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DIGITAL COMPETENCES OF SCHOOL LEADER: A SYSTEMATIC REVIEW

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Abstract. In recent years, Information and Communication Technologies (ICT) have played a significant role in enhancing the quality of life. However, their integration and potential in the field of education remain in a developmental phase. In this context, the present study conducts a systematic review of the literature on the digital competence of school leaders from 2015 to 2024. The primary objective is to identify prevailing research trends and suggest potential directions for future inquiry. The review methodology follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. After applying inclusion, exclusion, and thematic relevance criteria to studies indexed in the Scopus database, a total of 24 publications were selected for analysis. The findings reveal that digital competence is a multidimensional construct encompassing strategic, pedagogical, technical, and ethical components. Competent digital leaders play a vital role in fostering teacher development, managing innovation, and aligning technology use with institutional goals. However, disparities in context, limited empirical studies from under-resourced regions, and fragmented frameworks remain persistent challenges. The review concludes by recommending future research to develop adaptable competence models, investigate emerging technologies such as AI in leadership, and evaluate the long-term effects of digital leadership practices.

Keywords: digital competence, school leader, systematic review, educational innovation, scopus database.

1. Introduction

Digital competence has become an indispensable skill for educational leaders in the modern era. In simple terms, digital competence extends beyond the mere ability to use technology; it encompasses the capacity to lead in the implementation and management of these technologies to enhance educational quality and leadership effectiveness. In this regard, the digital competence of school leaders is critical for fostering the integration of ICT into educational practices. As highlighted by Bastos and Oliveira (2015), the digital literacy of school leaders directly influences their ability to promote ICT integration within schools and to manage and advance the digital learning environment [1].

The ability to use technology does not only require school leaders to be technically proficient but also to be able to lead the strategic implementation of technology to achieve educational goals. Abdullah and Kadir (2023) [2] argue that digital leadership involves much more than technical know-how; it also includes the ability to communicate, disseminate information, and strategically apply technology within educational settings. This implies that school leaders must not only

understand digital tools but must also utilize them effectively to manage schools and foster a culture of innovation in teaching, learning, and administration.

The relationship between the digital competence of school leaders and the professional development of teachers is also crucial. In the research conducted by Analiza and Tanghal (2022) [3], school leaders are seen as key agents in leading digital transformation within schools and have a significant impact on the professional growth of teachers, especially through the provision of learning opportunities and professional development initiatives related to technology. This encompasses not only the adoption of technology in teaching but also the support of teachers in developing their own digital competences, helping them to integrate new technologies into their classrooms.

This need for digital leadership became especially evident during the COVID-19 pandemic, when schools worldwide had to rapidly transition to remote learning. During this period, school leaders faced considerable challenges in integrating ICT into both school management and teaching, while also dealing with issues related to infrastructure, teacher training, and the readiness of students and parents. As Gerona (2022) emphasized, applying ICT in school management is not just necessary but an invaluable asset in the context of globalization, where school leaders must be able to manage and oversee educational programs, particularly during periods of remote learning [4].

Despite increasing attention to digital competence, there is still limited systematic understanding of the specific skills and behaviors school leaders need to effectively implement technology in diverse educational contexts. Existing literature often focuses on general leadership or teacher ICT use, while overlooking the unique digital roles of school principals. As Tømte (2024) [5] points out, defining and evaluating digital competences is crucial for designing targeted leadership development programs and informing digital transformation strategies.

Given the importance of these issues, this study aims to explore the core digital competences that school leaders require in the context of digital transformation. The study will address the following research questions:

1. What are the core digital competences required for school leaders in the context of digital transformation?

How do these competences influence leadership effectiveness in teaching, learning, and school management?

