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**TRANSFORMATION OF DIGITAL-BASED EDUCATION SUPERVISION IN
THE AI ERA****Shafia Afdhalia¹ Nur Azizah Dikamba² Rosida Kaila³**^{1,2,3}KH Abdul Chalim University¹E-mail: fana09845@gmail.com¹ azizadikamba@gmail.com²
kailulros@gmail.com³**ABSTRACT**

This study aims to analyze the transformation of digital-based educational supervision in the era of Artificial Intelligence (AI), including the shift from manual to digital supervision systems, the integration of AI in educational supervision, AI-based supervision models, and the opportunities and challenges of their implementation. The method employed in this study was a Systematic Literature Review (SLR) guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A total of 22 national and international scientific articles published between 2020 and 2025 were selected and analyzed. The findings indicate that educational supervision has transformed from a conventional model into a technology-based digital supervision system utilizing online platforms, real-time monitoring systems, cloud-based data storage, and digital data analytics. The integration of Artificial Intelligence (AI) enables supervision processes to be conducted more objectively, efficiently, and data-driven through learning analytics, digital dashboards, and automated recommendation systems. AI-based supervision models have evolved into AI-assisted supervision, predictive supervision, real-time supervision, and hybrid intelligence supervision, which combines human intelligence with artificial intelligence. However, its implementation still faces several challenges, including limited technological infrastructure, low digital literacy, ethical and data privacy concerns, and resistance to change. This study concludes that digital and AI-based educational supervision has significant potential to improve effectiveness, efficiency, objectivity, and decision-making quality in education. Therefore, supportive policies, human resource capacity building, and adequate regulations are essential to ensure its successful and sustainable implementation.

Keywords: *Educational Supervision; Digital Transformation; Artificial Intelligence (AI), Digital-Based Supervision. E-Supervision.*

ABSTRAK

Penelitian ini bertujuan untuk menganalisis transformasi pengawasan pendidikan berbasis digital di era Artificial Intelligence (AI), termasuk perubahan pengawasan dari sistem manual ke digital, integrasi AI dalam pengawasan pendidikan, model pengawasan berbasis AI, serta peluang dan tantangan implementasinya. Metode yang digunakan adalah Systematic Literature Review (SLR) dengan mengacu pada pedoman Preferred Reporting Items for Systematic

Reviews and Meta-Analysis (PRISMA) untuk 22 artikel ilmiah nasional dan internasional yang diterbitkan pada periode 2020-2025. Hasil penelitian menunjukkan bahwa pengawasan pendidikan telah mengalami transformasi dari model konvensional menjadi pengawasan berbasis teknologi digital yang memanfaatkan platform online, sistem pemantauan real-time, penyimpanan data berbasis cloud, dan analisis data digital. Integrasi Artificial Intelligence (AI) dalam pengawasan memungkinkan penerapan evaluasi dan pemantauan pembelajaran secara lebih objektif, cepat, dan berbasis data melalui analisis pembelajaran, dasbor digital, dan sistem rekomendasi otomatis. Model pengawasan berbasis AI sedang berkembang dalam bentuk pengawasan berbantuan AI, pengawasan prediktif, pengawasan waktu nyata, dan pengawasan kecerdasan hibrida yang menggabungkan kecerdasan manusia dan kecerdasan buatan. Namun, implementasinya masih menghadapi berbagai tantangan berupa infrastruktur teknologi yang terbatas, literasi digital yang rendah, masalah etika dan privasi data, serta resistensi terhadap perubahan. Penelitian ini menekankan bahwa pengawasan pendidikan berbasis digital dan berbasis AI berpotensi meningkatkan efektivitas, efisiensi, objektivitas, dan kualitas pengambilan keputusan dalam pendidikan, sehingga diperlukan dukungan kebijakan, penguatan kompetensi sumber daya manusia, dan regulasi yang memadai untuk memastikan implementasinya berjalan secara optimal dan berkelanjutan.

