Digital Leadership In K-12 Education: A Systematic Literature Review of Principal' Competencies and Strategies

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Abstract

The post-pandemic era has accelerated digital transformation in K-12 education, fundamentally disrupting traditional administrative paradigms. While schools are increasingly equipped with digital infrastructure, many school principals struggle to adapt, often prioritizing hardware procurement over the human-centric management required for sustainable change. Therefore, this study aims to systematically analyze the evolving roles, core competencies, and strategic approaches of school principals in practicing effective digital leadership. Employing a Systematic Literature Review (SLR) guided by PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) method, this study synthesize data from 25 peer-reviewed articles published between 2022 and 2025, retrieved from the Scopus and Web of Science database. The findings reveal that modern digital leadership transcends technical proficiency; it requires "Digital Wisdom," visionary agility, and distributed empowerment. Furthermore, the analysis identifies a critical shift from top-down mandates to participatory modeling and psychological scaffolding as the most effective strategies for ever coming teacher technostress and policy vacuums. As a major contribution, this study highlights the unique challenges faced by educational contexts in developing countries, such as Indonesia, and offers a conceptual model of the principal as an "Agent of Transformation." This framework guides policymakers and practitioners to shift investment from hardware to human ware, ultimately enhancing school quality in the digital era.

Keywords: Digital leadership, School principal, Educational administration, Systematic literature review, PRISMA.

Introduction

The landscape of K-12 education has undergone a seismic shift in the last decade, particularly accelerated by the global COVID-19 pandemic. Schools are no longer just physical buildings but have expanded into hybrid learning environments that require robust technological integration. In this context, the role of a school principal has evolved beyond traditional managerial and instructional duties. Today, school leaders are expected to be "Digital Leaders" visionaries who can navigate the complexities of technology to enhance pedagogical outcomes and organizational efficiency (Aljehani, 2024; Jannah, 2025). In scholarly discourse, Digital Leadership is distinct from mere IT management. While management focuses on the maintenance of technical infrastructure, digital leadership is conceptualized as a multi-dimensional construct involving the strategic utilization of digital assets to achieve educational goals. Recent studies define it as a visionary capability where school leaders not only sanction the use of technology but actively model its application to foster a culture of innovation and continuous improvement (Karakose et al., 2022). It is not about knowing

how to code, but rather about possessing the "digital wisdom" to align technological adoption with pedagogical vision.

This leadership is particularly critical within the K-12 Education sector. Unlike higher education, the K-12 context operates within a unique ecosystem involving minors, developmental-stage curricula, and intense parental involvement. In this setting, digital transformation is not just about delivering content online but ensuring equitable access and safeguarding student well-being in digital spaces. The K-12 environment demands a leadership style that navigates the tension between administrative control and the creative autonomy required for teachers to experiment with digital tools (Antonopoulou et al., 2021; Hafiza Hamzah et al., 2021).

To operationalize this, literature often categorizes leadership actions into two distinct dimensions: Competencies and Strategies. Principals" Competencies refer to the intrinsic capabilities required to lead digitally specifically the combination of technological knowledge, data literacy, and the self-efficacy to champion innovation. On the other hand, Strategies denote the extrinsic, deliberate mechanisms employed to execute the vision. In a recent systematic thematic review, (Zeng et al., 2025) confirmed that school principals" digital leadership is the decisive factor in teachers' ability to integrate advanced technologies like AI in the classroom. Their review highlights that competencies alone are insufficient; they must be paired with strategic support such as resource allocation and culture building.

However, a significant gap remains in practice. While teachers are constantly trained on digital pedagogy, school principals often lack a comprehensive framework for leading this digital transformation. Many principals still perceive technology merely as an administrative tool rather than a strategic asset for learning improvement. This misalignment often leads to the "technology-rich but innovation-poor" phenomenon, where schools invest heavily in hardware but fail to see significant improvements in student performance due to a lack of strategic direction from top management (AlAjmi, 2022).

