teachers' technology literacy. A systematic literature review (SLR) was conducted, analyzing 15 peer reviewed articles between 2021 and 2026. The findings reveal that effective an inclusive digital leadership style significantly reduces teachers' resistance to technology while enhancing their digital competencies in both pedagogical and administrative practices. The study's result Effective and inclusive digital leadership significantly reduces teachers' resistance to technology while enhancing their digital competencies in both pedagogical and administrative practices. The study's novelty lies in its focus on the managerial orchestration of cultural change rather than mere hardware provision. It concludes that effective digital transformation depends on the principal's ability to orchestrate technology-based work culture. The practical implication underscores there is an urgent need for structured digital leadership training for school administrators to sustain educational innovation, particularly in the age of AI. Such training should equip principals with skills to manage cultural transformation, foster teacher buy-in, and integrate technology meaningfully into daily school operations. Contribution study's this work advances a nuanced understanding of leadership as the pivotal driver of successful technology integration in schools. It concludes that effective digital transformation depends critically on the principal's ability to orchestrate a technology-infused work culture, thereby providing a conceptual framework for future empirical studies on digital leadership in deep learning and basic education settings.

Keywords: Digital Leadership, Educational Transformation, School Management, School Principals, Technology Literacy

A. Introduction

The global education landscape is currently navigating a vortex of rapid digital transformation, propelled by advances in artificial intelligence and cloud-based learning platforms that are fundamentally reshaping pedagogical practices (Lytras et al., 2024). In Indonesia, this shift is codified in the *Merdeka Belajar* policy, which

mandates that educational units adapt to a digital ecosystem to enhance learning quality. It is widely acknowledged that the success of this digitalization depends not merely on hardware procurement but critically on human resource capacity, particularly teachers' readiness to integrate technology into instruction. Teacher technology literacy extends beyond operational skills to encompass the ability to select, evaluate, and utilize digital tools for meaningful learning. Within this context, school principals are recognized as pivotal figures, tasked with evolving from bureaucratic administrators into digital leaders' individuals capable of building a digital vision, fostering innovation, and empowering staff through technology (Okunlola & Naicker, 2025).

Despite this acknowledged importance, a significant gap remains in the literature. While many studies have explored school leadership broadly, research specifically investigating the mechanism by which principals transform into digital leaders and how this transformation directly impacts teacher technology literacy is still limited, particularly within Indonesian primary and secondary schools. The existing state of the art predominantly focuses on the procurement of digital assets or the competencies required of teachers, often overlooking the managerial orchestration of behavioral change and organizational culture driven by leadership. There is a lack of empirical insight into how principals' communication strategies and internal policies can systematically reduce teacher resistance to technology and foster digital adoption (David et al., 2023).

The novelty of this study, therefore, lies in its focus on the transformational process of school leadership as the central driver of teacher digital capacity, addressing the behavioral and cultural dimensions often neglected in technology-centric research (Bidhendi et al., 2026). Its primary contribution is to provide a comprehensive theoretical and practical framework for education administrators seeking to manage schools effectively in the digital age. By examining the nuanced strategies of digital leaders, this research aims to illuminate how schools can cultivate a learning ecosystem that meets contemporary demands. This study, therefore, seeks to answer the following research question: How does the transformation of the school principal's role into that of a digital leader occur, and to what extent do the identified dimensions of this leadership contribute to the improvement of teachers' technology literacy?

B. Methods

This research was conducted using the Systematic Literature Review (SLR) approach, which is a structured method for identifying, assessing and synthesizing relevant results of previous research (Azarian et al., 2023). The main focus of this study is to examine how to The Transformation of Principalship: Digital Leadership in Improving Teachers' ICT Literacy. This study employed a Systematic Literature Review (SLR) following the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) guidelines. The review protocol included the following

steps: (1) formulation research questions; (2) systematic search of databases (Scopus, ERIC, and Google Scholar) using the term “Digital Leadership” and “Educational Transformation” and “Technology Literacy”; (3) screening of articles based on inclusion criteria (peer-reviewed articles published between 2021 and 2026, English language, focus on Merdeka Belajar basic education; (4) quality assessment using established criteria for qualitative and quantitative studies; (5) data extraction using a standardized form; (6) thematic synthesis of finding. A total of 15 articles meeting all criteria were included in the final analysis. This synthesis aims to get a complete picture of the effectiveness and challenges of educational supervision in a variety of contexts. The findings are then used as the basis for the formulation of practical recommendations for education stakeholders, such as principals, teachers, and policymakers, to design an adaptive, collaborative, and supportive supervision system that supports the development of the teaching profession. Thus, this method not only contribute to the development of science, but also provides a strategic reference in educational practice in the field.