Kata kunci: *Pengawasan Pendidikan; Transformasi Digital; Kecerdasan Buatan (AI), Pengawasan berbasis digital, Pengawasan Elektronik.*

INTRODUCTION

The transformation of education supervision in the digital era is an important phenomenon that marks a paradigm shift in education management from a conventional model to a more adaptive, transparent, and technology-based system. Supervision that was previously carried out through direct observation and administrative approaches is now beginning to develop into a digital system that utilizes information and communication technology (ICT) to improve the effectiveness of teacher coaching and the quality of learning. These changes are part of the education system's response to the demands of the Industrial Revolution 4.0 and Society 5.0 which emphasizes the integration of humans, technology, and artificial intelligence in all aspects of modern educational life.

In the context of its implementation, digital-based education supervision or e-supervision has been widely implemented through various platforms such as Learning Management Systems (LMS), video conferencing applications, and cloud-based reporting systems. Research shows that the use of digital systems in supervision is able to improve the efficiency, accuracy, and documentation of the supervision process in a more systematic and structured manner. In addition, e-supervision also facilitates communication between supervisors and teachers in the process of reflection and evaluation of learning without being limited by space and time.

Furthermore, this transformation not only has an impact on the technical aspects of the implementation of supervision, but also on improving the

professionalism of teachers. Digital-based supervision allows the teacher performance monitoring process to be carried out more objectively and sustainably, so that it can provide more targeted feedback for the development of pedagogic competencies. Several literature studies show that the digitization of supervision contributes significantly to improving teacher performance and professionalism through a more measurable and data-based evaluation system.

As technology develops more and more, the integration of artificial intelligence (AI) has become an important part of the transformation of modern education supervision. AI has the ability to process large amounts of data (big data), identify learning patterns, and produce predictive analysis that can be used in educational decision-making. In the context of supervision, AI can help education supervisors analyze teacher performance, identify training needs, and provide more personalized and adaptive professional development recommendations.

In addition, the development of AI in education has also encouraged the emergence of the concept of hybrid intelligence, which is the collaboration between human intelligence and machine intelligence in the educational decision-making process. This approach allows supervision to be not only evaluative, but also analytical and predictive, thus supporting data-driven decision-making. This makes educational supervision more strategic in improving the quality of learning in a sustainable manner.

However, the implementation of digital-based supervision and AI still faces various challenges that are quite complex. One of the main challenges is the low digital literacy among educators and education supervisors, which has an impact on the lack of optimal use of technology in the supervision process. In addition, the digital infrastructure gap between regions is also a significant obstacle in the equitable distribution of technology-based supervision implementation, especially in remote and disadvantaged areas.

Other issues that are no less important are the aspects of ethics, privacy, and data security. The use of AI in educational supervision involves managing sensitive data such as teacher performance, learning activities, and student data. Without clear regulations, the use of this data can pose a risk of privacy violations and misuse of information. Therefore, strict ethical policies and guidelines are needed in the implementation of AI in the education sector so that its use remains in a responsible corridor.

On the other hand, recent studies have also shown that the integration of AI in education has a significant positive impact on personalization of learning and supervision. AI is able to adjust the coaching process based on the individual needs of teachers, so that supervision becomes more adaptive and effective. In addition, AI also supports an analytics-based evaluation system that is able to improve accuracy in educational decision-making.

The development of education policies in various countries also shows that digital transformation and AI in education have become a global strategic agenda. Many countries have begun to develop national roadmaps and policies related to the implementation of AI in the education system, including in aspects of supervision, curriculum, and educational human resource development. This shows that AI-based supervision transformation is no longer an option, but a strategic necessity in facing the global digital education era.

Thus, it can be concluded that the transformation of digital-based education supervision in the era of Artificial Intelligence (AI) is a fundamental change in the modern education management system. The integration of digital technology and AI not only improves supervision efficiency, but also strengthens the objectivity, accuracy, and quality of decision-making in education. However, the successful implementation of this transformation is highly dependent on the readiness of human resources, technological infrastructure, and regulations that support the ethical and responsible use of AI.

Therefore, a study on the transformation of digital-based education supervision in the AI era is very important to be carried out, in order to provide a comprehensive overview of the opportunities, challenges, and implementation strategies in improving the quality of education in a sustainable manner.