2. Content

2.1. Literature review

2.1.1. Digital Transformation and Education 4.0

Mišianiková et al. (2021) [6] conceptualize digital transformation as a holistic endeavor comprising two core dimensions: the school as a community of stakeholders - including teachers, students, and administrators - and the school as a digitally enabled learning environment. This dual focus underscores the imperative to enhance educational quality through deliberate and strategic action plans. Effective digital transformation necessitates school leaders equipped with strategic foresight and the capacity to mobilize stakeholders in fostering a digitally inclusive and forward-thinking institutional culture.

Kin and Kareem (2019) and Kin, et al. (2022) contextualize digital transformation within the framework of the Fourth Industrial Revolution (FIR) and its implications for Education 4.0 [7] [8]. They advocate reimagining educational leadership to address systemic disruptions brought about by advanced technologies. The study identifies digital literacy as a cornerstone of effective school management and emphasizes the urgency of upskilling and reskilling leaders to maintain institutional competitiveness. The authors further highlight the critical need for innovative

approaches to leadership that prioritize efficiency, continuous learning, and integration of sophisticated digital tools.

Tanghal and Tanghal (2022) explored the transformative impact of the COVID-19 pandemic, which acted as a catalyst for rapid digital adoption in schools [3]. Their findings underscore the dual technical and managerial nature of digital competences required by school leaders. The ability to adapt swiftly, implement digital strategies, and leverage data-driven decision-making emerged as essential during crisis conditions, reflecting the heightened demands of contemporary educational leadership.

2.1.2. Core Digital Competences of School Leaders

Nailufar et al. (2023) [9] underscore the multifaceted role of school principals in fostering digital competences within educational settings. As pivotal decision-makers, principals are tasked with designing and executing digital literacy frameworks that address diverse institutional needs. Their roles encompass:

- Educators: Strategically enhancing teachers' digital proficiencies.
- Managers: Optimizing technological and human resources to achieve institutional objectives.
- Administrators: Overseeing the documentation and organization of school operations.
- Supervisors: Guiding and monitoring the effective deployment of digital initiatives.

The authors emphasize strategic leadership as critical to overcoming challenges such as resistance to technological change and infrastructural gaps.

Samosa (2023) highlights the strategic imperative for school leaders to embrace digital technology in cultivating meaningful, transparent, and engaging school cultures [10]. Effective digital leadership transcends mere technical implementation, focusing instead on fostering a collaborative and achievement-oriented institutional ethos. Samosa identifies essential components of digital leadership, including:

- Establishing a unified vision for technology integration.
- Facilitating professional development opportunities for staff.
- Promoting collaboration among institutional stakeholders.

Building on this, Wijayati et al. (2023) [11] describe digital leadership as a dynamic process of influencing teams through intentional use of digital tools to enhance decision-making and operational efficiency. By adopting transformational and distributed leadership styles, school leaders inspire positive changes in digital practices while addressing systemic challenges such as administrative inefficiencies and curricular misalignments.

Zhu et al. (2024) extends this discourse by identifying the increasing complexity of digital policymaking and implementation [12]. Effective digital leadership is defined by the ability to design robust digital ecosystems, ensure cybersecurity, and employ data analytics for strategic planning and decision-making.

2.1.3. The Impact of Digital Leadership Competences

Abdullah and Kadir (2023) examine the positive correlation between principals' digital leadership and teachers' technological integration into instructional practices [2]. Their findings reveal that effective leaders foster environments conducive to continuous professional development, collaborative learning, and alignment of digital initiatives with institutional goals.

Similarly, Bastos and Oliveira (2015) assess the influence of digital literacy among school leaders in Portugal [1]. Their study concludes that leaders with advanced digital competences are better positioned to drive innovation and collaboration across educational communities. The authors advocate for sustained professional development programs tailored to the evolving demands of digital leadership.

2.1.4. Barriers to Digital Transformation

Despite its promise, digital transformation in education is hindered by significant challenges. Håkansson Lindqvist and Pettersson (2019) identify four critical dimensions of these barriers [13]:

1. Technical: The integration of diverse hardware, software, and systems.
2. Pedagogical: Incorporating digital tools into effective teaching and learning practices.
3. Organizational: Managing infrastructural and systemic processes in digital environments.
4. Administrative: Ensuring compliance with regulatory and policy frameworks.

