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CHALLENGES AND STRATEGIES OF SCHOOL PRINCIPALS IN DIGITAL LEARNING ERA: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

This study aimed to analyze the challenges and strategies of school principals in digital learning era. The study employed a Systematic Literature Review (SLR) method by following the PRISMA 2020 guidelines. A total of 15 peer-reviewed articles published between 2022 and 2026 were selected from several academic databases, including Scopus, ERIC, and Google Scholar (SINTA-indexed journals), based on predetermined inclusion and exclusion criteria. The findings indicate that the challenges faced by school principals in supporting learning in the digital era include limited technological infrastructure, low levels of teachers' digital competence, and insufficient digital-based professional training. In addition, several strategies are identified as essential in supporting learning in the digital era, including the development of visionary leadership, teacher professional development through digital training, and the establishment of collaborative leadership. The novelty of this study is the limited number of studies that simultaneously examine both the challenges and strategies of school principals in digital-era learning through a systematic literature review approach. Therefore, this study provides a more comprehensive understanding of the challenges and strategies required by school principals in responding to the transformation of learning in the digital era.

ABSTRAK

Penelitian ini bertujuan untuk menganalisis tantangan dan strategi kepala sekolah dalam pembelajaran di era digital. Penelitian ini menggunakan metode Systematic Literature Review (SLR) dengan mengacu pada pedoman PRISMA 2020. Sebanyak 15 artikel peer-review yang diterbitkan pada tahun 2022 hingga 2026 dipilih dari beberapa basis data akademik, yaitu Scopus, ERIC, dan Google Scholar (jurnal terindeks SINTA) berdasarkan kriteria inklusi dan eksklusi yang telah ditentukan. Hasil penelitian menunjukkan bahwa tantangan yang dihadapi kepala sekolah dalam pembelajaran di era digital adalah keterbatasan infrastruktur teknologi, rendahnya kompetensi digital guru, dan kurangnya pelatihan profesional berbasis digital. Selain itu, adapun strategi yang diidentifikasi sebagai hal penting dalam mendukung pembelajaran di era digital adalah membentuk kepemimpinan visioner, pengembangan profesional guru melalui pelatihan digital, dan membentuk kepemimpinan kolaboratif. Keterbaruan penelitian ini adalah masih terbatasnya kajian yang membahas secara bersamaan tantangan dan strategi kepemimpinan kepala sekolah dalam pembelajaran di era digital melalui metode systematic literature review. Untuk itu, penelitian ini berupaya memberikan gambaran yang lebih komprehensif mengenai tantangan dan strategi kepala sekolah dalam menghadapi transformasi pembelajaran di era digital.

Kata kunci: *Tantangan, Strategi, Kepala Sekolah, Era Pembelajran Digital, Systematic Literature Review*

PENDAHULUAN

The development of digital technology has brought major changes to education in the 21st century. Digital transformation not only affects classroom learning processes, but also changes school administration systems, communication, and overall school management. According to Suratman et al. (2024), the digital era requires educational institutions to adapt to technological developments in order to remain relevant to the needs of modern society. In addition, digital transformation encourages schools to create innovative and technology-based learning environments to support the effectiveness of 21st-century education. The presence of technology in education provides opportunities for schools to improve the quality of learning through the use of interactive digital media and platforms (Anisyah et al., 2024). On the other hand, the use of technology also strengthens communication and collaboration among teachers, students, and school principals in creating a more effective and efficient educational process.

Along with the increasing use of technology in educational environments, the role of school principals becomes more important in ensuring that the digital transformation process runs effectively and in a well-directed manner. In this context, school principals not only act as managers of educational institutions, but also as leaders of change who guide schools in adapting to technological developments. According to Berkovich & Hassan (2025), the digital leadership of school principals is one of the main factors in creating innovative and effective learning environments that meet the demands of 21st-century education. In addition, school principals are responsible for managing the use of educational technology, starting from planning and implementation to the evaluation of digital-based learning in schools (Riski et al., 2023). Therefore, innovative and adaptive leadership is needed to support teachers and students in using technology effectively in the learning process.