RESEARCH METHODS

This research uses a systematic approach. Literature Review (SLR) to systematically synthesize empirical findings related to digital-based education transformation in the Artificial Intelligence (AI) era. The SLR method was chosen because it is able to provide a comprehensive, systematic, and evidence-based picture of the development of concepts, implementations, challenges, and opportunities for the use of digital technology and artificial intelligence in educational supervision practices.

The implementation of the research refers to the guidelines of Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) which consists of the stages of identification, screening, eligibility, and inclusion. The use of the PRISMA guidelines aims to ensure the transparency of the literature selection process and increase the validity of research synthesis results.

Research data sources were obtained from various academic databases, namely Google Scholar, SINTA, DOAJ, and Scopus. The search strategy was carried out using a combination of keywords: digital educational supervision, AI-based supervision, e-supervision, artificial intelligence in education, digital transformation of educational supervision, digital education supervision, and AI-based educational supervision. The literature searched is limited to scientific

articles published in the range of 2020-2025 to match the latest developments in digital technology and artificial intelligence in the world of education.

Inclusion criteria include; (1) research articles that discuss digital-based or AI-based supervision; (2) articles published in accredited national journals and reputable international journals; (3) the article is available in *full-text*; and (4) the article is relevant to the research purpose. The exclusion criteria include articles that do not discuss direct educational supervision, duplicate articles, and articles that do not explain the research method clearly.

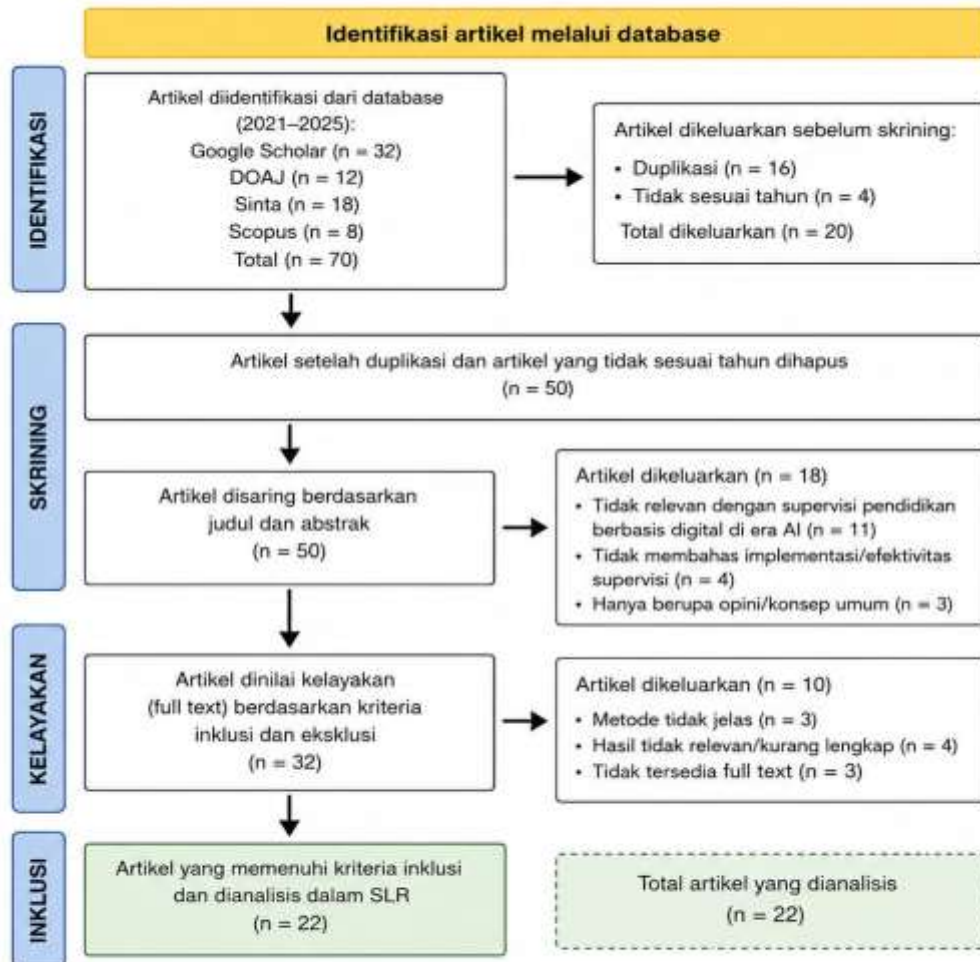
The literature selection process follows the PRISMA flow. At the identification stage, 5 articles were obtained from various databases. After a duplicate check, 7 articles were deleted so that 38 articles remained for the screening stage. At the title and abstract screening stage, as many as 10 articles were eliminated because they did not meet the inclusion criteria. Thus, 22 articles were obtained that met all the criteria and were used in the final synthesis process.