To address these challenges, the authors call for leadership training programs that equip school leaders with the competences required to balance these multifaceted demands.

Abdul Razzak (2015) highlights additional barriers, including inequitable access to ICT resources, insufficient teacher training, and resistance to technological adoption [14]. The study critiques the gap between policy aspirations and on-the-ground implementation, attributing these discrepancies to inadequate leadership preparation. Recommendations include strategic resource allocation, comprehensive training for educators and leaders, and the formulation of pragmatic policies to bridge systemic gaps.

2.2. Research method

2.2.1. Data Collection

Using the Scopus database from https://www.scopus.com/, we conducted a structured search technique to retrieve peer-reviewed articles from publishers such as Emerald, Springer, ScienceDirect, SAGE, EBSCOHost, and ERIC. The authors' university library is linked to these sources. These well-known publishers are significant for this paper because the publications chosen would enable the production of a review with valid and reliable findings. We formulated three inclusion and two exclusion criteria for the review. As presented in Table 1, every article had to meet the inclusion and exclusion criteria. We applied the "AND" and "OR" operators to identify word combinations like "digital competence," "school leadership," "educational management," and "ICT integration".

The Boolean search string used was: ("digital competence" OR "digital competence") AND ("school leadership" OR "educational leadership") AND ("ICT integration" OR "educational management"). We applied this search string with filters for publication years (2015–2024), peer-reviewed journal articles, and the English language. We formulated three inclusion and two exclusion criteria. All selected articles had to meet these criteria to be included in the review.

The abstracts of each article were evaluated to ensure their potential relevance to the research topic. We collected all potential articles and then examined them individually for any focus relevant to digital transformation. 31 articles were derived from the initial search. These articles were further screened to remove duplicates and irrelevant articles, leaving 28 articles relevant to digital competence of principals. Another screening was carried out on the 28 articles, and 24 articles met the exclusion and inclusion criteria about the digital competence of principals.

2.2.2. Data Analysis

The analysis was conducted concurrently with data collection as the processes of data collection, data analysis, and report authoring are interrelated and occur simultaneously. Selected articles were retrieved from Scopus databases in December 2024, and the data required for the systematic literature review were obtained and extracted. Content analysis, the constant comparative technique, and grounded theory were employed to inductively construct the themes during the coding procedure to answer the two research questions.

2.3. Results

2.3.1. Definition of Digital Competence

Digital competence, particularly in the context of school leadership, is a multidimensional

concept that includes the knowledge, skills, and attitudes necessary for effectively utilizing digital technologies to meet both organizational and educational goals (Table 1). Bastos and Oliveira (2015) define digital literacy as not only the capacity to use technology for communication and collaboration but also the understanding of its role in fostering lifelong learning. In a similar vein, Sary, et al. (2023) [15] emphasize that digital competence encompasses the ability to access, use, create, and share digital resources effectively to achieve specific objectives. This perspective highlights the broad scope of digital competence, which goes beyond technical proficiency to include cognitive and ethical dimensions critical for navigating the complexities of the digital environment.

In the educational context, digital competence extends to both managerial and pedagogical dimensions. Tømte and Smedsrud (2023) argue that digital transformation is not just about the adoption of technology, but also involves managing organizational changes, aligning resources, and cultivating a culture of innovation [5]. For school leaders, this means integrating technology into strategic planning processes, ensuring that digital initiatives align with institutional goals, and fostering a digital ecosystem that supports the needs of all stakeholders. School principals, therefore, must demonstrate leadership that goes beyond technical skills, ensuring that digital tools are not only integrated into teaching and learning but also in the overall management and development of the school.