C. Results and Discussion

Table 1. Article Journal Review

No	Title	Author	Research Objective	Research Methods	Research Result	Conclusion
1	Principals’ Digital Leadership Competencies in the Fourth Industrial Revolution: Teachers’ Perspectives.	(Okunlola & Naicker, 2025)	This study explores teachers’ perspectives on high school principals’ digital leadership competencies in Oyo State, Nigeria, a region grappling with the digital divide	This offers a counterpoint to research in high-income countries. Using a quantitative, descriptive research design, 381 teachers across three senatorial districts were selected via multi-stage sampling. Descriptive statistics (percentages, mean, and standard deviation) and inferential statistics (independent t-test) were used for analysis at a 0.05 significance level.	The findings revealed that high school leaders possess the skills to meet the ISTE-A digital leadership standards set by the International Society for Technology in Education (ISTE). Female leaders exhibited slightly higher digital skills than males, though gender was insignificant in meeting the ISTE-A standards overall. The study underscores the importance of digital leadership in school management, offering practical implications for leadership practices, policy decisions, and future research. Although the ISTE-A standards are met, the emphasis on systemic improvement highlights how Nigerian principals adapt strategies to local resource constraints, differing from high-tech education systems.	This study investigated how high school leaders meet the ISTE-A digital leadership standards in school management in terms of visionary leadership, digital learning culture, professional development, systemic improvement, and digital citizenship. It found that teachers perceived principals as meeting the ISTE-A standards. However, it should be acknowledged that there is a potential gap between perception and practice. Teacher assessments may be influenced by personal biases or a partial view of leadership actions rather than actual implementation realities. Hence, future research should combine these perceptual measures with objective indicators to validate whether reported compliance translates to tangible digital transformation in schools.
2	Examining Teachers’ Perspectives on School Principals’ Digital Leadership Roles and Technology Capabilities	(Karakose et al., 2021)	The study aims to consolidate the understanding of local government digital technology adoption strategies via the Preferred	A systematic literature review has been carried out using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol, and the following research	The results show that: (a) Strategies concerning the people aspects include building a platform for public participation, employees’ skills, and decision-makers’ positive mindset development. (b) Strategies	This research reviews the technology adoption opportunities, challenges, and strategies through the lens of the PPT framework. This framework provides an understanding of how the balance

	during the COVID-19 Pandemic.		Reporting Items for Systematic Reviews and Understanding Local Government Digital Technology Adoption Strategies: A PRISMA Review. It analyses the adoption opportunities, challenges, and strategies through the lens of people, processes, and technology frameworks.	questions were identified for the present study: How do local governments use strategies to adopt digital technologies? The literature search task was conducted in February 2023. To answer this research question, the literature was reviewed in four steps: (a) identification; (b) screening; (c) eligibility; and (d) inclusion.	concerning the process aspects include recognizing the players’ roles, having a clear aim and procedure, proper regulation, and receiving user input. (c) Strategies considering the technology aspects include understanding the effect of the technology, technological preparedness, and convenience adoption. The findings inform local government policymakers in digital technology adoption and transformation endeavours.	between the people, process, and technology aspects should be maintained to successfully implement digital technologies. The findings indicate several opportunities and challenges in adopting digital technology for local government activities. The opportunities are increasing citizen convenience and engagement, perceived usefulness, increased accountability among decision-makers, cost-effective financial management, enhanced service delivery, improved user-friendliness, and reduced complexity.
3.	Teachers’ Digital Leadership and Competencies in Primary Education: A Cross-Sectional Behavioral Study	(Antonopoulou et al., 2025)	The objectives of this study are also to identify the effects of different kinds of leadership styles on teachers’ satisfaction and the adoption of digital practices and to identify gaps in educators’ digital skills.	Quantitative design was supported, and for research purposes, a structured survey was administered to 105 primary school teachers.	The results indicate that transformational leadership plays a pivotal role in enhancing teachers’ satisfaction and fostering the adoption of digital leadership practices; hence, it is of special importance when promoting digital transformation in schools.	This research points out the critical role of transformational and digital leadership in enhancing the learning environment, especially in primary schools in Western Greece. This research highlights a large gap between the perceived need for digital leader ship and the current digital competence of teachers, which turns out to be a huge barrier to effective digital transformation.
4	Elevating Teachers’ Professional Digital Competence: Synergies of Principals’ Instructional E-	(Rasdiana et al., 2024)	This investigation aims to shed light on disparities and formulate strategies to bridge the digital divide. In this context, the	This study delves into the structural impact of PIS and PTL on TPDC mediated by SDC. Quantitative methods were employed to address	Technology leadership directly affects both school culture and teachers’ professional digital competence. School digital culture, in turn, significantly influences teachers’	Based on the research findings, it is evident that there is a substantial influence among the four variables – instructional e-supervision, technology leadership,