Data analysis was carried out through thematic analysis techniques by grouping research findings into several main themes, namely: (1) transformation of educational supervision from conventional to digital systems, (2) implementation of digital supervision platforms and applications, (3) the use of Artificial Intelligence in the process of monitoring and evaluation of learning, (4) the benefits of Navy-based supervision on the effectiveness of education supervision, and (5) challenges and prospects development of future educational supervision. The results of the analysis are then presented descriptively to produce a comprehensive understanding of the transformation of digital-based education supervision in the AI era.

RESULTS AND DISCUSSION

Based on the literature selection process using the Systematic Literature Review (SLR) method, 22 articles were obtained that met the inclusion criteria and were analyzed in depth. The data studied came from various scientific databases such as Google Scholar, DOAJ, Sinta, and accredited national journals with a publication range of 2021–2025

GAMBAR 1. DIAGRAM ALUR SELEKSI ARTIKEL BERDASARKAN PRISMA



Sumber: Diadaptasi dari PRISMA 2020 Statement (Page et al., 2021).

Referensi:

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ*, 372, n71.

The results of the analysis show that the transformation of digital-based education supervision in the era of Artificial Intelligence (AI) has changed supervision practices from conventional models to a more flexible, data-based, collaborative, and adaptive system to technological developments.

This transformation is characterized by the use of various digital platforms in the implementation of academic supervision, such as Learning Management System (LMS), Google Classroom, Microsoft Teams, Zoom Meeting, and e-supervision applications. The use of digital technology allows supervisors and principals to monitor, evaluate, and coach teachers more effectively without being limited by distance and time. Research by Afifah et al. shows that e-supervision is able to expand the scope of supervision, especially in the 3T areas (frontier,

outermost, and disadvantaged), so that the teacher development process can take place in a sustainable manner.

Subsequent findings suggest that the integration of AI in educational supervision contributes to increased decision-making effectiveness. AI technology is able to assist supervisors in collecting, processing, and analyzing learning data automatically so as to produce more accurate information to determine supervision follow-up. The use of AI allows the identification of teacher training needs, competency mapping, analysis of student learning outcomes, and the preparation of coaching recommendations faster than manual methods. In addition, AI supports the development of evidence-based supervision systems so that the quality of supervision decisions becomes more objective and measurable.

The results of the study also show that digital-based supervision has a positive impact on improving teacher professionalism. Through digital platforms, supervisors can provide real-time feedback, facilitate learning reflection, and document supervision results systematically. Research on the validation of digital academic supervision instruments found that digital supervision is able to support the improvement of teachers' pedagogic, professional, and digital literacy competencies through the stages of assessment, observation, reflection, solution-giving, and well-documented follow-up.

In addition to improving teacher professionalism, digital supervision transformation also strengthens transparency and accountability in education management. All data from observation, assessment, and supervision follow-up can be stored in a digital system so that it is easily accessed, verified, and evaluated on an ongoing basis. The implementation of the e-supervision model using the Smart Digital Madrasah platform shows that the supervision process becomes more efficient, documented, and facilitates coordination between school principals, supervisors, and teachers.

Nonetheless, various studies have identified a number of challenges in the implementation of digital-based education supervision in the AI era. The main obstacles include limited technology infrastructure, uneven internet access, low digital competence of some teachers and supervisors, and limited funding for the development of digital systems. This condition is still an obstacle, especially for schools in remote areas and areas with limited technology facilities.