Table 1. The collected definitions of digital competence from publications

Author (Year)	Name of Publication	Digital Competence
Bastos, G., & Oliveira, I. (2015).	Springer International Publishing.	digital literacy that involves the competence not only to use technologies appropriately, namely to communicate and collaborate with peers and colleagues, but also to understand the relationship between technology and lifelong learning
Sary, Dudija, and Moslem (2023)	European Journal of Educational Research	accessing, using, creating, and sharing digital resources effectively to achieve specific objectives
Tømte and Smedsrud (2023)	Frontiers in Education	adoption of technology in managing organizational changes, aligning resources, and cultivating a culture of innovation
Cheng, E. C. K., & Wang, T. (2023).	*Computers and Education: Artificial Intelligence*	Digital leadership enhances and fosters digital teaching and learning with principals playing a crucial role A principal's attitude and knowledge of technology influence teaching effectiveness and teachers' ability to integrate technology
Kilcoyne, A. (2024).	*Computers in the Schools*	Technology-related leadership duties include three broad types of activities. Firstly, principals are tasked with setting directions, which entails developing a joint vision, creating shared meaning, developing expectations and communicating goals within the school community. Secondly, they must prioritize fostering professional development at the individual and collective levels while leading by example through their actions and practices. Lastly, school principals are called upon to develop the organization by allocating resources, adapting structures and regulations, cultivating a joint culture of innovation, and actively engaging with external stakeholders.

Willermark, S., Gellerstedt, M., & Nilsson, P. (2024).	*School Leadership & Management*	Digital transformation constitutes a multifaceted process, where an organisation adopts digital technology to create new or modify existing products, services, and operations.
Tømte (2024)	Computers and Education	School leaders would also need to cope with digital infrastructure, including adequate hardware and software, privacy, and information security
Ruloff, M., & Petko, D. (2025).	*International Journal of Leadership in Education*	The 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.

Taken together, these definitions highlight that digital competence encompasses not only technical but also strategic and ethical dimensions essential for school leadership in the digital era. Scholars conceptualize digital competence as a multidimensional construct. While some focus on basic digital literacy and tool usage [15], others emphasize leadership and systemic management roles. A growing strand also incorporates ethical awareness and an innovation mindset as essential components.

2.3.2. Dimensions and Practical Applications of Digital Competences

The practical application of digital competences in school leadership is multifaceted, encompassing administrative, pedagogical, and technological responsibilities that are crucial for the successful integration of digital tools in education. Several frameworks and studies provide insight into the key manifestations of digital leadership:

- Leadership Activities: Kilcoyne (2024) identifies three main leadership activities related to technology integration [16]: Setting Directions; Professional Development; Organizational Development
- Dual Dimensions of Leadership: Tømte (2024) outlines two critical dimensions of leadership administrative and pedagogical both of which require digital competences. On the administrative side, principals must oversee the management of digital infrastructure, ensure privacy and security, while also allocate resources effectively to support technological initiatives. On the pedagogical side, principals should foster innovative teaching and learning practices, integrating digital tools to enhance educational experiences (Tømte, 2024) [5]. These two dimensions underline the complexity of leadership in the digital age, requiring school leaders to balance technological management with fostering pedagogical innovation.
- Skill Frameworks: The ISTE Standards for Education Leaders [16] provide a comprehensive framework for evaluating the digital competences of school leaders. These standards emphasize key competences such as equity advocacy, visionary planning, empowering leadership, systems design, and continuous professional learning. These competences underscore the importance of principals being not only strategic planners but also active participants in driving digital transformation within their schools [16]. In addition, Tømte and Smedsrud (2023) [17] emphasize the need for school leaders to promote digital transformation through governance and the alignment of digital initiatives with school policies and goals.

In line with these frameworks, several studies have explored the relationship between school leaders' digital leadership and teachers' digital competences. Abdullah and Kadir (2023) found a strong correlation between principals' digital leadership and teachers' digital competences in secondary schools, highlighting the importance of principals' role in fostering a culture of digital literacy [2]. Similarly, Abdul Razzak (2015) [14] examined the challenges faced by school leadership in integrating ICT in schools, emphasizing the need for principals to develop both the technical and managerial competences required for successful technology adoption in education.