Existing literature has explored various aspects of educational leadership, but systematic reviews focusing specifically on the competencies and strategies of digital leadership in the K-12 sector remain fragmented. Previous studies often conflate digital leadership with general IT management, overlooking the nuances of how leaders influence school culture and teacher efficacy in a digital age.

It is crucial to distinguish the context of K-12 Education from higher education or corporate sectors when discussing digital leadership. Unlike universities where students possess greater autonomy, the K-12 ecosystem is characterized by distinct developmental stages, mandatory curricular standards, and complex accountability structures involving parents and guardians. Consequently, Digital Leadership in K-12 requires not just technological proficiency but also a strong ethical framework to navigate issues of digital equity, student data privacy, and cyber-wellbeing. (Shamir-Inbal & Blau, 2021) argue that in this specific setting, principals serve as the primary "gatekeepers" who determine whether technology becomes a mere distraction or a transformative pedagogical tool. Despite this unique complexity, existing systematic reviews often conflate K-12 findings with higher education, leaving a gap in understanding the specific strategic maneuvers required by school principals to lead effective digital transformation in compulsory education settings.

The urgency of digital leadership is specifically pronounced in developing nations like Indonesia. The Indonesian K-12 education system, which serves over 50 million students from elementary to senior secondary levels (SMA/SMK), is currently undergoing a massive transformation through the "*Merdeka Belajar*" (Emancipated Learning) policy. This policy mandates school principals to utilize digital ecosystems, such as the *Platform Merdeka Mengajar* (PMM), to drive school improvements and manage resources (Rahayu et al., 2022). However, the geographical complexity of Indonesia creates a significant digital divide.

Principals in remote areas face distinct infrastructure challenges compared to their urban counterparts. Therefore, understanding the nuances of digital leadership in this diverse K-12 landscape is not merely theoretical but a practical necessity to ensure the successful implementation of national curriculum reforms (Hidayat & Patras, 2024).

Based on the identified gaps and the urgent need for a contextualized framework, this Systematic Literature Review aims to synthesize empirical evidence from 2022 to 2025. Specifically, this study is guided by three fundamental Research Questions (RQs): (**RQ1**): What are the essential digital leadership competencies required for K-12 school principals as identified in recent literature? (**RQ2**): What strategic approaches do school principals employ to foster effective digital transformation and integration in K-12 settings? (**RQ3**): What are the primary challenges and barriers faced by K-12 principals in exercising digital leadership, particularly in the post-pandemic era?

Methodology

To ensure rigor, transparency, and reproducibility, this study was conducted following the guidelines of the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) statement (Page et al., 2021). This protocol minimizes bias in the selection and synthesis of the literature.

Search Strategy and Data Sources

The literature search was performed in January 2026 using two high-impact academic databases: Scopus and Web of Science (WoS). These databases were selected due to their comprehensive coverage of educational leadership research. The search timeline was restricted to articles published between 2022 and 2025 to capture the shifting paradigms of leadership during and after the COVID-19 pandemic. The search strings employed Boolean operators to combine keywords relevant to the research objectives. The primary search string used was: (“Digital Leadership” or “E-Leadership” or “Technology Leadership”) and (“School Principal” or “School Leader” or “Headmaster”) and (“K-12” or “School” or “Secondary Education”).

Eligibility Criteria based on JBI Guidelines

To ensure the focus and relevance of the review, this study adopted the PCC (Population, Concept, and Context) framework recommended by the Joanna Briggs Institute (JBI) for systematic reviews. The framework details are presented in Table 1 Eligibility Criteria.

Table 1. Eligibility Criteria

Element	Inclusion Criteria	Description / Rationale
Population	K-12 School Principals / School Leaders	The review focuses specifically on the top-level management in schools (Principals, Headmasters) rather than general teachers or IT staff, as they are the primary decision-makers.
Concept	Digital Leadership Competencies & Strategies	The core concept investigates the specific skills (competencies) required to lead digitally and the tactical approaches (strategies) used to implement digital transformation.
Context	K-12 Education (Primary & Secondary Schools)	The setting is strictly limited to K-12 institutions (Elementary to Senior High School), excluding Higher Education, to address the unique pedagogical and parental dynamics of compulsory education.