	Supervision, Technology Leadership and Digital Culture for Educational Excellence in Digital-Savvy Era.		principal’s instructional e-supervision (PIS) and technology leadership (PTL) play a pivotal role in nurturing a school’s digital culture (SDC). This culture is crucial for ensuring the effectiveness of the collaborative learning process that meets the needs of students in this digital-savvy era.	research hypotheses through structural equation modelling (SEM) analysis with AMOS, utilizing inner and outer model techniques.	professional digital competence. While teacher professional digital competence exhibits a lower coefficient in response to technology leadership, it demonstrates a higher level of significance when traversing the school digital culture pathway.	school digital culture, and teacher professional digital competence – although the impact is characterized by varying coefficients. Instructional e-supervision affects TPDC directly, but its coefficient effect is the lowest.
5.	Rural primary school principals’ leadership strategies for ICT integration.	(Nhlumayo, 2024)	This paper explored the factors influencing the leadership strategies of school principals in rural primary schools regarding the integration of information and communication technologies (ICTs) in the process of teaching and learning in their schools. School principals are responsible for ensuring that there is ICTs integration in their schools’ teaching and learning processes	This study used a qualitative multiple case study couched in the interpretive paradigm.	The paper recommends customised in-service training for school principals and teachers to alter and improve their exposure to, attitudes, perceptions toward ICT integration in teaching and learning.	This paper concludes that, as learning-centred leaders, school principals have a responsibility to lead the process of teaching and learning. Despite the situatedness of the school and without being directly involved, school principals have to be acquainted with the ICT tools so that they are able to advocate for and promote the integration of ICTs in their schools. The implication is that, as a learning-centred leader, the school principal needs to provide structured professional development opportunities for teachers so that they are able to rely on his or her support or guidance in integrating ICT into their teaching. Therefore, this paper recommends customized capacity building

						workshops and in-service training activities for rural school principals to equip them with competence, skills, and knowledge to lead teaching and learning in their schools.
6.	Madrasah Principal Digital Leadership Innovation in Digital Learning Transformation	(Umah et al., 2023)	The purpose of this research is to know and describe in depth, detail, and is oriented towards developing a theory based on findings about the digital transformation process in schools.	The method in this study is to use a qualitative approach with one subject from the principal of the Madrasah Ibtidaiyah Muslimat Nahdhatul Ulama, Sidoarjo.	The results of the study show that the digital skills of madrasa principals have an impact on the digital transformation process in madrasahs.	It is also a guideline for carrying out digital transformation with various changes, including: creating madrasa settings, effective and efficient digital technology management, inspiring work climate, organizational culture, digital madrasa environment.
7.	Teachers' digital competence in the post COVID-19 era: The effects of digital nativeness, and digital leadership capital.	(Jogezai et al., 2023)	This study was conducted to determine teachers' DC and reveal if their DC was explained by their digital naiveness and principals' digital instructional leadership capital.	This was a quantitative study aiming to explain the influence of DN and principals' DIL on teachers' DC. Shank and Brown (2013) posit that the primary objective of a quantitative study is to test hypotheses.	This study examined teachers' DC as the frontline implementers, while also considering the leadership capital of school principals, who were crucial in spontaneous response and decision-making in the face of the pandemic's uncertainty. Initially, the study reported DC and DN profiles of teachers, followed by an analysis for hypothesis testing.	This study examined teachers' DC as frontline implementers, looking at the influence of their DN on their DC and school principals' DIL in spontaneous pandemic response and decision-making. Before hypothesis testing, the DC and DN profiles of teachers were identified and found to be moderate. DC profiles of teachers emphasize coordination and communication, which may improve collaboration and communication when addressing their DC. However, the meaningfulness of such coordination must be established.
8.	The Principal Management in Digital Literacy Empowerment of Elementary School	(Marmoah et al., 2023)	This study aims to describe the principal's management in empowering teachers'	This study uses a qualitative descriptive approach.	The results show that, first, the need for principals in digital literacy with the highest acquisition of ICT indicators in principal management is	His research implies that digital literacy skills have an important impact on improving the professionalism of teachers,

