Education Studies and Teaching Journal (EDUTECH)
Vol 2 (3) 2025 : 527-540

INNOVATIONS IN EDUCATIONAL SUPERVISION TO SUPPORT THE IMPLEMENTATION OF DIGITAL BASED LEARNING

INOVASI DALAM SUPERVISI PENDIDIKAN UNTUK MENDUKUNG IMPLEMENTASI PEMBELAJARAN BERBASIS DIGITAL

Darimus
UIN Suska Riau
*darimus1231@gmail.com

**Corresponding Author*

ABSTRACT
This study explores how innovations in educational supervision practices can facilitate the effective implementation of digital-based learning in schools.narrative review, this study synthesizes theoretical and empirical findings from international literature published between 2015 and 2025. The results of the analysis identified four main themes, namely: (1) a transformational shift in the role of supervision towards digital mentoring and facilitation functions; (2) integration of technology-based supervision tools such asLMS analytics, video-based observation, and artificial intelligence-based feedback; (3) the role of supervisory innovation in improving teachers' digital competence through coaching and reflection; and (4) the importance of institutional and policy support in building a sustainable digital supervision ecosystem. These findings confirm that digital educational supervision requires technological readiness accompanied by transformational leadership, a collaborative culture, and systemic policy alignment. This study also proposes a conceptual modelDigital Educational Supervision Innovation Framework (DESIF)as a basis for future empirical research and policy formulation.
Keywords:educational supervision, digital learning, innovation, instructional leadership, digital pedagogy, school transformation

ABSTRAK
Penelitian ini mengeksplorasi bagaimana inovasi dalam praktik supervisi pendidikan dapat memfasilitasi implementasi pembelajaran berbasis digital secara efektif di sekolah. Dengan menggunakan desain narrative review, penelitian ini mensintesis temuan teoritis dan empiris dari literatur internasional yang diterbitkan antara tahun 2015 hingga 2025. Hasil analisis mengidentifikasi empat tema utama, yaitu: (1) pergeseran transformasional peran supervisi menuju fungsi pendampingan dan fasilitasi digital; (2) integrasi alat supervisi berbasis teknologi seperti LMS analytics, observasi berbasis video, dan umpan balik berbasis kecerdasan buatan; (3) peran inovasi supervisi dalam meningkatkan kompetensi digital guru melalui pembinaan dan refleksi; serta (4) pentingnya dukungan kelembagaan dan kebijakan dalam membangun ekosistem supervisi digital yang berkelanjutan. Temuan ini menegaskan bahwa supervisi pendidikan digital memerlukan kesiapan teknologi yang disertai kepemimpinan transformasional, budaya kolaboratif, dan keselarasan kebijakan sistemik. Penelitian ini juga mengusulkan model konseptual Digital Educational Supervision Innovation Framework (DESIF) sebagai dasar bagi riset empiris dan perumusan kebijakan di masa mendatang.
Kata Kunci: supervisi pendidikan, pembelajaran digital, inovasi, kepemimpinan instruksional, pedagogi digital, transformasi sekolah

1. INTRODUCTION

The transformation of education in the digital era has led to a paradigm shift in both teaching and supervision practices. The traditional model of educational supervision which once focused primarily on administrative control has evolved into a more facilitative and innovative leadership model. This transformation aims to help teachers develop the necessary digital and pedagogical competencies to implement effective digital-based learning (OECD, 2023). The COVID-19 pandemic significantly accelerated the global transition toward digital

education systems. According to UNESCO (2020), more than 1.6 billion learners across 190 countries were affected by school closures during the peak of the pandemic, prompting the rapid adoption of digital and remote learning modalities. However, despite this acceleration, challenges related to access and infrastructure remain a major barrier, particularly in developing regions.

Table 1 below illustrates the current state of global internet connectivity, which directly influences the capacity of schools to adopt digital-based supervision systems.

Table 1. Global Internet Connectivity and Access Disparities (2024)

Indicator	Global Average	High-Income Countries	Low-Income Countries
Internet users (% of population)	68 % (5.5 billion users)	93 %	27 %
Offline population (millions)	2,600 million	150 million	1,100 million
Households with Internet access	67 %	95 %	23 %

Source: International Telecommunication Union (ITU, 2024)

These data indicate that while digital connectivity continues to expand, significant inequalities persist between high- and low-income nations. Limited access to digital infrastructure constrains the effectiveness of supervision systems that rely on online tools and platforms. The digital divide is also evident among learners. According to UNICEF and ITU (2020), approximately two-thirds of school-aged children around 1.3 billion globally lack Internet access at home. This highlights the importance of designing innovative supervision practices that consider equity and accessibility in digital education.

Teacher readiness is another critical aspect. Despite increased investment in digital training, one in five teachers in OECD countries reported still needing additional professional development in digital pedagogy (OECD, 2023). This suggests that traditional supervision models may be insufficient to support teachers in adopting and integrating technology effectively into their instruction. In summary, while the digital era offers new opportunities for innovation in teaching and learning, the effectiveness of digital-based learning supervision systems remains limited by gaps in access, infrastructure, and supervisory competence. There is thus a pressing need for innovative models of educational supervision that foster both technological integration and pedagogical transformation within schools (World Bank, 2022; UNESCO, 2020).