In addition to technical challenges, ethical issues are an important concern in the application of AI in educational supervision. The use of AI in education data management raises issues related to data security, user privacy, algorithm transparency, and potential bias in the decision-making process. Therefore, the implementation of AI in educational supervision requires clear regulations, ethical guidelines, and oversight mechanisms so that technology can be used responsibly and does not reduce human values in education.

Overall, the results of the study show that the transformation of digital-based education supervision in the AI era makes a significant contribution to improving the quality of education through increasing supervision effectiveness, teacher professionalism, administrative efficiency, and data-based decision-making. However, successful implementation requires adequate infrastructure support, increased digital literacy of human resources, and policies that support the ethical, safe, and sustainable use of technology and AI.

DISCUSSION

Transformation of Educational Supervision from Manual to Digital

Educational supervision was initially carried out manually through direct classroom observation, learning administration checks in the form of physical documents, and face-to-face feedback delivery. This supervision model has the advantage of direct interaction between supervisors and teachers, but often faces obstacles in the form of time constraints, costs, and relatively narrow supervision ranges. Along with the development of information and communication technology, educational supervision has undergone a transformation towards a digital system that allows the supervision process to be carried out more flexibly, efficiently, and continuously.

According to Ayuningrum and Atikah (2024), the transformation of digital supervision emerged in response to the needs of 21st century education and the implementation of the Independent Curriculum which demands a supervision system that is more adaptive to technological developments. In digital supervision, learning observation activities, data collection, teacher performance assessment, and reporting of supervision results can be carried out through digital platforms to increase the effectiveness of the teacher development process.

Ramadhan et al. (2025) explained that digital-based supervision is a change from the conventional supervision model to supervision that utilizes information technology to improve the efficiency, accountability, and quality of teacher professional development. The use of supervision applications, cloud-based data storage, and online monitoring systems allow school principals and supervisors to obtain data in real-time so that decision-making becomes faster and more accurate.

Digital transformation also changes the supervisory paradigm from an administrative control approach to a collaborative professional coaching approach. Communication between supervisors and teachers is no longer limited to formal meetings, but can take place on an ongoing basis through digital media. Effective communication contributes to improving teacher professionalism, learning quality, and developing a culture of reflection in educational practice.

In the era of Artificial Intelligence (AI), educational supervision has undergone more advanced development through the use of automated data analysis,

artificial intelligence-based evaluation systems, and rapid information processing. AI technology allows supervisors to identify learning weaknesses, analyze teacher training needs, and provide follow-up recommendations based on available data. The presence of AI also helps automate supervision administration so that supervisors can focus more on academic coaching and improving the quality of learning.

In addition to increasing efficiency, digital supervision also supports the equitable distribution of education quality. Through the e-supervision system, supervisors can monitor schools in remote areas without having to make regular physical visits. This provides a greater opportunity for teachers to obtain professional guidance on an ongoing basis despite being in different locations.

Various studies show that the success of digital supervision transformation is greatly influenced by the digital competence of teachers and supervisors, the availability of technological infrastructure, and policy support for educational institutions. Effective supervision must be able to combine the use of technology with a humanist approach so that technology functions as a supporting tool, not a substitute for professional interaction between supervisors and teachers.

Based on the synthesis of various studies, it can be concluded that the transformation of educational supervision from manual to digital is a strategic step in improving the quality of education. This change not only speeds up the supervision and evaluation process, but also strengthens the professionalism of teachers, increases the effectiveness of academic coaching, and supports data-driven decision-making in the era of artificial intelligence.

Integration of AI in supervision

The integration of artificial intelligence (AI) in educational supervision represents a transformation from a conventional evaluation system to data-driven supervision. AI does not play a role as a substitute for supervisors or educators, but rather as a decision support system that helps the process of analyzing teacher performance more objectively and efficiently. UNESCO (2021) emphasized that the use of AI in education must be oriented to the human-centered principle, which is to still place humans as the main decision-makers.