Furthermore, the role of school leaders in promoting digital competences has become especially prominent during crises such as the COVID-19 pandemic. Tanghal and Tanghal (2022) examined how school heads' digital competences were tested amid the pandemic, showing that effective digital leadership was crucial in ensuring continuity of education during school closures [3]. Their study highlights the dynamic nature of digital leadership, which requires continuous adaptation to emerging challenges and technologies.

Digital competences in school leadership are essential for navigating the complexities of the digital age. Effective school leaders must demonstrate a blend of administrative, pedagogical, and technological competences, fostering an environment that promotes both digital literacy and innovation. This requires a strategic approach to professional development, resource management, and organizational transformation, ensuring that technology integration aligns with the broader educational goals of the school. The frameworks and studies discussed provide valuable insights into the essential roles and responsibilities of school leaders in promoting digital competences, particularly in the context of ongoing digital transformations in education.

These leadership roles—strategic, pedagogical, and organizational - underscore the complex and evolving nature of digital competences. A principal's ability to balance these roles effectively appears to be a critical success factor in driving meaningful digital transformation. Overall, these manifestations suggest that effective school leadership requires an integrated approach to resource management, staff development, and vision-building.

2.3.3. Impact and Educational Outcomes of Digital Competences

2.3.3.1. Impact on teaching, learning, and institutional performance

The digital competence of school principals is a critical determinant of teaching effectiveness, students' learning outcomes, and overall school performance. Recent research underscores the essential role of digital leadership in shaping these educational outcomes, highlighting key areas of influence:

- Transformational Leadership: Ruloff and Petko (2021) [18] assert that transformational leadership is linked to the swift integration of digital technologies in schools. Principals who adopt this leadership style focus on achieving educational goals and aligning digital tools with pedagogical strategies, rather than solely on tool adoption. This proactive leadership fosters an environment where technological advancements are seamlessly integrated with teaching practices, driving forward educational innovation.
- Teacher Empowerment and Effectiveness: Cheng and Wang (2023) [19] emphasize that a principal's digital leadership has a direct impact on teachers' ability to incorporate technology into their pedagogy. By fostering a culture of innovation, this leadership empowers educators to use digital tools effectively, leading to enhanced teaching practices and a more engaging learning environment for students. This influence is particularly important in contexts where principals are tasked with eliminating barriers for teachers to incorporate new technologies, as seen in the case of Hong Kong's educational landscape [19].
- Innovative Behavior: Sary et al. (2023) identify a positive correlation between the digital competence of school leaders and the fostering of innovative work behaviors [15]. Principals who exhibit strong digital skills are more likely to inspire and support innovative practices, driving systemic improvements within schools. The capacity to lead digital transformation is essential in creating an environment where continuous innovation is encouraged and embedded in the school's operations and culture.
- ICT Integration and Digital Literacy: Abdul Razzak (2015) explored the challenges faced by school leaders in Bahrain as they work to promote ICT integration in education [14]. The study reveals that principals must overcome several barriers, including lack of resources and insufficient professional development, to effectively lead the digital transformation of their schools. Similarly,

Bastos and Oliveira (2015) highlight the importance of digital literacy for school leaders, pointing to its direct impact on the success of digital initiatives within schools [1].

- Addressing Barriers to Digital Transformation: Digital poverty remains a significant barrier to digital education, even in a country with advanced technological infrastructure. The leadership of principals in these contexts is critical for overcoming such barriers and ensuring that digital tools are integrated into the teaching and learning process, particularly in disadvantaged schools.
- Digital Leadership in Crisis Contexts: The COVID-19 crisis has underscored the need for school leaders to possess strong digital competences. Tanghal and Tanghal (2022) discussed how school heads in the Philippines adapted their leadership styles to ensure the continuity of education during the pandemic [3]. This adaptive leadership highlights the growing need for principals to be digitally literate, enabling them to manage online learning environments and support teachers and students in navigating digital tools.