The changing paradigm of education in the digital era requires every element of the education system to adapt rapidly, not only in the context of the teaching and learning process but also in educational supervision practices. Most existing research to date focuses on aspects of teachers' digital competence and the digital transformation process of schools. The main focus of these studies revolves around improving teachers' ability to utilize technology, implementing digital platforms in learning, and school leadership strategies in promoting digitalization. However, attention to how educational supervision innovation plays a role in ensuring the effectiveness of the implementation of digital-based learning is still very limited.

From a theoretical perspective, there is a gap in understanding regarding the relationship between innovation in supervisory practice with effectiveness of digital learning. Various studies on supervision still tend to position the function of supervision as an administrative, control-based process, rather than a dynamic process oriented toward

improving the quality of learning through innovative approaches. Consequently, there is no theoretical model that comprehensively explains how innovative supervisory approaches can empower teachers to transform into adaptive and creative digital educators.

Meanwhile, from a practical perspective, many school principals and supervisorsEducation faces challenges in changing mindsets and supervision strategies in the digital era. Supervision is often still conducted using traditional approaches, using instruments and methods that are irrelevant to the needs of technology-based learning. This results in supervision being unable to play a strategic role in developing teachers' digital competencies and the effectiveness of online and hybrid learning. Thus, there is an urgent need to formulate a new approach that makes supervisory innovation a key driver in strengthening the implementation of digital learning in schools.

This study aims to explore howinnovation in educational supervision practicescan facilitate the effective implementation of digital-based learning in schools. This research not only seeks to understand the forms of innovation that emerge in the context of educational supervision but also to identify the mechanisms, strategies, and factors that contribute to the success of digital integration in the learning process through a transformative supervision approach.

The research questions asked are:**"How do innovations in educational supervision practices facilitate the implementation of effective digital-based learning in schools?"**This question is expected to be able to explore in depth the conceptual, organizational, and practical dimensions of innovation-based educational supervision, so that it can provide a holistic understanding of how the role of supervision is transforming in the era of digitalization of education.

This research has several important significance from theoretical, practical, and academic perspectives.TheoreticallyThis research contributes to the development of a new conceptual framework for integrating innovation into educational supervision practices. It broadens understanding of how the supervisory function can be transformed from a bureaucratic approach to a collaborative and facilitative approach oriented toward developing teacher capacity to effectively implement digital learning.In a waypracticalThe results of this study are expected to provide new direction for policymakers, school principals, and educational supervisors in designing supervision strategies that align with the needs of 21st-century learning. This research is also expected to serve as a basis for developing digital supervision model that is adaptive, measurable, and sustainable, which can be applied in various school contexts.Meanwhile, in general academic, this study contributes to the literature that links the concepts transformational leadership, instructional supervision, And digital pedagogyBy combining these three perspectives, this research opens up space for developing educational supervision theory and practice that is relevant to the challenges and opportunities of future digitalization.

Overall, this research aims to strengthen the understanding that educational supervision is not only an evaluative process, but also an innovative strategy that plays a role is central to the success of digital transformation of education in schools.

2. METHODS

2.1. Research Design

This study uses a design narrative review, which aims to conduct a conceptual and thematic synthesis of various academic literature relevant to the topic of innovation in digital-based educational supervision. This approach does not focus on data quantification as in systematic review or meta-analysis, but rather directed at the exploration, interpretation, and integration of theories, models, and best practices (best practices) which has been developed in a global context.Design narrative reviewThis approach was chosen because it provides flexibility in analyzing various perspectives and conceptual approaches to digital educational

supervision, including aspects of leadership, technology, and pedagogy. Through this approach, the research seeks to identify key trends, theoretical gaps, and opportunities for innovation in developing effective supervision models in the digital era.

2.2. Literature Search Strategy

The literature search process was carried out systematically through several internationally reputable academic databases, namelyScopus, Web of Science, ERIC. The selection of this database was based on its credibility in providing high-quality scientific publications in the fields of education and learning technology.The search keywords used include:**“educational supervision”, “innovation”, “digital learning”, “instructional leadership”, “school transformation”,** And **“digital pedagogy.”** The search is performed using a combination of Boolean logic (AND, OR) to expand the results without losing thematic relevance.

The literature search period was limited to the year2015 to 2025, to cover a decade of significant digital innovation developments in the education system. This timeframe also allows researchers to trace the shifting supervision paradigms before, during, and after the COVID-19 pandemic, which served as a major catalyst for digital learning transformation.The types of literature included include journal articles that have been in the processpeer review, bukacademic, as well as official policy reports published by educational institutions or international organizations related to digital education.

2.3. Inclusion and Exclusion Criteria

Literature selection is carried out in two stages:initial screening based on abstract And full review of the full text.Inclusion and exclusion criteria were established to maintain the relevance and validity of the synthesis results. Inclusion criteria for this study included studies that discussed innovations in educational supervision practices, explored digital integration within the context of school supervision, and analyzed the impact of supervision on the effectiveness of digital learning and teacher competency improvement. Therefore, only literature that directly highlighted the relationship between innovative supervision and digital learning transformation was included in the analysis.