The implementation of AI in education supervision is realized through learning analytics, digital dashboards, and real-time monitoring systems that enable data-driven evaluation. A number of studies have shown that AI technology is able to improve the accuracy of performance analysis and support evidence-based decision-making in education (Zawacki-Richter et al., 2019; Chen et al., 2020; Motlagh et al., 2023). Thus, supervision becomes more systematic, fast, and measurable.

However, the application of AI in education supervision still faces challenges such as algorithm bias, data privacy, and digital literacy gaps.

Williamson & Eynon (2020) emphasized that inequality of access to technology can affect the quality of AI implementation in the education sector. Therefore, regulation and ethical supervision are needed in its use.

Conceptually, AI-based supervision leads to a hybrid intelligence model, which is a collaboration between human intelligence and artificial intelligence. In this model, AI acts as an analytical tool and recommender, while the final decision remains with humans (Selwyn, 2023; Sharples, 2023).

AI-based educational supervisions model

Based on various studies, AI-based educational supervision models develop in four main forms, namely AI-assisted supervision, predictive supervision, real-time supervision, and hybrid intelligence supervision. These four models show that the use of AI in supervision focuses not only on automating the evaluation process, but also on improving the quality of data-driven decision-making.

Nevertheless, the hybrid intelligence model is considered the most relevant for the educational context, as it retains the role of humans as the main decision-makers, while AI serves as an analysis and recommendation tool. This is in line with the views of UNESCO (2021) which emphasizes the importance of a human-centered approach to AI in the education system

Implementation Challenges

Challenges Based on various studies, the challenges of implementing AI-based educational supervision include aspects of infrastructure, human resources, ethics, and organizational culture. The digital divide and low AI literacy are the main obstacles in the equitable application of this technology. In addition, the issue of data privacy and resistance to change shows that digital transformation in supervision is not only technical, but also social and cultural.

Therefore, the implementation of AI in education supervision requires a holistic approach that includes increasing human resource capacity, providing equitable infrastructure, and strict ethical regulations so that the use of AI remains in the humanistic educational corridor.

Opportunities and impacts

Opportunities and Impacts of AI-Based Supervision

The integration of AI in educational supervision provides various strategic opportunities, especially in improving the efficiency of supervisory work through the automation of data processing, reporting, and teacher performance analysis. AI also contributes to increasing the objectivity of assessments because evaluations are conducted data-driven, thereby reducing the subjective bias of supervisors.

In addition, AI allows supervision to function more formatively by supporting the professional development of teachers personally through data-driven

training needs analysis. In the managerial aspect, AI accelerates decision-making due to data-driven decision-making, making it more accurate and measurable.

Its broader impact is that AI drives the transformation of the education system towards a more transparent, accountable, and modern direction. However, in principle, AI is still positioned as an auxiliary tool, not a substitute for the role of humans in educational supervision.

CONCLUSION

The transformation of educational supervision from a manual system to a digital system is a response to the development of information technology and the demands of 21st century education. This change allows the supervision process to be more effective, efficient, flexible, and sustainable through the use of digital platforms that support learning observation, data collection, teacher performance evaluation, and real-time reporting. Digitization of supervision not only improves the quality of supervision, but also expands access to professional coaching for teachers in various regions.

The integration of Artificial Intelligence (AI) in education supervision further strengthens this transformation through the use of automated data analysis, learning analytics, digital dashboards, and data-based monitoring systems. AI acts as a decision support tool that helps supervisors identify teacher development needs, analyze learning quality, and provide follow-up recommendations more objectively and accurately. The hybrid intelligence-based supervision model is the most relevant approach because it combines the analytical capabilities of AI with human professional considerations so that supervision remains humanistic.

However, the implementation of AI-based supervision still faces various challenges, such as limited technology infrastructure, low digital and AI literacy, data security and privacy issues, and resistance to organizational change. Therefore, the success of the transformation of educational supervision depends not only on technological sophistication, but also on the readiness of human resources, policy support, and the application of ethical principles in the use of AI. Overall, digital-based and AI-based supervision has great potential to improve the quality of education through faster, objective, transparent, and data-driven decision-making.

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