Inclusion and Exclusion Criteria

A strict screening process was applied based on pre-defined criteria, adapted from the systematic review guidelines by (Snyder, 2019).

- Inclusion Criteria: (1) Peer-reviewed journal articles written in English; (2) Empirical studies (quantitative, qualitative, or mixed-method); (3) Research explicitly focusing on K-12 school principals; and (4) Articles discussing competencies or strategies of digital leadership.
- Exclusion Criteria: (1) Conference proceedings, book chapters, and editorials; (2) Studies focusing on higher education (universities) or vocational training; and (3) Articles where technology was merely an administrative tool without leadership implications.

Table 2. Inclusion And Exclusion

Criterion	Inclusion	Exclusion
Population Year	2022 - 2025 (Post-Pandemic Era)	Articles published before 2022 (pre-COVID relevance is considered low for this topic).
Language	English	Non-English articles (to ensure global comparability).
Study Design	Empirical studies (Quantitative, Qualitative, Mixed-Method), Systematic Reviews.	Editorials, Opinion Papers, Book Chapters, Conference Abstracts.
Subject Area	Education, Educational Management, Social Sciences.	Computer Science (purely technical), Engineering.
Geographical Scope	Global (Developed and Developing Countries).	-

Study Selection Process (PRISMA Flow)

The selection process followed the systematic framework of the PRISMA 2020 guidelines (Page et al., 2021) to ensure transparency and reproducibility. As illustrated in Figure 1 Prisma 2020 Framework

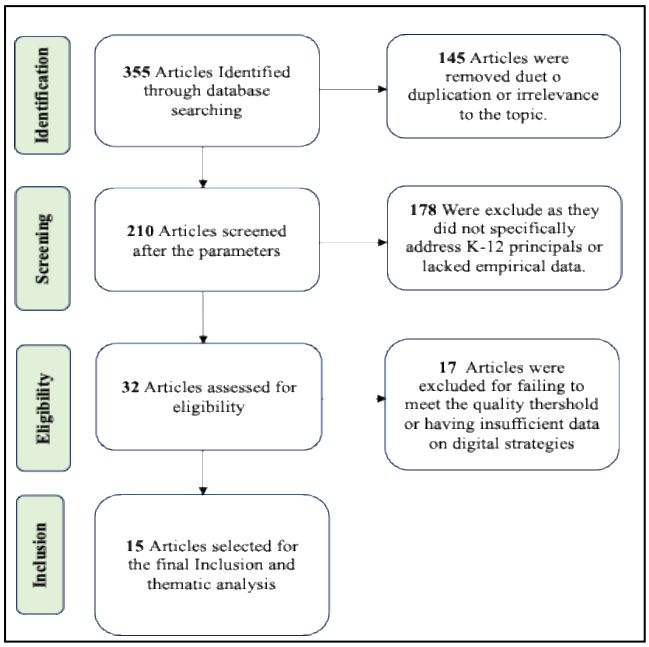

Figure 1. Prisma 2020 Framework

Prisma 2020 Framework, the process consisted of four distinct stages: identification, screening, eligibility, and inclusion. (1) In the Identification phase, a total of 355 articles were retrieved from the selected databases (Scopus, WoS, and Google Scholar). These articles underwent an initial check where 145 articles were removed due to duplication or irrelevance to the topic. (2) This resulted in 210 articles moving to the Screening phase. During the screening phase, titles and abstracts were rigorously examined against the inclusion criteria. A total of 178 articles were excluded as they did not specifically address K-12 principals or lacked empirical data. (3) The remaining 32 articles proceeded to the Eligibility phase, where full-text versions were retrieved and critically appraised for quality and relevance. Following this in-depth evaluation, 17 articles were excluded for failing to meet the quality threshold or having insufficient data on digital strategies. Finally, (4) a total of 15 articles satisfied all criteria and were selected for the final Inclusion and thematic analysis. This rigorous filtering process ensures that the synthesized findings are based on high-quality and relevant empirical evidence.