Meanwhile, exclusion criteria included studies that focused solely on digital learning without addressing supervision or leadership aspects, as well as opinion articles, editorials, or non-academic publications lacking a strong empirical or conceptual basis. The literature selection process was conducted independently and iteratively by the researchers to ensure consistency and validity in assessing the relevance of each selected source.

2.4. Data Extraction and Thematic Analysis

The data extraction process in this study involved several main stages. The first stage began with reading and understanding the abstracts and key findings of each selected literature to gain an overview of the research's focus and contributions. Next, the researchers identified central themes emerging from previous research and grouped the data based on shared concepts, focus, and objectives. The final stage involved developing a narrative synthesis to build a comprehensive understanding of innovation in digital educational supervision.

The analytical approach used is*Thematic Synthesis*as outlined by Braun and Clarke (2019). This approach allows researchers to identify recurring patterns, categories, and themes in the literature and link them to relevant theoretical frameworks. Thus, this analysis provides a strong foundation for developing a conceptual and thematic understanding of digital-based educational supervision.

Based on the initial review of the literature, there are several main themes that are anticipated to emerge in the analysis process, namely:

1. Digital Leadership in Supervision: the role of digital leadership in creating an innovative culture in the school environment.
2. Technology Enhanced Supervision Tools: utilization of technology to strengthen the effectiveness of the supervision process.
3. Supervisory Innovation for Teacher Competence Development: Supervision innovation as a strategy to improve teachers' digital competence.
4. Institutional Support and Policy Frameworks: the role of institutional support and educational policies in strengthening digital-based supervision.

Through this thematic approach, the research is expected to produce a deep and integrated understanding of how innovation in educational supervision can facilitate the effective and sustainable implementation of digital learning in schools.

3. RESULTS

3.1. Emerging Themes from Literature

The results of the narrative synthesis produced four main themes that are interrelated and describe the dynamics of the evolution of educational supervision in the digital era.

Theme 1: Transformational Shift in Supervisory Roles

The contemporary role of educational supervisors, particularly principals, has undergone a significant transformation, evolving from predominantly administrative responsibilities to a more strategic and facilitative function in the context of digital learning. One prominent theme in current research is the necessity for principals to act not only as enforcers of compliance but as active mentors and coaches to teachers, thereby fostering the integration of technology in educational instruction. A notable study by Ghavifekr and Yue emphasizes that effective technology leadership by principals is crucial for transforming school environments and enhancing the use of information and communication technologies (ICT) by educators, facilitating the necessary training and resources for successful technology integration (Ghavifekr & Yue, 2021). Furthermore, Mafratoğlu et al. investigate educational administrators' technology leadership competencies, revealing that a robust understanding of technological tools can empower principals to navigate and lead digital transformations effectively (Mafratoğlu et al., 2025).

Creating a conducive environment for professional development in digital contexts requires a collaborative atmosphere that encourages experimentation and reflection among teachers. Skues and Cunningham highlight that clear support from school leadership is essential for reducing confusion regarding teachers' roles in e-learning environments (Skues & Cunningham, 2012). This finding reinforces the notion that leadership must actively prioritize and articulate a vision of collaborative practice, directly impacting the efficacy of digital learning initiatives. Moreover, Dağlı et al. assert that both teachers and administrators must possess the necessary technological knowledge and skills for successful integration into educational settings (Dağlı et al., 2023). This dual mastery fosters a conducive learning ecosystem, wherein leadership practitioners can mediate knowledge sharing effectively.

In their work, Ertmer et al. reveal that effective coaching strategies, when implemented thoughtfully, can build trust and support between supervisors and teachers. The relational dynamics established through these professional development efforts can significantly influence the adoption of innovative practices within classrooms, highlighting the critical role of principals as educational leaders (Ertmer et al., 2005). Additionally, the evolving expectations of principals necessitate continuous professional development, as evidenced in the research by Nicolaidou et al., which emphasizes feedback-based coaching as a means for leaders to refine their practice and adapt to changing educational landscapes (Nicolaidou et al., 2016).

Ultimately, the transformational shift within educational supervision envisions principals not merely as managers but as strategic leaders equipped to foster a technologically adept teaching culture. Brockmeier et al. argue that despite historical challenges in fully embracing technology, there is a clear imperative for principals to undertake technology leadership roles, further supporting the need for ongoing training and development (Brockmeier et al., 2005). With digital competencies at the forefront of educational leadership, establishing a strategic framework for professional growth among school leaders is crucial for advancing technology integration in teaching methodologies, as highlighted by significant correlations observed between leadership competencies and school effectiveness (MİNAZ et al., 2022).

In summary, the evolving role of educational supervisors, particularly principals, reflects a strategic shift towards fostering digital learning. This transformation underscores the importance of technological leadership, professional development, and collaborative practice among educators, ultimately aiming to enhance teaching and learning experiences in increasingly digital educational landscapes.