	Teachers. <i>Revista Romaneasca Pentru Educatie Multidimensionala</i> ,		digital literacy in elementary schools.		57.53%; indicators for accessing information from the internet in the leadership process are 56.22%, and indicators for teacher support in using ICT are 54.87%. Second, the principle of empowering teachers' digital literacy requires steps: identifying, planning, organizing, actuating, and controlling.	especially in the online learning process.
9.	School principals' educational goals and leadership styles for digital transformation: results from case studies in upper secondary schools.	(Ruloff & Petko, 2025)	The present study explores how their ambitions and educational goals affect their approaches to leadership for digital transformation in their schools	The study employs an exploratory and qualitative research approach based on interviews with a full sample of nine upper secondary school principals from Central Switzerland. Transcripts have been analyzed using qualitative content analysis.	The findings suggest that all principals express a clear orientation toward student-oriented teaching when integrating technology in their schools. However, there are substantial differences in terms of leadership processes to address this change: One principal oriented toward transformational leadership reported more rapid and more profound changes than all the principals oriented toward a more transactional type of leadership.	Transformational leadership is associated with faster implementation of digital technologies and also with a clearer focus on educational goals rather than on tools. This study expands the knowledge on principals' technology leadership practices as it provides insights into school leaders' attitudes and concepts and highlights the benefits of transformational leadership.
10.	Principals' Technology Leadership Behavior and Teachers' Use of Information and Communication Technology (ICT) in Bhutan	(Gyeltshen, 2021)	This study examined the relationship between principals' technology leadership behaviour and teachers' use of ICT in classroom teaching and learning in Bhutan.	Data was gathered from 329 middle secondary school teachers through survey questionnaires.	The study found that principals' technology leadership behaviour in Bhutan was at moderate levels with a positive relationship to teachers' use of ICT.	The study conducted clearly indicated that principals in Bhutan showed some level of behaviours as technological leaders and further, affirmed that there is a significant relationship between principals' technology leadership and teachers' use of ICT in the Bhutanese school context.
11.	A Review of the Conceptual Structure and Evolution of Digital	(Karakose et al., 2024)	This study aims to map the conceptual and thematic evolution of this	This study employed science mapping methodology and used SciMAT software	The results indicated that with a growing focus on technology or e-leadership, considering the	Digital leadership is regarded as a broader concept for application in investigating the knowledge, skills,

	Leadership Research in Education.		research on digital leadership in the education field to offer a better insight into the strategic themes that are sufficiently or insufficiently addressed; that is, to identify aspects that are clearly defined or left shrouded in shadow.	(version 1.1.04) to map the evolution of thematic strands across three periods of the field's development. The analysis was conducted using metadata obtained from 174 articles that are indexed on WOS and Scopus.	developments in the world of computers and the internet, research into digital leadership has gained momentum in recent years, particularly following the COVID-19 pandemic	competencies, and perspectives of school leaders to facilitate the healthy integration of digital technologies into education, school administration, and student learning.
12.	Examining the Role of School Leadership in the Digital Advancement of Educational Organizations.	(Raptis et al., 2024)	This study examines the viewpoints of primary education teachers in the Dodecanese Prefecture regarding the role of school leadership in the digital development of educational organizations during the 2022–2023 school year.	The study is founded on a quantitative survey of 117 teachers, with data collected through an online questionnaire.	The study found a positive correlation between teachers' level of education and their level of digital literacy. Nevertheless, it appears that the gender of the principal did not noticeably affect the views of teachers regarding their role in promoting the integration of digital technologies in the school.	In conclusion, it appears that principals have adapted their communication methods with teachers in the post-COVID-19 era. This includes the use of mixed communication methods, often incorporating new technologies, particularly in situations such as emergencies caused by bad weather, pandemics, or geographically inaccessible areas.
13.	The Impact of Digital Leadership on Teachers' Acceptance and Use of Digital Technologies.	(Sunu, 2022)	Teachers' lack of digital competence causes learning not to be carried out optimally. Thus, the challenge for teachers is getting tougher since, in this digital era, technology mastery plays a significant role in creating quality education. Considering the importance of technology and the role of leadership in education,	The research data were collected by distributing questionnaires to measure digital leadership and questionnaires to measure teachers' acceptance and use of digital technology. The collected data were analyzed using simple regression analysis with the help of SPSS 20 for windows. The study showed that the significance of the regression direction was	According to the research objective, which is to identify the influence of digital leadership on teachers' acceptance and use of digital technology, the researchers conducted a simple linear regression analysis according to the data obtained from the two questionnaires used in this study. Before performing simple linear regression analysis, the researcher conducted several prerequisite tests to perform regression analysis.	Based on the results of this study, it can be concluded that digital leadership has a significant influence on the acceptance and use of digital technology by teachers. This is evident from the results of the analysis, which show that digital leadership contributes as much as 79.8% to the acceptance and use of digital technology, especially the use of Google Classroom during the online learning process during the Covid-19 pandemic.