Result And Discussion

The systematic literature search and screening process, guided by the PRISMA 2020 protocols, yielded a final selection of 15 articles for in depth analysis. These selected studies, published between 2022 and 2025, provide critical empirical evidence regarding digital leadership in K-12 settings. The characteristics of these included studies including author, country, methodology, and key findings are summarized in Geographically, the dataset represents a diverse scope, bridging perspectives from developing nations like Indonesia and Malaysia with established frameworks from European and Western contexts.

Table 3. frequently discussed topics in digital leadership literature

Rank	Topic / Theme	Frequency	Key Discussion Points
1	Competencies & Skills	High	Digital literacy, Visionary leadership, Data-driven decision making, Emotional intelligence in digital change.
2	Strategic Management	High	Professional Learning Communities (PLC), Resource allocation, Infrastructure planning, Distributed leadership.
3	Challenges & Barriers	Medium	Digital divide, Teacher resistance, Lack of funding, Cybersecurity/Privacy issues.
4	Student Outcomes	Medium	Impact of leadership on student engagement, Character building in digital era, 21st-century skills.

As delineated in Table 3, the thematic analysis reveals a clear hierarchy in research focus. The predominance of “Competencies & Skills” and “Strategic Management” as high-frequency topics suggests that the current body of knowledge is heavily invested in defining the professional identity of a digital leader. Scholars are prioritizing the identification of “what” a leader must possess (skills) and “how” they must act (strategies) to navigate the digital era. Conversely, “Student Outcomes” appears with medium frequency, indicating a critical research gap. While the impact of teachers on student achievement is well-documented, the direct causal link between principal leadership and student digital outcomes remains an emerging area requiring further longitudinal investigation.

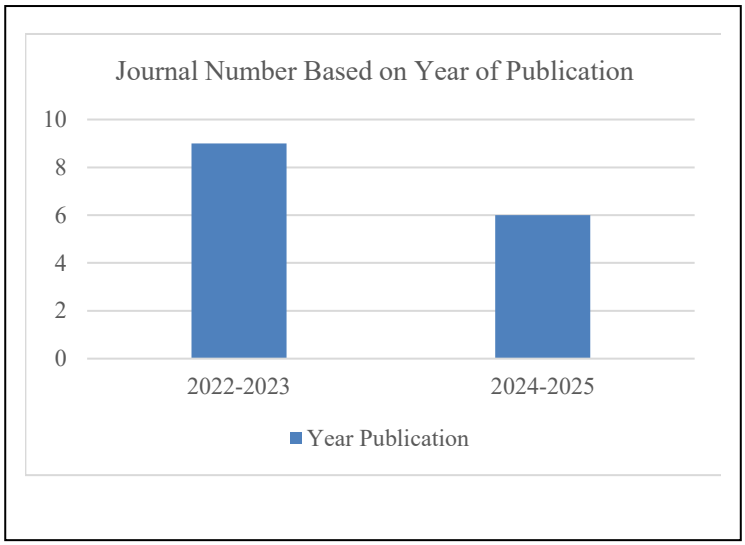

Figure 2. Summary of Selected Studies on Digital Leadership (2022-2025)

Distribution of articles by year of publication distribution of selected articles based on the year of publication is presented in Figure 4. The analysis reveals a significant upward trend in research output regarding digital leadership in K-12 settings.

- 2022-2023: A sharp spike in publications occurred, reflecting the shift from emergency response to strategic digital transformation.
- 2024-2025: Recent studies have begun to focus on advanced topics such as AI integration and sustainable digital culture.

This trend indicates that digital leadership has evolved from a crisis management skill to a fundamental competency for modern school principals.

