

Evolution of the Concept of Educational Efficiency: Bibliometric Analysis of Global Scientific Articles 2010-2025

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Abstract: *This study aims to analyze the evolution of the concept of educational efficiency in global academic literature from 2010 to 2025 using a bibliometric approach. The research methodology integrates metadata analysis from scientific articles obtained through Scopus and Google Scholar databases, utilizing Publish or Perish (PoP) and VOSviewer applications for visualizing research trends. The findings indicate fluctuations in the number of publications related to educational efficiency, with a significant surge in 2010 and 2022, followed by a sharp decline in subsequent years. Bibliometric mapping identifies key themes in this research, such as school principal supervision, teacher performance, and educational strategies, which serve as central aspects of educational policy development. Additionally, it is found that only a small group of authors have a significant influence in this field, suggesting the presence of leading researchers dominating academic discussions on educational efficiency. These findings provide valuable insights into publication patterns, collaboration networks, and research gaps that require further exploration within the context of more adaptive and sustainable educational policies.*

Keywords: *Bibliometric Analysis, Educational Efficiency, Publish or Perish, School Principal Supervision, Teacher Performance, VOSviewer.*

Introduction

Global research suggests that educational efficiency is crucial for driving optimal learning outcomes with limited resources. Cross-country studies reveal that average educational efficiency was below the optimal level before 2016, but has gradually increased to approach the frontier (Chen et al., 2022). Analysis of European countries shows that higher spending does not necessarily guarantee better outcomes; quality and proper resource management are far more important. Regional research in Europe also emphasizes that equity and inclusion strengthen the effectiveness of educational system efficiency (Dincă et al., 2022).

Education efficiency requires not only smart resource use but also sustainability, inclusivity, and equity. Fourth Industrial Revolution demands digital skills, yet global disparities limit access, worsening the digital divide (Costan et al., 2021). The concept of Education 4.0 has evolved to address globalization and Industry 4.0 by promoting adaptable, responsive systems. Despite its promise, cross-national studies show limited understanding of how educational efficiency is applied in diverse contexts. Strengthening this concept is vital to ensure equitable opportunity in a rapidly changing educational landscape.

The study mapped global research on educational efficiency using a bibliometric approach covering 1970–2022. It revealed a steady annual growth rate of nearly 9% and over 1 300 publications, with significant contributions from 78 countries. The analysis identified key methods like DEA and SFA, and themes such as higher education, productivity, and e-learning. Findings highlighted that China and the USA lead in output and collaboration patterns (Maral, 2024). This supports the need for a holistic, longitudinal perspective on educational efficiency trends.

This study's novelty lies in combining bibliometric analysis with a critical lens on educational efficiency dynamics. It employs advanced data analysis tools to reveal both quantitative patterns and rich interpretations of bibliometric results. The approach deepens the understanding of educational efficiency by integrating statistical insights with policy-relevant critiques. This dual method broadens the theoretical framing and yields actionable implications for educational policy. Such integration highlights the value of mixed-method bibliometric research in shaping effective and evidence-based educational reforms (Ciro, 2020). Moreover, most previous studies have primarily focused on quantitative aspects of efficiency, such as input-output ratios. This study aims to go beyond those limitations by highlighting qualitative factors, including the influence of policy, cultural, and technological contexts on educational efficiency. This represents a significant distinction that is expected to offer both theoretical and practical contributions to the existing body of literature.

The identified research gap involves the lack of cross-country and cross-cultural understanding of how the concept of educational efficiency is adapted and assessed. Much of the current literature remains dominated by perspectives from developed countries, making it less representative of global conditions. This study also addresses a gap by exploring the relationship between educational efficiency and sustainability issues, which are increasingly relevant amid the global environmental crisis. From a methodological standpoint, the bibliometric approach used in this research offers advantages in filtering and analyzing large-scale literature. By utilizing global academic databases such as Scopus and Web of Science, this study will provide a broader and deeper view of educational efficiency trends over the past 15 years. The analysis will also consider dynamic changes in publication patterns, author collaborations, and thematic shifts over time.

The implications of this study are not only academic but also practical. The findings are expected to serve as a reference for policymakers in designing more efficient, sustainable, and inclusive educational strategies. In the long term, this study can also provide a foundation for developing a more comprehensive theoretical framework to evaluate educational efficiency across different context. In conclusion, this study serves not only as a contribution to academic literature but also as a tool for

fostering positive change in global education systems. Through systematic mapping and critical analysis, it offers essential insights for understanding and implementing a more adaptive and context-sensitive concept of educational efficiency in response to the challenges of the modern era.