			this study aimed to analyses the impact of digital leadership on teachers' acceptance and use of digital technologies.	8,581 with a significance (sig.) of 0.000, which indicates that the regression direction is significant.		
14.	Unpacking the Realities of Digital Leadership Among School Leaders: A Quantitative Study.	(Kok Ming & Mansor, 2024)	This study aims to investigate the current level of digital leadership among school leaders in Perak.	A quantitative approach was used with an adapted questionnaire. A total of 97 primary teachers were selected randomly and involved in this study.	This suggests the importance of investing in developing digital leadership skills among school leaders to encourage ongoing innovation in education. It also highlights the need for further exploration of digital leadership strategies for school leaders.	In conclusion, this study offers practical insights for improving teaching practices and organizational management in the digital era, aiming to drive positive change and innovation in Perak's schools.
15.	The Influence of Principals' e-Leadership on the Effectiveness of Schools' Public Relations and Organizational Improvement.	(Wiyono et al., 2023)	This study aims to examine the effect of principals' e-leadership on the effectiveness of schools' public relations and school improvement.	The sample of this research was taken randomly, comprising 200 principals in Indonesia. A questionnaire was used for data collection, filled out by all participants. In addition, descriptive statistics and structural equation modelling were used for data analysis.	The study results showed that there is a direct influence of principals' e-leadership on the effectiveness of schools' public relations.	Based on the conclusions obtained in this study, several recommendations can be put forward. To increase the effectiveness of schools' public relations, it is necessary to increase the capacity of the principals in leading schools using information and communication technology. To develop school progress, it is necessary to have capable principals manage Sustainability 2023, 15, 1296 15 of 17 schools using information and communication technology. Based on these findings, it can be concluded that the use of ICT in school leadership can improve school progress by increasing the effectiveness of schools' public relations.

Based on the results of the above research which contains the result of an article review that is closely related to the title of the research, Principals' Digital Leadership Competencies in the Fourth Industrial Revolution Teachers' Perspectives (Okunlola & Naicker, 2025) explores teachers' perspectives on high school principals' digital leadership competencies in Oyo State, Nigeria, a region grappling with digital divide. This article has an advantage Teacher assessment may be influenced by personal biases or a partial view of leadership actions rather than actual implementation realities. The article successfully confirms that underscores the importance of digital leadership in school management, offering practical implications for leadership practices, policy decisions, and future research. However, its weakness lies in the use of a literature study method, it should be acknowledged that there is a potential gap between perception and practice. In this context, the proposed research has strongly novelty because it should combine these perceptual measures with objective indicators to validate whether reported compliance translates to tangible digital transformation in schools. This research has potential to be at the intersection transformational principalship, digital leadership and ICT literacy. With strong methodology design (e.g., mixed methods or SEM) these studies have more comprehensive theoretical and practical.

Then (Karakose et al., 2021) This article discussed the technology adoption opportunities, challenges, and strategies through the lens of the PPT framework. This framework provides an understanding of how the balance between the people, process, and technology aspects should be maintained to successfully implement digital technologies. The author uses the preferred reporting items for systematic reviews and meta-analyses (PRISMA) protocol, and the following research questions were identified for the study: how do the government use strategic to adopt the digital technology? The result of the study: (1) strategic concerning the people aspects include building a platform for public participation, employees' skill, and decision maker; (2) strategic concerning the process aspect include recognizing the players' roles, having a clear aim and procedure regulation; (3) strategic concerning in the technology aspect, the effect technology and technology preparedness, and convenient adoption. However, its weakness lies because those challenges include the lack of technical staff and knowledge, the lack of decision-makers' support, accelerated societal inequalities, lack of planning, internal and external collaboration, ethical framework, technical infrastructure readiness, security, and challenges related to privacy and data.