Behind the importance of digital leadership in supporting the learning process, school principals also face various challenges in managing technological transformation in schools. Although digital technology offers many benefits in education, the implementation process in schools still encounters several obstacles. One of the main challenges is the limited digital competence of teachers in using learning technology effectively. According to Dasruth & Naicker (2026), digital leadership in schools is often hindered by the low readiness of teachers and resistance to technological change in the educational process. In some schools, limited digital infrastructure, such as unequal internet access and a lack of digital facilities, also becomes a challenge in supporting technology-based educational transformation (Habibi et al., 2023). These conditions make technology-based learning in some schools less effective and not yet fully optimized. As a result, the use of digital technology in creating innovative and interactive learning processes remains limited.

As an effort to deal with various challenges in the digital learning era, school principals need to have digital leadership strategies to adapt to technological developments. School principals are not only required to understand the use of technology in learning, but also to build a positive and innovative digital culture within the school environment. These strategies can be carried out through continuous development of teachers' digital competence by providing training, workshops, and guidance in the use of learning technology (Rodrigues, 2020). In addition, school principals can cooperate with the government and private sectors to support the provision of digital facilities and infrastructure in schools (Juharyanto et al., 2020). Furthermore, school principals can also encourage teachers to use offline digital learning media that can be applied flexibly based on learning needs (Arif et al., 2023).

Previous studies have examined the leadership of school principals in digital learning era. Several challenges faced by school principals include limited access to technology, infrastructure, and school resources, which become major obstacles in implementing Education 4.0 in schools in South Africa using a qualitative single case study (Dasruth & Naicker, 2026), differences in teachers' readiness to accept and apply digital technology become the main challenge faced by school principals in the digital transformation process in senior high schools in Switzerland using an exploratory study (Ruloff & Petko, 2025), limited digital infrastructure, lack of teacher training, and insufficient understanding of the use of artificial intelligence in education also become challenges experienced by elementary and secondary school principals in Cyprus in a qualitative study (Kafa, 2025), and lack of funding, limited resources and technological infrastructure, as well as inadequate technical support in implementing technology in public secondary schools in Southwest Nigeria become challenges faced by school principals in the digital era using a survey study (Ogegbo & Olujuwon, 2025). In addition, several studies also identify various strategies used by school principals digital learning era, namely collaborative leadership strategies become the dominant approach applied by secondary school principals in Ireland in the digital era using a small-scale qualitative study (Kicoyne, 2026), strengthen teachers' digital competence through continuous training and mentoring become the main approach used by school principals to improve the quality of technology-based learning in elementary schools in Indonesia using a case study research (Thahir, 2025), developing visionary leadership to encourage technology integration also becomes the main strategy applied by school principals in the Philippines in leading digital transformation in excellent schools using a case study method (Baldera et al., 2025), and school principals in Bulgaria prioritize collaborative leadership strategies in directing digital transformation in education in a mixed-method study (Mizova et al., 2026).

Based on the previous studies mentioned above, it can be concluded that most of the earlier research still focuses separately on the challenges and strategies of school principals in digital learning era. In general, the challenges faced by school principals relate to limited infrastructure and access to technology, differences in teachers' readiness to apply digital technology, lack of optimal support and training for teachers, and limited school resources (Dasruth & Naicker, 2026; Ruloff & Petko, 2025; Kafa, 2025; Ogegbo & Olujuwon, 2025). Meanwhile, the strategies used by school principals in the digital learning era include building collaborative and visionary leadership, strengthening teachers' digital competence through continuous training, and developing school systems that support the integration of technology in learning (Kicoyne, 2026; Thahir, 2025; Baldera et al., 2025; Mizova et al., 2026). In addition, most previous studies use research designs such as single case studies, exploratory studies, qualitative research, survey methods, small-scale qualitative studies, case studies, and mixed-method research. However, there is still limited research that specifically analyzes both the challenges and strategies of school principals in the digital learning era at the same time. Furthermore, the use of the systematic literature review (SLR) method is still limited.

This study is important because research discussing both the challenges and strategies of school principals in digital learning era is still limited. Therefore, this study aims to fill the gap by using the systematic literature review (SLR) method to analyze the challenges faced by school principals and the strategies implemented in the digital learning era. The research question of this study is: What are the challenges and strategies faced by school principals in digital learning era?

MEHOD

Research Design

This study used the Systematic Literature Review (SLR) method by following the PRISMA 2020 (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. The use of these guidelines aimed to ensure that the process of searching, selecting, and analyzing the literature was conducted systematically, structurally, and transparently, and could be replicated by other researchers.