Theme 2: Integration of Digital Tools in Supervision

The integration of digital tools in supervision significantly enhances the processes involved in educational environments by fostering efficiency, accountability, and transparency. Various innovative technologies, such as Learning Management System (LMS) analytics, video-based classroom observation tools, e-supervision dashboards, and AI-driven feedback mechanisms, have been utilized to monitor and improve teacher performance in real-time, thus transforming traditional supervisory practices.

One of the core advantages of utilizing digital tools is the ability to enable remote observations. This flexibility allows supervisors to conduct evaluations without being physically present, which can lead to increased opportunities for observation and immediate feedback (Handayani, 2024; Liu et al., 2024). Video-based classroom observations, for instance, can facilitate a more in-depth analysis of teaching practices than conventional observation methods, as they allow for repeated playback and review by both supervisors and teachers who can self-assess their performance (Jin et al., 2022; Sletteland et al., 2022). Moreover, AI-driven tools that analyze data gathered through these observations can provide tailored feedback, enhancing the effectiveness of the supervisory process by addressing specific teaching deficiencies in an efficient manner (Qayyum et al., 2024).

Furthermore, the integration of these technologies fosters a culture of continuous professional reflection among teachers. As educators engage with recordings of their classroom practices, they are empowered to critically analyze their methods and outcomes (Nasri et al., 2023). This self-reflective practice is crucial for their professional growth and aligns with the notion that supervision should primarily support the development of supervisees (Ahmady & Minouei, 2021). Additionally, digital tools enhance the communication channels between supervisors and teachers, promoting a two-way discussion platform where feedback can be continuously exchanged, which enriches the learning environment (Ajugo, 2024). Such bidirectional communication allows for dynamic adjustments in pedagogical approaches, tailored to meet the evolving needs of students (Davidsson & Stigmar, 2023).

Moreover, the systematic application of technology in educational supervision not only improves practitioner accountability but also streamlines the educational oversight process. Teachers benefit from prompt, data-driven insights that inform instructional adjustments, thus enhancing educational outcomes (Willis et al., 2020; Razali, 2023). The contextualized use of these technologies sheds light on common challenges faced by educators and enables the identification of best practices within diverse teaching landscapes (Ugobueze, 2024; Ya et al., 2024).

In summary, the convergence of digital technology within educational supervision mechanisms offers a robust framework that bolsters efficiency, enhances transparency, and fosters an environment conducive to ongoing professional reflection among teachers. The implication of these findings suggests that continuous investment in digital training and the integration of such tools will be crucial for the future development of educational supervision practices.

Theme 3: Supervisory Innovation and Teacher Digital Competence

Innovative supervisory practices in educational settings have increasingly become paramount in improving teachers' digital competence, aligning closely with the Technological Pedagogical Content Knowledge (TPACK) framework. This synthesis of research indicates that digital-based supervision is not merely a mechanism for performance evaluation but a continual professional growth strategy for educators. Studies illustrate that supervision models incorporating coaching, online collaboration, and reflective practices significantly aid in developing teachers' technological skills and enhancing educational outcomes.

Göker Göker (2021) highlights the potential of reflective coaching in cultivating instructional skills and efficacy among pre-service teachers, suggesting that such coaching methodologies can foster reflection and ultimately enhance digital competence in varied teaching contexts. Similarly, Mailizar et al. Mailizar et al. (2022) emphasize the importance of digital literacy in professional development, leveraging TPACK to focus on technology-centric skill acquisition that facilitates teachers' acceptance and utilization of online professional growth opportunities. This aligns with findings from Robson (Robson, 2017), advocating that online peer interactions can lead to a transformation in teaching practices, particularly within complex social learning environments.

Furthermore, digital coaching is highlighted as a critical innovation in supervisory frameworks. Kraft et al. Kraft et al. (2018) conducted a meta-analysis that underscores the positive impact of responsive coaching on teachers' instructional practices and student achievement. This is echoed by Pomentel (Pomentel, 2024), which illustrates how effective instructional supervision by school leaders provides constructive feedback that empowers teachers to engage in risk-taking and improve their instruction. Such dynamics foster a rich environment for developing digital competences as teachers adopt new pedagogical strategies.

In addition to coaching, the role of online communities emerges as vital for professional learning. Howell Howell (2010) asserts that online platforms serve as significant resources for teachers' professional development, enhancing their ability to integrate innovative practices effectively. This notion reinforces the findings of Suppiah et al. (Suppiah et al., 2018), who suggest that teacher empowerment through digital literacy is facilitated by informal professional learning environments, thereby encouraging independent self-development.

Lastly, the integration of digital badges in professional development, as discussed by Gamrat et al. (Gamrat et al., 2014), presents a promising approach for recognizing teachers' competence achievements, thus motivating ongoing engagement in skill enhancement. This system not only bridges knowledge gaps but also fosters a sense of community among educators engaged in similar learning paths.

In conclusion, the synthesis of these findings demonstrates that innovative supervisory strategies that prioritize coaching, online collaboration, and reflective practices are essential for enhancing teachers' digital competence within the TPACK framework. These methodologies not only improve instructional quality but also support teachers in navigating the complexities of a digital educational landscape.