However (Antonopoulou et al., 2025) discussed analyzing the effects of leadership styles on teachers' satisfaction and the adoption of digital practices and to identify the gaps in educators' digital skill. The study uses quantitative design was supported, and for research purposes, a structured survey was administered to 105 primary school teachers. This article has an advantage this research highlights a large gap between the perceived need for digital leadership and the current digital competence of teachers, which turns out to be a huge barrier to effective digital transformation. The

results indicate that transformational leadership plays a pivotal role in enhancing teachers' satisfaction and fostering the adoption of digital leadership practice; hence it is of special important when promoting digital transformation. As the result point to a large gap in the digital competencies of teachers that targeted professional development programs could make up for this study delves into the structural impact of PIS and PTL on TPDC mediated by SDC. Quantitative methods were employed to address research hypotheses through structural equation modelling (SEM) analysis with AMOS, utilizing inner and outer model techniques. This article has an advantage Technology leadership directly affects both school culture and teachers' professional digital competence. School digital culture, in turn, significantly influences teachers' professional digital competence. Also have weakness in lie although the impact is characterized by varying coefficients. Instructional e-supervision affects TPDC directly, but its coefficient effect is the lowest.

Furthermore (Nhlumayo, 2024) make a significant the factors influencing the leadership strategic of schools regarding the integration of information and communication technology (ICT) in the process of teaching and learning in their school. School Principals are responsible for ensuring that there is ICTs integration in their school teaching and learning process. This study uses a qualitative multiple case study couched in the interpretive paradigm. This article has an advantage the paper recommends customized in-service training for school principals and teachers to alter and improve their exposure to, attitudes, perceptions toward ICT integration in teaching and learning. Learning-centered leaders, school principals have a responsibility to lead the process of teaching and learning. this paper recommends customized capacity building workshops and in-service training activities for rural school principals to equip them with competence, skills, and knowledge to lead teaching and learning in their schools. Compared to articles that have been published in the Scopus indexed journal, this research sits an important intersection between Transformational Principal, Digital Leadership, and ICT Literacy. With a strong empirical methodology (e.g., mixed methods or SEM), this research has a potential to make more comprehensive and competitive theoretical and practical contribution to publication in accredited national journals as reputable international journals.

In addition (Umah et al., 2023) make important to know and describe in depth, detail and is oriented towards developing a theory based on findings about the digital transformation process in school. The method in this study is to use a qualitative approach with one subject from the principal of the Madrasah Ibtidaiyah Muslimat Nahdhatul Ulama, Sidoarjo. Data collection techniques in this study include interviews, participant observation, and documentation. This study has an advantage the results of the study show that the digital skills of madrasah principals have an impact on the digital transformation process in madrasas. Madrasah digital transformation appears explicitly in the achievement indicators of the vision and the formation of a digital team under the coordination of the Sarpras team. it is also a guideline for carrying out digital transformation with various changes, including;

creating madrasa settings, effective and efficient digital technology management, inspiring work climate, organizational culture, digital madrasa environment. In this context, the proposed research has strong novelty value because with carrying out digital transformation with various changes, effective and efficient digital technology management, inspiring work climate, organizational culture, digital madrasah environment. Examined teachers' DC as the frontline implementers, while also considering the leadership capital of school principals, who were crucial in spontaneous response and decision-making in the face of the pandemic's uncertainty. Initially, the study reported DC and DN profiles of teachers, followed by an analysis for hypothesis testing. That article has an advantage their DN on their DC and school principals' DIL in spontaneous pandemic response and decision-making, which may improve collaboration and communication when addressing their DC. However, the meaningfulness of such coordination must be established (Jogezai et al., 2023).