Reseach Strategy

The literature search process was carried out through three main academic databases that were relevant to the research topic, namely:

1. Scopus
2. ERIC
3. Google Scholar (SINTA-indexed journals)

In the search process, this study used Boolean operators to select articles that matched the focus of the study. The keywords used in the search were ("leadership challenge" OR "digital challenge" OR "educational challenge") AND ("leadership strategy" OR "digital strategy" OR "educational strategy") AND ("school principal" OR "school leader" OR "principal leadership") AND ("digital learning" OR "digital era" OR "digital transformation" OR "technology-based learning").

Inclusion and Exclusion Criteria

Inclusion Criteria:

1. Articles were published between 2022 and 2026
2. Articles had gone through a peer-review process
3. Studies focused on the challenges and strategies of school principals in digital learning era
4. Studies were conducted in Indonesia as well as in international contexts.
5. Articles were written in English.
6. The selected articles were based on empirical research, including quantitative, qualitative, or mixed-method studies.

Exclusion Criteria:

1. Publications that did not go through a peer-review process (theses, proceedings, or research reports)
2. Articles that did not focus on the challenges and strategies of school principals in digital learning era
3. Articles that were only conceptual or theoretical without empirical data were excluded
4. Duplicate articles
5. Articles that did not provide full-text access

Article Selection Process (PRISMA Stages)

The article selection process in this study was carried out through four main stages, as follows:

1. Identification
   At the indentification stage, a total of 801 articles were identified from several databases, namely Scopus (121 articles), ERIC (274 articles), and Google Scholar (406 articles).
2. Screening
   During the screening stage, 449 duplicate articles were removed, leaving 352 articles. Furthermore, screening based on titles and abstracts was conducted, and 45 articles

were excluded because of lack of relevant to the research topic. As a result, 302 articles remained.

3. Eligibility
   The next stage involved assessing the eligibility of the 302 articles through a full-text review. From this process, 287 articles were excluded because it did not focus on the challenges and strategies of school principals in digital learning era, were not published within the determined year range, or were not written in English.
4. Inclusion
   At the final stage, 15 articles met all the criteria and were included in the final analysis of the study. The processes of identification, screening, eligibility, and inclusion were presented in the PRISMA flow diagram in Figure 1 below:

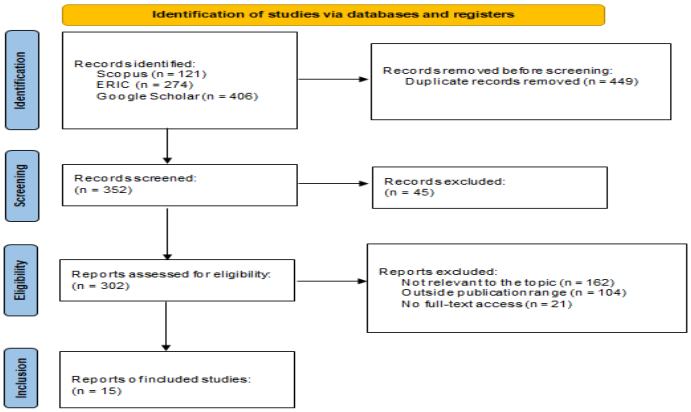


Figure 1. PRISMA Flowchart of the Study Selection Process

Data Extraction and Analysis

Data Extraction

The data from the selected articles were then extracted and organized into an analysis matrix that included the following information:

1. Author
2. Year of publication
3. Title
4. Journal name
5. Research design
6. Journal index

Data Analysis

After 15 articles were selected as the final sample, the next step involved extracting and analyzing the data using a thematic approach. The analysis was conducted by identifying patterns and themes that appeared in each article. Furthermore, the findings were grouped into several main themes related to the challenges and strategies of school principals in digital learning era. The analyzed articles came from several major databases, namely Scopus Q1 (4 articles), Scopus Q2 (2 articles), ERIC (4 articles), and SINTA 2 (5 articles), as presented in the figure below:

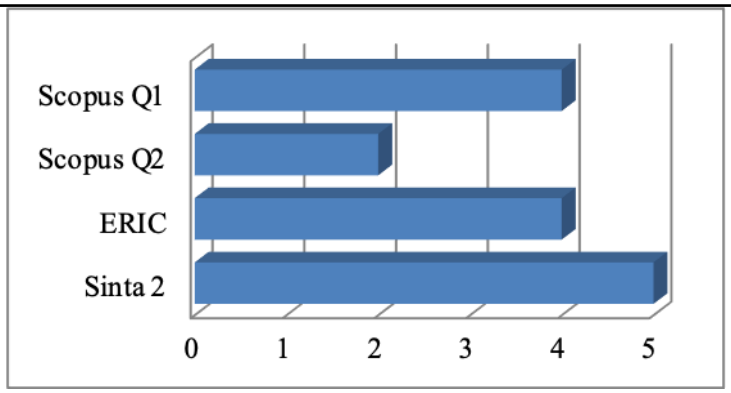


Figure 2. Databases Sources of the Selected Articles

The data obtained from all selected articles were then summarized in a data extraction table to make the presentation of the research findings easier and more organized. This extraction table presented important information from each article in a concise and systematic manner. A total of 15 articles that met the research criteria were described in more detail in Table 1 below:

Table 1. The Selected Journal Articles

No	Author(S) and Year	Title	Journal Name	Research Design	International Index
1.	Dasruth & Naicker (2026)	Conceptualising a School Leaders' Digital Leadership Framework to lead Education 4.0 in a South African School District	SAGE Open	A qualitative single case study	Scopus Q1
2.	Ruloff & Petko (2025)	School Principals' Educational Goals and Leadership Styles for Digital Transformation: Results from Case Studies in Upper Secondary Schools.	International Journal of Leadership in Education	Exploratory study	Scopus Q1
3.	Kicoyne (2026)	Navigating Through Disruption: How are School Principals Leading Digital Learning in Secondary Schools in Ireland	Computers in the Schools	Small-scale qualitative	Scopus Q1
4.	Thahir (2025)	Digital Leadership of School Principals in Enhancing Technology-based Learning Quality	International Journal of Studies in International Education	Case study	Scopus Q1
5.	Baldera et al. (2025)	Digital Leadership Pioneers: Navigating Outstanding School Principals' Successes in the Evolving Educational Landscape	International Journal of Learning, Teaching, and Educational Research	Case study	Scopus Q2
6.	Mizova et al. (2026)	Leading the Digital Transformation of Education: The Perspective of School	Administrative Sciences	Mixed-method	Scopus Q2

		Principals.			
7.	Kafa (2025)	Exploring Integration Aspects of School Leadership in the Contexts of Digitalization and Artificial Intelligence	International Journal of Educational Management	Qualitative study	ERIC (Education Resources Information Center)
8.	A'mar & Eleyan (2022)	Effect of Principal's Technology Leadership on Teacher's Technology Integration	International Journal of Instruction	Cross-sectional survey	ERIC (Education Resources Information Center)
9.	Ogegbo & Olujuwon (2025)	Exploring Principal's Use and Management of Technology in Public Secondary Schools	International Journal of Education and Development using Information and Communication Technology (IJEDICT)	Survey study	ERIC (Education Resources Information Center)
10.	Uzorka et al. (2025)	Education Leadership in the Digital era: Navigating Challenges and embracing Opportunities.	International Journal of Technology in Education and Science (IJTES)	Qualitative study	ERIC (Education Resources Information Center)
11.	Mulyaniapi et al. (2024)	Digital Leadership Influencing the Capabilities of Early Childhood Education Organizations in School Mover 1 Bandung	Mimbar Sekolah Dasar	Quantitative study	Sinta 2
12.	Johari et al. (2023)	Challenges of School Leaders' Digital Leadership: An Initial Study in Bintulu, Serawak, Malaysia.	Jurnal Akuntabilitas Manajemen Pendidikan	Case study	Sinta 2
13.	Novianto et al. (2025)	The Principal's Role in Developing Teachers of the Digital Teaching Journal by Using AppSheet at Junior High School	Scaffolding: Jurnal Pendidikan Islam dan Multikulturalisme	Case study	Sinta 2
14.	Suryaman & Setiyani (2025)	Assessing the Readiness of School Principals for Digital Leadership: An Exploratory Data Analysis Approach	Tadbir: Jurnal Studi Manajemen Pendidikan	Qualitative descriptive	Sinta 2
15.	Sunu (2022)	The Impact of Digital Leadership in Teachers' Acceptance and Use of Digital Technologies	Mimbar Ilmu	Survey study	Sinta 2