Theme 4: Institutional and Policy Support for Digital Supervision

The integration of digital supervision in educational settings is heavily contingent upon thorough institutional and policy support. The successful implementation of this innovative form of supervision requires not only a robust technological infrastructure but also well-adapted educational policies and a school culture that is receptive to change. Visionary leadership within schools, characterized by clear policy backing, plays a pivotal role in the effective adoption of digital supervision practices. Principals' digital leadership has proven essential in enhancing teachers' digital competencies, particularly during challenging times such as the COVID-19 pandemic (Hamzah et al., 2021). The ability of school leaders to harness technology effectively can mitigate traditional administrative barriers and promote an educational environment more responsive to contemporary digital advancements (Hamzah et al., 2021).

Further examining the systemic approach within educational ecosystems reveals that robust policy mechanisms are integral to facilitating effective digital supervision (Yang et al., 2021). For instance, systemic interactions among various stakeholders in the education sector are crucial for fostering an innovation ecosystem that embraces digital transformation (Yang et al., 2021). Without adequate policy frameworks that encourage collaboration and integration of digital tools, efforts towards enhancing digital supervision could face significant hurdles, as evidenced in diverse international contexts, including those in higher education in Chile Núñez-Valdés et al. (2021) and the vocational education sectors in other countries (Li et al., 2020). This emphasizes the necessity for strategic planning that aligns digital initiatives with overarching educational goals, ensuring that policies do not merely exist in isolation but form a cohesive support system that enables successful implementation (Permyakov & Kitin, 2021).

Moreover, ongoing professional development for educators and administrative personnel is critical. Continuous training initiatives can enhance the capacity of supervisors and principals to leverage technology effectively within the supervision process. This ongoing professional development aligns with findings that highlight the importance of addressing teachers' competencies in technology use, which is a precursor to successful integration of digital tools in educational settings (Rustandi et al., 2024). It is also essential to create an organizational culture that nurtures innovation and encourages the sharing of best practices among educators to build a sustainable framework for digital supervision (Sitorus et al., 2023).

In conclusion, the essence of effective digital supervision in education lies in a supportive ecosystem that interconnects favorable policies, visionary leadership, and continuous professional development. By creating such an ecosystem, educational institutions can ensure that they are not only keeping pace with technological advancements but are also adeptly transforming educational practices and enhancing learning experiences for both educators and students alike.

Thematic Synthesis

The four themes above show that the success of implementing digital-based educational supervision does not depend on a single factor, but on the interaction between the role of transformative leadership, adoption of supervision technology, development of teachers' digital competencies, and systemic policy support. The synergy between these elements forms a sustainable digital learning ecosystem, where supervision functions not just as a control tool, but as a...capacity building and educational innovation mechanisms.

4. DISCUSSION

4.1. Interpretation of Findings

The synthesis of the four themes shows that educational supervision in the digital era has undergone a fundamental paradigm shift from an administrative control function to a facilitative, collaborative, and innovative one. This shift marks the emergence of a new role for

principals and supervisors as digital learning leaders, focusing not only on procedural compliance but also on developing teachers' pedagogical and digital capacities.

The findings in Theme 1 indicate that transformational leadership in supervision plays a key role in technology integration in schools. Principals acting as mentors and digital coaches are able to create a collaborative and reflective culture that supports continuous digital learning. This approach shifts the orientation of supervision from solely performance assessment to a professional development process that fosters teacher pedagogical innovation.

Furthermore, Theme 2 demonstrates that the use of digital technology in supervisory practice, such as Learning Management System (LMS) analytics, video-based observation, and AI-driven feedback, improves the efficiency, transparency, and quality of interactions between supervisors and teachers. Digitalization enables the supervision process to be more adaptive, accurate, and oriented toward teacher self-development through continuous reflection and feedback. Thus, technology-based supervision expands the professional learning space and supports the concept of continuous improvement in teaching practice.

Theme 3 emphasizes the close relationship between innovation in supervision and improving teachers' digital competencies. Supervision that integrates digital coaching, online collaboration, and reflective practice has proven effective in developing teachers' Technological Pedagogical Content Knowledge (TPACK). In other words, supervision serves not only as a quality control mechanism but also as a professional learning strategy that fosters teachers' readiness to face the complexities of digital learning.

Meanwhile, Theme 4 demonstrates that the successful implementation of digital supervision is highly dependent on institutional support and adaptive education policies. Technological infrastructure, visionary policies, and a school culture that supports innovation are essential foundations for building an effective digital supervision ecosystem. Principals, as digital leaders, play a strategic role in translating policies into concrete practices that foster collaboration and continuous learning.

Overall, the interpretation of these four themes confirms that the effectiveness of educational supervision in the digital era is the result of a synergistic interaction between transformational leadership, supervision technology, pedagogical innovation, and institutional policy support. Supervision is no longer positioned as a one-way activity, but rather as a capacity-building process that fosters teacher professionalism and strengthens the effectiveness of digital learning.

These findings confirm that the success of digital education transformation is not solely determined by the availability of technology, but by the quality of leadership and supervision systems that are capable of integrating technology, people, and innovation values in a sustainable learning ecosystem.