Then (Marmoah et al., 2023) examine the principal's management in empowering teachers' digital literacy in elementary school. This study uses a qualitative descriptive approach. The subjects used in this study were principals of public elementary schools in Simo Boyolali, Indonesia. The total subjects who participated were eight principals. This article shows that; (1) the need for principals in digital literacy with the highest acquisition of ICT indicator in principal management is 57.53 %; indicators for accessing information from the internet in the leadership process are 56.22 %, and indicators for teachers using ICT. an advantage This research implies that digital literacy skills have an important impact on improving the professionalism of teachers, especially in the online learning process. The principle of empowering teachers' digital literacy requires steps: identifying, planning, organizing, actuating, and controlling. Also, this study has weakness in literature there some of low data analyzed with numeric percentage to prove the data sampling.

Meanwhile (Gyeltshen, 2021) examined the relationship between principals' technology leadership behavior and teachers' use of ICT in classroom teaching and learning in Bhutan. The article has an advantage The study found that principals' technology leadership behavior in Bhutan was at moderate levels with a positive relationship to teachers' use of ICT. However, their qualitative research approach based on interview with full sample of nine upper secondary school in Switzerland. This conducted clearly indicated that principals in Bhutan showed some level of behaviors as technological leaders and further, affirmed that there is a significant relationship between principals' technology leadership and teachers' use of ICT in the Bhutanese school context. Revealed that two of the principal's technology leadership dimensions: support, management and operation; and productivity and professional practices were the best predictors of teachers' use of ICT in the classroom.

Then (Raptis et al., 2024) focus in this study founded on a quantitative survey of 117 teachers, with data collected through an online questionnaire. After presenting the respondents' demographic profile, a descriptive and inferential analysis was

conducted using the SPSS 29.0 statistical program. This article has an advantage it appears that principals have adapted their communication methods with teachers in the post-COVID-19 era. This includes the use of mixed communication methods, often incorporating new technologies, particularly in situations such as emergencies caused by bad weather, pandemics, or geographically inaccessible areas. The study used to identify the influence of digital leadership on teachers' acceptance and use of digital technology, the researchers conducted a simple linear regression analysis according to the data obtained from the two questionnaires used in this study. This study has advantage digital leadership has a significant influence on the acceptance and use of digital technology by teachers. This is evident from the results of the analysis, which show that digital leadership contributes as much as 79.8% to the acceptance and use of digital technology, especially the use of Google Classroom during the online learning process during the Covid-19 pandemic (Sunu, 2022).

Finally, (Kok Ming & Mansor, 2024) strengthen uses quantitative approach with an adapted questionnaire. A total of 97 primary teachers were selected randomly and involved in this study. This study explained advantage the study offers practical insights for improving teaching practices and organizational management in the digital era, aiming to drive positive change and innovation in Perak's schools. This research was taken randomly, comprising 200 principals in Indonesia. A questionnaire was used for data collection, filled out by all participants. This study has an advantage several recommendations can be put forward. To increase the effectiveness of schools' public relations, it is necessary to increase the capacity of the principals in leading schools using information and communication technology. Based on these findings, it can be concluded that the use of ICT in school leadership can improve school progress by increasing the effectiveness of schools' public relations. Therefore, it is recommended that principals improve their ICT skills to increase their school's progress.

D. Conclusions

This systematic literature review confirms that the transformation of principalship through digital leadership plays a vital role in improving teachers' ICT literacy. The majority of studies highlight that principal who adopt digital leadership practices particularly transformational leadership can significantly reduce teacher resistance to technology while enhancing digital competencies in both pedagogical and administrative contexts. The findings provide critical insights into school leaders' attitudes and concepts regarding technology integration, demonstrating that effective digital leadership is not merely about providing hardware but about orchestrating a technology-based work culture. Practical Implication to develop school progress and ensure sustainability, it is necessary to increase the capacity of principals in leading schools using information and communication technology. Specifically, the use of ICT in school leadership can improve school progress by enhancing the effectiveness of schools' public relations and internal management. Therefore, it is strongly

recommended that principals actively improve their ICT skills to drive their school's future advancement. Structured digital leadership training programs for school administrators are urgently needed to sustain educational innovation, particularly in the age of AI. Future Research Recommendation the studies reviewed predominantly employed qualitative approaches with case study designs, which limits the generalizability of findings across diverse settings. Future investigations should employ mixed-method designs that combine the depth of phenomenological analysis with broader quantitative approaches. Longitudinal studies tracking how principals develop and apply data literacy over time would also strengthen understanding of this competency's evolution. Finally, comparative research examining how contextual factors such as national policies, school culture, and resource availability influence the relationship between data-driven leadership and teacher outcomes across different institutional settings would enhance the field's external validity.

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