RESULT AND DISCUSSION

Result

The following section presented various the challenges faced by school principals in digital learning era. A summary of these challenges was presented in the table below:

Table 2. School Principals' Challenges in the Digital Learning Era

No	Challenges of School Principals	Frequency (f)	Percentage (%)
1.	Limited infrastructure and access to school technology	2	20
2.	Differences in teachers' readiness and digital competence	2	20
3.	Lack of digital-based training and professional development for teachers	2	20
4.	The lack of support in terms of funding systems and implementation policies	2	20
5.	Low level of understanding and readiness of school principals regarding digital technology and artificial intelligence (AI)	2	20

Table 2 summarized the challenges faced by school principals in digital learning era that emerged from the selected articles. The five identified challenges had the same frequency and percentage. Limited infrastructure and access to school technology were found in 2 articles, representing 20%. This challenge emphasized that unequal digital facilities, limited devices, and uneven access to technology still became obstacles in implementing digital leadership in schools (Dasruth & Naicker, 2026; Ogegbo & Olujuwon, 2025). In addition, differences in teachers' readiness and digital competence were also found in 2 articles with a percentage of 20%. This challenge showed that variations in teachers' ability to use digital technology became barriers to the digital transformation process in schools (Ruloff & Petko, 2025; Ogegbo & Olujuwon, 2025).

The next challenge was the lack of digital-based training and professional development for teachers, which was identified in 2 articles with a percentage of 20%. This challenge highlighted that limited continuous training programs for teachers and educational staff still became obstacles to school principals in the digital era (Kafa, 2025; Johari et al., 2023). Another challenge was the lack of support in terms of funding systems and implementation policies, which was also found in 2 articles with a percentage of 20%. This challenge indicated that the success of digital transformation was strongly influenced by budget support, school policies, and the availability of adequate support systems (Dasruth & Naicker, 2026; Ogegbo & Olujuwon, 2025). The final challenge was the low level of understanding and readiness of school principals regarding digital technology and artificial intelligence (AI), which was identified in 2 articles with a percentage of 20%. This challenge illustrated that there was still a gap in the digital leadership competence of school principals, especially in understanding and integrating AI-based technology into school management (Kafa, 2025; Johari et al., 2023).

Furthermore, the following section presented various the strategies used by school principals in digital learning era. A summary of these strategies was presented in the table below:

Table 3. School Principals' Strategies in the Digital Learning Era

No	Strategies of School Principals	Frequency (f)	Percentage (%)

1.	Visionary leadership and digital readiness	3	17.65
2.	Teacher professional development through digital training	3	17.65
3.	Collaborative leadership in digital transformation	3	17.65
4.	Integration of technology into the learning process	3	17.65
5.	Strengthening digital-based school systems and management	2	11.76
6.	Innovation and adaptation to digital technological changes	3	17.65

Table 3 summarized the strategies of school principals in digital learning era that emerged from the selected articles. Six identified strategies had the same frequency and percentage. Visionary leadership and digital readiness were found in 3 articles with a percentage of 17.65%. This strategy emphasized the ability of school principals to build a digital vision and mission, as well as readiness to face digital transformation (Mizova et al., 2026; Suryaman & Setiyani, 2025; Sunu, 2022). Furthermore, teacher professional development through digital training was also found in 3 articles with a percentage of 17.65%. This strategy showed that improving teachers' competence through technology training and continuous mentoring became an important key in supporting digital-based learning (A'mar & Eleyan, 2022; Uzorka et al., 2025; Mulyaniapi et al., 2024).

The next strategy was collaborative leadership in digital transformation, which was identified in 3 articles with a percentage of 17.65%. This strategy emphasized the importance of collaboration among school principals, teachers, and stakeholders in building an inclusive digital school culture (Kicoyne, 2026; Baldera et al., 2025; Mizova et al., 2026). Another strategy was the integration of technology into the learning process, which was also found in 3 articles with a percentage of 17.65%. This strategy showed that school principals played an important role in encouraging the use of learning applications, digital platforms, and educational technology to improve the quality of learning (Thahir, 2025; Novianto et al., 2025; Sunu, 2022).