The digital competence of school principals is integral to fostering a culture of innovation, empowering teachers, and ensuring effective digital integration in schools. Principals who exhibit strong digital leadership not only enhance teaching effectiveness but also lead the charge in creating schools that are resilient, forward-thinking, and capable of thriving in an increasingly digital world.

Digital competence is a key driver of educational outcomes, influencing both student achievement and institutional performance:

- Enhanced Learning Environments: Principals with strong digital skills can create enriched learning environments that integrate technology effectively. This approach supports diverse learning needs and fosters a culture of continuous improvement.
- Improved Teacher Support: Digital competence enables principals to provide targeted support to teachers, facilitating professional development and enhancing instructional practices. This support is particularly crucial in adapting to digital transformations and leveraging new pedagogical opportunities.
- Strategic Innovation: Digital competence equips principals with the tools to lead strategic innovations, aligning technological advancements with educational goals. This alignment ensures that digital tools are used not merely as add-ons but as integral components of teaching and learning processes.

2.3.3.2. Factors affecting Digital Competence development

The development and application of digital competence among school principals are shaped by various factors, ranging from institutional support to individual attitudes. Understanding these factors is crucial for designing effective interventions:

- Institutional and Cultural Context: Carpenter et al. (2024) highlight the role of institutional support, cultural attitudes towards technology, and resource availability in shaping digital competence. Schools with a strong culture of innovation and collaboration are better positioned to foster digital leadership [20].
- Barriers to ICT Integration: Studies by Lorenz et al. (2016) [21] identify several obstacles to ICT integration, including inadequate training, insufficient resources, poor internet connectivity, and resistance to change. Addressing these barriers requires systemic interventions at both policy and institutional levels.
- Policy and Governance: Pettersson (2018) underscores the importance of aligning digital competence initiatives with educational policies and systemic goals. Effective governance structures provide the necessary framework for implementing digital transformations sustainably [22].
- Professional Development: Abdul Razzak (2015) emphasizes the need for continuous professional training to address gaps in digital literacy and leadership skills. Tailored training

programs that focus on practical applications and strategic planning can significantly enhance principals' digital competences [14].

- Technological Infrastructure: The availability and quality of technological resources play a critical role in enabling digital competences. Tømte and Smedsrud (2023) stress the importance of robust infrastructure, including hardware, software, and secure networks, in supporting effective technology integration [5].

It becomes evident that the development of digital competences is context-dependent, shaped by both systemic structures and individual readiness. Thus, capacity-building must be aligned with these contextual realities to ensure effective implementation. Multiple studies confirm that school leaders' digital competence is a key enabler of educational innovation. It supports teachers in integrating ICT, enhances student learning experiences, and aligns institutional vision with technology use [18], [19]. This relationship becomes even more critical in times of crisis such as the COVID-19 pandemic [3].

3. Conclusions

In conclusion, this review highlights the indispensable role of digital competences in strengthening school leadership and improving institutional effectiveness. Despite the progress made in integrating digital skills into leadership practices, the identified gaps signal the need for continued efforts to better equip school leaders with the necessary tools and knowledge to thrive in the digital era. Future research should focus on refining frameworks for digital competences and exploring innovative approaches to training and professional development for principals. Additionally, policies must evolve to support the integration of digital technologies in educational leadership, ensuring that digital transformation aligns with broader educational goals. Collaboration between researchers, policymakers, and educational practitioners is crucial to creating an environment where digital competences can flourish, ultimately empowering school leaders to navigate challenges and drive meaningful change in their institutions. As we move forward, the dynamic nature of digital advancements demands an ongoing commitment to reimagining leadership practices in ways that enhance learning outcomes and institutional success in the digital age.

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