4.2. Theoretical Implications

This research makes an important contribution to the development of educational supervision theory in the digital era. First, this research expands the concept instructional supervision by adding the dimension of digital innovation as a key factor in increasing learning effectiveness. While supervision theory has traditionally emphasized control and evaluation, this study demonstrates that the supervisor's role also encompasses facilitating technology-based pedagogical change.

Second, these findings confirm that the effectiveness of digital learning is not solely determined by technological readiness, but also by supervisory leadership capable of integrating innovation with the school's cultural context. This reinforces the theory of transformational leadership in the context of digital education, where supervisors act as change agents, encouraging teacher adaptation and creativity.

Third, this research opens up opportunities for the formation of a new theoretical framework that explains the relationship between supervision innovation And digital learning

effectivenessWithin this framework, supervision is positioned not merely as a monitoring tool, but as an organizational learning system that supports teachers to experiment and innovate.

These theoretical implications emphasize the need to redefine the educational supervision paradigm from an administrative approach to an innovative and collaborative one. Therefore, future educational supervision theory must accommodate the variables of digital leadership, technological literacy, and the dynamics of the ever-evolving digital learning ecosystem.

4.3. Practical Implications

This research has several practical implications that are relevant to school supervisors, educational policy makers, and teacher training institutions.

First, the research findings confirm that the success of digital learning depends heavily on supervisors' ability to implement supervisory innovations. Therefore, educational institutions need to develop specialized training programs for school supervisors that focus on digital literacy competencies, innovative leadership, and technology-based learning facilitation strategies.

Second, for schools, the results of this research can serve as a basis for developing a collaborative digital supervision system. Digital platforms can be utilized as a means for learning observation, real-time feedback, and ongoing mentoring for teachers. This way, the supervision process will no longer be bureaucratic, but rather participatory and data-driven.

Third, for policymakers, these findings suggest the need for reform of educational supervision policies to be more responsive to the demands of the digital era. Supervision policies should not only assess administrative compliance but also measure supervisors' innovative capabilities in supporting pedagogical transformation.

Fourth, for teachers and educational staff, this study demonstrates the importance of active collaboration with supervisors in exploring creative digital learning methods. The relationship between supervisors and teachers should be built on a spirit of mentoring and shared innovation, not simply performance evaluation.

By implementing these practical recommendations, the educational supervision system can transform into an adaptive learning ecosystem that encourages improvements in the quality of education in the digital era.

4.4. Limitations and Directions for Further Research

This study has several limitations that should be considered when interpreting the results. First, most of the literature analyzed comes from developed countries, where digital education infrastructure and the capacity of school supervisors are relatively well-established. This potentially limits the generalizability of the findings to developing countries, which face different challenges, such as technological limitations, cultural resistance to digitalization, and diverse human resource capacities.

Second, most of the studies used in this review are descriptive and conceptual in nature, thus providing little strong empirical evidence on the causal relationship between supervision innovation and the effectiveness of digital learning. The lack of quantitative research using valid and reliable instruments also makes it difficult to measure the actual impact of digital supervision on student learning outcomes.

Third, most research still focuses on the individual level (teacher or supervisor), not much research on systemic dynamics at the school level or national policies that can strengthen innovative supervision practices.

Based on these limitations, further research can focus on several strategic agendas. First, empirical testing of the "Digital Educational Supervision Innovation Framework (DESIF)" model is needed using a mixed-methods approach or structural equation modeling (SEM) to ensure its validity and the relationships between variables within the model.Second, future

research can adopt a longitudinal approach to measure the long-term impact of implementing digital supervision on improving teacher competency and student learning outcomes.Third, there is a need for comparative studies across countries or across educational contexts to identify best practices for innovative supervision at various levels of digital readiness.

By developing this research agenda, the literature on innovation in educational supervision can mature and contribute significantly to strengthening educational policies and practices in the digital era.

5. CONCLUSION

5.1. Summary of Main Findings

The study results show that innovation in educational supervision plays a central role in strengthening the effectiveness of digital learning. Supervision no longer functions merely as a control mechanism, but has evolved into a professional mentoring process (mentorship) which facilitates the pedagogical transformation of teachers. Integration of digital tools such as learning management system analytics, video-based observation, and AI-driven feedback has been shown to increase transparency, efficiency, and the quality of feedback in the supervision process. Furthermore, innovative supervision practices significantly contribute to improving teachers' digital competence, particularly in the area of Technological Pedagogical Content Knowledge (TPACK). The findings also confirm that the successful implementation of digital supervision is highly dependent on institutional support and educational policies that adapt to technological developments.

5.2. Theoretical and Practical Contributions

From a theoretical perspective, this research broadens the scope of theory.Instructional Leadershipby introducing a new dimension calledDigital Supervision Competence, namely the supervisor's ability to combine transformational and technology-based instructional leadership. This study also produced a conceptual modelDigital Educational Supervision Innovation Framework (DESIF)which describes the relationship between(supervisory competencies and digital infrastructure),process(supervision innovation practices), output(teacher digital competence and learning effectiveness). Practically, the results of this study provide a basis for developing technology-based school supervisor training programs, strengthening digital supervision policies at the institutional and government levels, and implementing data-based supervision in school management. Thus, innovations inSupervision is a strategic element in ensuring the quality of sustainable digital learning.