The next strategy was strengthening digital-based school systems and management, which was found in 2 articles with a percentage of 11.76%. This strategy illustrated the importance of improving digital-based school systems, management, and governance led by school principals (Uzorka et al., 2025; Suryaman & Setiyani, 2025). The final strategy was innovation and adaptation to digital technological changes, which was identified in 3 articles with a percentage of 17.65%. This strategy emphasized the ability of school principals to adapt to technological developments and create innovation in educational management during the digital era (Baldera et al., 2025; Mizova et al., 2026; Uzorka et al., 2025).

Discussion

The findings show that the school principals in digital learning era faces various interconnected challenges, namely technological infrastructure, teachers' digital competence, and the readiness of school principals to use digital technology. Unequal access to technology and limited support for digital facilities can hinder the effective implementation of digital leadership in schools (Dasruth & Naicker, 2026; Ogegbo & Olujuwon, 2025). In addition, differences in teachers' readiness and digital competence indicate that technology-based educational transformation does not only depend on the availability of devices, but also on the ability of human resources to integrate technology into the learning process. Teachers' digital competence becomes an important factor in supporting successful learning in the

digital era (Ruloff & Petko, 2025).

This study also shows that the lack of digital-based professional training and limited support from school systems and policies become important challenges in school principals in digital learning era. Continuous training is highly needed to improve the abilities of teachers and school principals in dealing with changes in educational technology (Kafa, 2025; Johari et al., 2023). In addition, support from school policies and funding also plays an important role in the success of digital transformation. The implementation of educational technology requires strong school management support, including policies, support systems, and adequate budget allocation (Dasruth & Naicker, 2026). Furthermore, the low level of understanding of digital technology and artificial intelligence (AI) among school principals indicates that principals are required to continuously adapt to technological developments in order to manage education effectively in the digital era (Kafa, 2025; Johari et al., 2023).

On the other hand, the findings of this study identify various strategies implemented by school principals to face challenges in digital learning era, such as developing visionary leadership, improving teacher professional development, applying collaborative leadership, integrating technology into learning, strengthening digital school systems, and creating innovation in response to technological changes. School principals who have a clear digital vision are able to encourage school transformation more effectively (Mizova et al., 2026; Suryaman & Setiyani, 2025; Sunu, 2022). In addition, improving teachers' competence through digital training becomes an important strategy in enhancing the quality of technology-based learning (A'mar & Eleyan, 2022; Uzorka et al., 2025; Mulyaniapi et al., 2024). Furthermore, collaborative leadership also plays an important role in creating an inclusive digital school culture through cooperation among school principals, teachers, and educational stakeholders (Kicoyne, 2026; Baldera et al., 2025; Mizova et al., 2026). Therefore, the ability of school principals to innovate and adapt to technological developments becomes a key factor in creating an educational system that remains relevant to the demands of the digital learning era.

CONCLUSION

Based on the findings of this study, it can be concluded that the school principals in digital learning era faces various challenges related to limited technological infrastructure, low digital competence among teachers, lack of digital-based professional training, limited support from school systems and policies, and the low level of understanding of digital technology and artificial intelligence (AI) among school principals. These challenges indicate that digital transformation in education does not only require the availability of technology, but also the readiness of human resources and adequate system support. To address these challenges, school principals apply various the strategies in digital learning era, such as developing visionary leadership and digital readiness, improving teacher professional development through digital training, implementing collaborative leadership, integrating technology into learning, strengthening digital-based school systems and management, as well as encouraging innovation and adaptation to technological developments. These strategies show that school principals play an important role in promoting educational transformation that is effective and relevant to the demands of learning in the digital era.

Overall, this study provides insights into the challenges and strategies of school principals in digital learning era in supporting technology-based educational transformation. This study suggests that school principals, teachers, and educational policymakers improve digital competence, strengthen school support systems, and provide continuous training to

respond to developments in educational technology. In addition, this study also has several limitations. The use of the systematic literature review (SLR) method means that the findings do not directly reflect the real experiences of school principals' leadership in digital learning practices at schools. Therefore, future studies are recommended to conduct empirical research to examine the implementation and effectiveness of school leadership strategies in the digital era across different educational contexts.

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