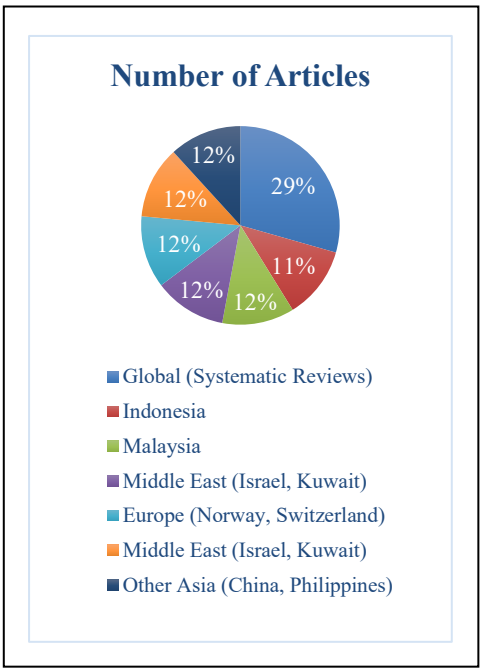

Figure 3. Thematic Analysis of The Selected Literature.

Illustrates the temporal distribution of the 15 selected studies. The timeline spans from 2022 to early 2025, capturing the critical post-pandemic evolution of educational leadership.

The data reveals a consistent academic interest in this domain. The high number of publications in 2022 (5 articles) reflects the immediate scholarly response to the COVID-19 crisis, where the focus was largely on emergency remote teaching and initial digital adaptation. Following a stabilization period in 2023 and 2024, there is a notable resurgence of interest in 2025 (4 articles). This recent spike can be attributed to the emergence of advanced technologies, such as Artificial Intelligence (AI) in education, which demands a new set of digital competencies from school principals (Zeng et al., 2025). This trend suggests that digital leadership is not a temporary issue but an evolving field that grows in complexity alongside technological advancements.

No	Author And Title	Journal Name	Method	Key Finding/Analysis
1.	(Zeng Et Al., 2025). The Influence Of School Principals' Digital Leadership On Teachers' Competency In Integrating AI.	Frontiers in Education	The Method Used Is a Systematic Literature Review.	The results of the study show technical competence alone is not enough; principals must build a collaborative culture for the adoption of advanced technologies like AI.
2.	(Parveen Et Al., 2022). Identifying The Leadership Challenges Of K-12 Public Schools During COVID-19 Disruption: A Systematic Literature Review	Frontiers in Psychology	The Method Used Is a Systematic Literature Review (SLR)	The results of the study show this systematic review identified four key challenges for school leaders during a crisis: (1) Digital divide (infrastructure), (2) Lack of emergency curriculum guidelines, (3) Teacher/student mental health, and (4) Parental resistance. Key findings: Principals are often "left alone" without clear central policy support when they need to make quick decisions.
3.	(Hidayat & Patras, 2024). Digital Leadership Of School Principals In Indonesia: Strategic Interventions Needed.	Pedagogia	The Method Used Qualitative	The results of the study show In Indonesia, the main challenge is the infrastructure gap. Key strategies include collaboration with the private sector and optimizing the PMM (*Merdeka Mengajar* Platform).
4.	(Witthöft Et Al., 2025). Digital Leadership and School Innovation: Exploring Principals' Roles.	Journal of Research on Technology in Education	The Method Used Quantitative	The results of the study A principal's "open innovation" mindset is key. Leaders must actively seek out external networks to accelerate technology adoption in schools.
5.	(Tømte, 2024). Conceptualization Of Professional Digital Competence for School Leaders.	Computers & Education	The Method Used Qualitative (Case Study)	The results of the study Defining new competencies: "Digital Stewardship", the ability to manage student data ethics and privacy in schools 1:1devices.