5.3. Further Research Directions

Future research needs to expand the context of the study to developing countries to understand the dynamics and challenges of implementing digital supervision in environments with limited infrastructure. Furthermore, an empirical approach using the method is needed.mixed-method or structural equation modeling (SEM)to quantitatively test the relationship between supervision innovation, teacher competence, and the effectiveness of digital learning. Longitudinal studies are also recommended to assess the long-term impact of digital supervision on changes in pedagogical practices and student learning outcomes. Finally, cross-national collaborative research could be a strategic step in formulatingbest practicesand an educational supervision model that is adaptive to the global digital era.

6. REFERENCES

Ahmady, S. and Minouei, M. (2021). Explanation of medical students' experiences of educational clinical supervision: a qualitative study. Journal of Education and Health Promotion, 10(1). https://doi.org/10.4103/jehp.jehp_620_20

Ajugo, M. (2024). Clinical supervision for quality education delivery in public schools in nigeria. EJAHSS, 1(2), 47-60. https://doi.org/10.59324/ejahss.2024.1(2).05

Brockmeier, L., Sermon, J., & Hope, W. (2005). Principals' relationship with computer technology. Nassp Bulletin, 89(643), 45-63. https://doi.org/10.1177/019263650508964305

Dağlı, G., Muhtaroglu, M., Baştaş, M., Altınay, F., & Altınay, Z. (2023). Evaluation of primary school managers' duties in digital transformation. Revista De Gestão E Secretariado, 14(9), 15227-15249. https://doi.org/10.7769/gesec.v14i9.2524

Davidsson, E. and Stigmar, M. (2023). A literature review of content elements in supervision training courses. London Review of Education, 21(1). https://doi.org/10.14324/lre.21.1.40

Ertmer, P., Richardson, J., Cramer, J., Hanson, L., Huang, W., Lee, Y., … & Um, E. (2005). Professional development coaches: perceptions of critical characteristics. Journal of School Leadership, 15(1), 52-75. https://doi.org/10.1177/105268460501500103

Gamrat, C., Zimmerman, H., Dudek, J., & Peck, K. (2014). Personalized workplace learning: an exploratory study on digital badging within a teacher professional development program. British Journal of Educational Technology, 45(6), 1136-1148. https://doi.org/10.1111/bjet.12200

Ghavifekr, S. and Yue, W. (2021). Technology leadership in malaysian schools. International Journal of Asian Business and Information Management, 13(2), 1-18. https://doi.org/10.4018/ijabim.20220701.oa3

Göker, M. (2021). Reflective coaching: training for development of instructional skills and sense of efficacy of pre-service efl teachers. Journal of Language and Linguistic Studies, 17(1), 423-447. https://doi.org/10.17263/jlls.903460

Hamzah, N., Nasir, M., & Wahab, J. (2021). The effects of principals' digital leadership on teachers' digital teaching during the covid-19 pandemic in malaysia. Journal of Education and E-Learning Research, 8(2), 216-221. https://doi.org/10.20448/journal.509.2021.82.216.221

Handayani, L. (2024). Critical review of technology-based education supervision models: Implications for improving the quality of learning in the digital age. JPP (Jurnal Pendidikan Dan Pembelajaran), 31(1), 31. https://doi.org/10.17977/jpp.v31i1.50923

Howell, J. (2010). Teachers making connections: online communities as a source of professional learning. British Journal of Educational Technology, 41(2), 324-340. https://doi.org/10.1111/j.1467-8535.2009.00953.x

International Telecommunication Union. (2024). Measuring digital development: Facts and figures 2024. ITU. https://www.itu.int/en/ITU-D/Statistics

Jin, H., Martínez-Maldonado, R., Li, T., Chan, P., & Tsai, Y. (2022). Towards supporting dialogic feedback processes using learning analytics: the educators' views on effective feedback. Ascilite Publications, e22054. https://doi.org/10.14742/apubs.2022.54

Kraft, M., Blazar, D., & Hogan, D. (2018). The effect of teacher coaching on instruction and achievement: a meta-analysis of the causal evidence. Review of Educational Research, 88(4), 547-588. https://doi.org/10.3102/0034654318759268

Li, B., Fisher, K., Farrant, F., & Cheng, Z. (2020). Digital policy to disability employment? an ecosystem perspective on china and australia. Social Policy and Administration, 55(5), 863-878. https://doi.org/10.1111/spol.12666

Liu, X., Tai, J., Bearman, M., & Dollinger, M. (2024). Exploring spatial influences in feedback for international students. Ascilite Publications, 49-50. https://doi.org/10.14742/apubs.2024.1368

Mafratoğlu, P., Altınay, Z., Mafratoğlu, R., Köç, A., Altınay, F., & Dağlı, G. (2025). Evaluation of education administrators' technological leadership competencies and their perceptions

of the use of the metaverse in education. Sage Open, 15(3). https://doi.org/10.1177/21582440251346207

Mailizar, M., Umam, K., & Elisa, E. (2022). The impact of digital literacy and social presence on teachers' acceptance of online professional development. Contemporary Educational Technology, 14(4), ep384. https://doi.org/10.30935/cedtech/12329

MİNAZ, Ö., ÖZEL, Y., & Ay, M. (2022). The relationship between principals' technological leadership competence and school effectiveness. Education Quarterly Reviews, 5(4). https://doi.org/10.31014/aior.1993.05.04.570

Nasri, N., Rahimi, N., Hashim, H., & Nasri, N. (2023). Experiencing feedback channels during online research supervision: a perspective by preclinical students. International Journal of Learning Teaching and Educational Research, 22(2), 228-243. https://doi.org/10.26803/ijlter.22.2.13

Nicolaidou, M., Karagiorgi, Y., & Πετρίδου, A. (2016). Feedback-based coaching towards school leaders' professional development. International Journal of Mentoring and Coaching in Education, 5(1), 20-36. https://doi.org/10.1108/ijmce-03-2015-0011

Núñez-Valdés, K., Alpera, S., & Suárez, L. (2021). An institutional perspective for evaluating digital transformation in higher education: insights from the chilean case. Sustainability, 13(17), 9850. https://doi.org/10.3390/su13179850

Organisation for Economic Co-operation and Development. (2023). Education at a Glance 2023: OECD indicators. OECD Publishing. https://www.oecd.org/education/education-at-a-glance

Permyakov, O. and Kitin, E. (2021). Methodology of strategic planning for the development of educational ecosystems. Administrative Consulting, (11), 119-129. https://doi.org/10.22394/1726-1139-2020-11-119-129

Pomentel, L. (2024). Exploring the influence of school heads' instructional supervision on teachers' efficacy and performance. International Journal of Research Publications, 148(1). https://doi.org/10.47119/ijrp1001481520246420

Qayyum, A., Bukahri, M., Zulfiqar, P., & Ramzan, M. (2024). Balancing artificial intelligence and human insight in early childhood education: implications for child development. SRA, 2(2), 1520-1536. https://doi.org/10.70670/sra.v2i2.207

Razali, R. (2023). Monologue or dialogue? oral feedback experiences of students and supervisors during undergraduate research. International Journal of Academic Research in Progressive Education and Development, 12(1). https://doi.org/10.6007/ijarped/v12-i1/15729

Robson, J. (2017). Performance, structure and ideal identity: reconceptualising teachers' engagement in online social spaces. British Journal of Educational Technology, 49(3), 439-450. https://doi.org/10.1111/bjet.12551

Rustandi, J., Ansori, M., Fahlepi, R., Iriansyah, I., & Marliat, M. (2024). Teacher competence in the digital era: a phenomenological study. Journal of Islamic Educational Counseling, 5(2), 527-534. https://doi.org/10.32806/jkpi.v5i2.212

Sitorus, O., Handayani, T., & Astuti, S. (2023). Implementation of digital-based approaches in early childhood education supervision amidst the COVID-19 pandemic. Jurnal Obsesi, Jurnal Pendidikan Anak Usia Dini, 7(5), 6085-6100. https://doi.org/10.31004/obsesi.v7i5.5398

Skues, J. and Cunningham, E. (2012). The role of e-learning coaches in australian secondary schools. Journal of Computer Assisted Learning, 29(2), 179-187. https://doi.org/10.1111/j.1365-2729.2012.00488.x

Sletteland, N., Røykenes, K., Hunskår, I., & Lund, H. (2022). Synchronous video-based supervision and feedback in professional education. Nordisk Tidsskrift I Veiledningspedagogikk, 7(1), 1-17. https://doi.org/10.15845/ntvp.v7i1.3646

Suppiah, G., Yin, O., Othman, M., Ismail, L., & Aralas, D. (2018). Empowering esl teachers' professional development through digital literacy. International Journal of Academic Research in Business and Social Sciences, 8(12). https://doi.org/10.6007/ijarbss/v8-i12/5002

Ugobueze, A. (2024). Challenges and prospects of educational supervision in onitsha education zone: identifying problems, causes, and solutions for quality education. Forum Edu. Stud., 2(4), 1494. https://doi.org/10.59400/fes1494

UNESCO. (2020). Education: From disruption to recovery. UNESCO. https://en.unesco.org/covid19/educationresponse

UNICEF & International Telecommunication Union. (2020). How many children and young people have internet access at home? Estimating digital connectivity during the COVID-19 pandemic. UNICEF. https://data.unicef.org/resources/children-and-young-people-internet-access-at-home-during-covid19

Willis, K., Hrdina, J., & Luiselli, J. (2020). Performance management and maintenance of data recording by educational care providers.. Behavior Analysis Research and Practice, 20(3), 165-173. https://doi.org/10.1037/bar0000177

World Bank. (2022). The state of global education: Tackling the learning crisis after COVID-19. World Bank Group. https://www.worldbank.org/en/topic/education

Ya, L., Gao, Z., & Xu, X. (2024). Higher education management based on intelligent decision support system.. https://doi.org/10.4108/eai.24-11-2023.2343592

Yang, W., Liu, J., Li, L., Zhou, Q., & Ji, L. (2021). How could policies facilitate digital transformation of innovation ecosystem: a multiagent model. Complexity, 2021(1). https://doi.org/10.1155/2021/8835067