6.	(Karakose Et Al., 2022). Examining The Intellectual Structure of Educational Technology Leadership.	Sustainability	The Method Used Bibliometric	The results of the study the research trend is shifting from “IT Management” to” Cultural Transformation”. Principals must be data literate for decision-making.
7.	(Rahman & Hamid, 2025). Digital Leadership Practices of Principals and Teachers’ Self-Efficacy in Secondary Schools	International Journal of Academic Research in Progressive Education and Development	The Method Used Quantitative (Survey)	The results of the study This recent study, which examined 162 teachers, found a positive correlation between principals’ digital leadership practices and teacher self-efficacy. These findings emphasize that to increase teacher confidence in teaching history/social sciences digitally, principals must actively model a culture of innovation, not just administrative instruction.
8.	(Shamir-Inbal & Blau, 2021). Facilitating Emergency Remote K-12 Teaching in Computing-Enhanced Virtual Learning Environments During COVID-19 Pandemic - Blessing or Curse?	Journal of Computer Assisted Learning	The Method Used Mixed Method	The results of the study Principals are the gatekeepers of digital well-being. A key strategy: limiting digital communication hours to prevent teacher burnout.
9.	(Alajmi, 2022). The Impact of Digital Leadership on Teachers' Technology Integration.	Int. Journal of Educational Research	The Method Used Quantitative	The results of the study Professional support (training) are more influential than simply providing hardware in improving teacher performance.
10.	(Purnomo Et Al., 2024). Transformation Of Digital-Based School Culture: Implications of Change Management on Virtual Learning Environment Integration.	Cogent Education	The Method Used Qualitative	The results of the study are Identifying the 7 stages of cultural change. Successful principals are those who are able to align their technological vision with their teachers' pedagogical values.
11.	(Uzorka & Kalabuki, 2025). Educational Leadership in The Digital Age: An Exploration of Impact.	Social Sciences & Humanities Open	The Method Used Qualitative	The results of the study Highlighting the importance of “E-Trust.” Leaders must build team trust virtually, which is more difficult than face-to-face.
12.	(Hafiza Hamzah Et Al., 2021). The Effects of Principals’ Digital Leadership on	Journal of Edu. & e-Learning	The Method Used Quantitative	The results of the study “Visionary Leadership” competency is the strongest predictor of teachers’ success in teaching online during the crisis.

	Teachers' Digital Teaching.			
13.	(Aliyah Et Al., 2025). Enhancing Digital Competencies in Education: A Comprehensive Framework for Teacher Training and Leadership	Al-Tanzim: Jurnal Manajemen Pendidikan Islam	The Method Used Qualitative (Case Study)	The results of the study Develop a "Digital Training Leadership Framework" based on TPACK and the Four-D model. Key findings: Hands-on training significantly improves teachers' technical competency (Canva 85%, PPT 81%). Leadership strategies should focus on continuous mentoring and the provision of policy infrastructure.
14.	(Widodo Et Al., 2025). The Evolving Role of School Principals: A Systematic Examination.	Journal of Educ. Management	The Method Used Systematic Review	The results of the study The SLR study of 15 articles concluded that the role of the principal has evolved from an administrative manager to an "Agent of Transformation." Modern principals must be able to design a "Conceptual Model" that combines technological innovation with a human-centered approach to create adaptive schools in the era of Society 5.0.
15.	(SULAK Et Al., 2022). Transformation Of School Principal Leadership in The Digital Era: Literature Review	IJARPED	The Method Used Systematic Literature Review (SLR)	The results of the study are Finding a significant positive relationship between the tendency for "Lifelong Learning" and the digital literacy level of elementary school teachers. Implications for leadership: Principals should design human resource development strategies that focus on cultivating a self-directed learning mindset, rather than simply providing short-term technical training.

Literature Search Analysis

A. Synthesized Findings from Selected Studies

The extraction of data from the selected 15 articles (as summarized in Table Summary of Selected Studies on Digital Leadership (2022-2025), provides a comprehensive answer to the research questions regarding competencies, strategies, and challenges of digital leadership in K-12 education.

B. Principals' Digital Competencies (RQ1)

The literature reveals a fundamental shift in the definition of a competent digital leader. The analysis confirms that technical proficiency (e.g., using specific software) is merely a baseline requirement. The higher-order competency identified across global and Indonesian studies (Karakose et al., 2022),

(Aliyah et al., 2025) is "Digital Wisdom" the pedagogical foresight to evaluate why and how technology should be integrated. Additionally, "Visionary Agility" emerges as a critical skill, enabling principals to anticipate technological disruptions (such as AI) and align them with the school's long-term educational goals.

C. Strategic Approaches for Digital Transformation (RQ2)

Addressing the second research question regarding implementation strategies, the synthesis reveals a critical paradigm shift. The literature suggests that effective digital leadership strategies must pivot from "Technocratic Approaches" (focusing on hardware) to "Psychological Scaffolding" (focusing on human readiness). First, (Rahman & Hamid, 2025) propose the strategy of "Participatory Modeling." Their study confirms that "top-down" instructions are ineffective in the digital era. Instead, the most powerful strategy is for principals to act as visible role models in using technology. This active demonstration significantly boosts teachers' self-efficacy, empowering them to integrate technology with confidence rather than compliance. Complementing this, (Sulak et al., 2022) argue for a strategy of "Lifelong Learning Cultivation." Digital tools evolve rapidly; thus, providing one-off technical training is insufficient. The deeper strategy involves transforming the school culture into a learning organization where principals foster a "growth mindset." By encouraging teachers to become autonomous lifelong learners, leaders ensure that digital adoption is sustainable and driven by internal motivation. Finally, navigating the volatility of digital transformation requires what (Parveen et al., 2022) describe as "Adaptive Crisis Leadership." In contexts where central policies are ambiguous or delayed, the strategy is to implement localized support systems. Effective principals proactively create "psychological safety nets" and clear internal guidelines to shield teachers from uncertainty and burnout during the transition period.

D. Barriers and Challenges in the Post-Pandemic Era (RQ3)

the review uncovers a "Dual-Layer Barrier." In developing regions, the primary hurdle remains the Infrastructure Divide (internet stability and device availability). However, a more pervasive challenge identified in recent studies (Shamir-Inbal & Blau, 2021), (Aliyah et al., 2025) is "Technostress" and "Change Fatigue." This indicates that even when infrastructure is present, the psychological resistance of senior teachers and the lack of digital well-being policies constitute the most significant barriers to sustainable transformation.

Conclusion

This systematic literature review has synthesized evidence from 2022 to 2025 to reconstruct the concept of digital leadership in K-12 education. The findings confirm that effective digital leadership is no longer synonymous with mere technological proficiency. Instead, it demands a triad of "Digital Wisdom," "Visionary Agility," and "Distributed Empowerment." The study reveals that while principals in developed nations focus on ethical stewardship and data privacy, their counterparts in developing regions, including Indonesia, are navigating the dual challenge of infrastructure deficits and teacher technostress. Critically, the analysis demonstrates that "top-down" mandates are ineffective; sustainable digital transformation is best achieved through distributed leadership models where principals empower teacher-leaders to drive grassroots innovation.

Based on these findings, this study offers two critical recommendations for educational policymakers and practitioners, particularly within the Indonesian "*Merdeka Belajar*" framework:

1) Shift from Procurement to People:
   Government interventions should pivot from solely focusing on hardware procurement (laptops/internet) to investing in "Humanware." Principals need training not just on how to use platforms like PMM, but on how to mentor teachers in integrating these tools pedagogically. The "Digital Training Leadership Framework" identified in this review serves as a viable model for national adoption.
2) Institutionalizing Distributed Leadership:
   School supervisors should encourage principals to form internal "Digital Task Forces" led by tech-savvy teachers. This reduces the administrative burden on principals and fosters a culture of peer-learning that is more resilient to change.

This review is limited to articles published in English, which may exclude relevant local studies in native languages. Furthermore, most selected studies are cross-sectional. Future research should prioritize longitudinal studies to measure the long-term impact of digital leadership on student learning outcomes and character development. Additionally, as Artificial Intelligence (AI) permeates K-12 education, further investigation is needed into the ethical leadership competencies required to govern AI usage in classrooms.

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