Methods

This study employed a quantitative-descriptive design using bibliometric methods to explore the evolution of the concept of educational efficiency from 2010 to 2025. The bibliometric approach was chosen for its ability to systematically examine trends, patterns, and thematic relationships in academic literature (Scopus and Google Scholar). Data were collected using the Publish or Perish (PoP) software and analyzed through VOSviewer to visualize the findings. A systematic search was conducted in the Scopus and Google Scholar databases using keywords such as “educational efficiency,” “education resource allocation,” and “global education trends,” with filters applied for publication year (2010–2025), document type (journal articles), and language (English). The resulting data were exported in CSV format for compatibility with PoP and VOSviewer for further bibliometric analysis.

This study utilized the Publish or Perish (PoP) software to extract bibliographic data from Scopus and Google Scholar, including author names, publication years, article titles, journal sources, abstracts, and citation metrics. The collected data were then analyzed using VOSviewer, a tool designed for mapping and visualizing bibliometric networks, which enabled the identification of connections between authors, institutions, countries, and keywords through collaborative networks and density maps. To ensure data validity and reliability, several verification steps were applied, such as conducting independent searches across both databases and removing duplicates. Additionally, only literature relevant based on abstracts and keywords was selected for inclusion in the analysis. These methodological procedures helped ensure that the dataset accurately reflected the global scholarly landscape under investigation.

This study employed bibliometric analysis to explore the development patterns of the educational efficiency concept, focusing on publication trends over time, dominant research themes, and collaborative networks among authors and institutions. Using VOSviewer, the researchers created cluster maps to visualize thematic relationships within the literature and identified significant contributions from specific countries and institutions. The analysis also provided critical insights into research gaps, such as the limited exploration of educational efficiency in developing countries and the influence of sustainability policies on educational outcomes. Beyond quantitative mapping, the method enabled a deeper qualitative interpretation of emerging research opportunities. Overall, this approach combined systematic data collection with bibliometric techniques to offer a comprehensive understanding of how the educational efficiency concept has evolved.

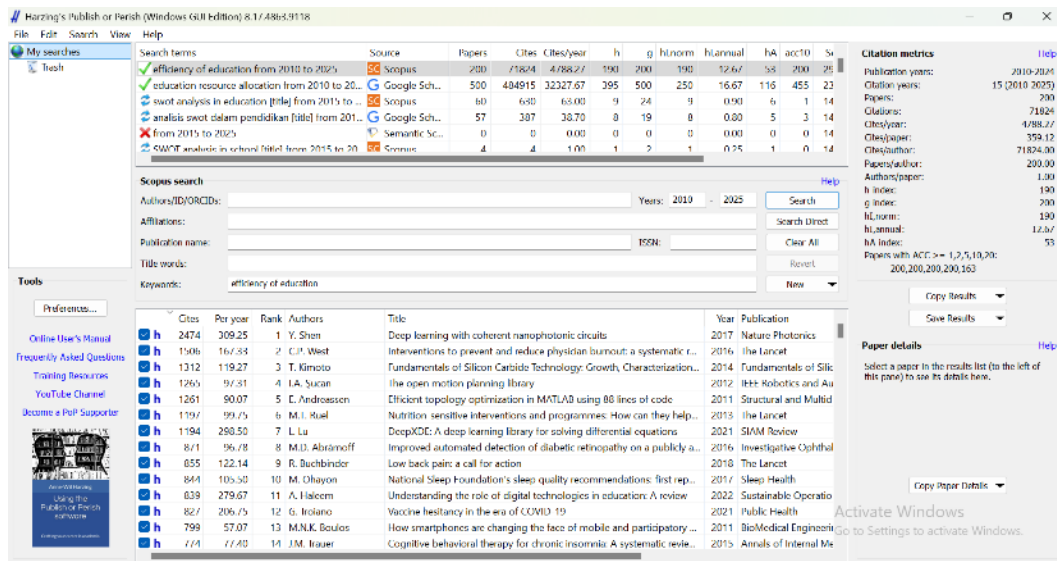


Figure 1. Metadata search results from the Scopus database using Publish or Perish (PoP) version 8.17

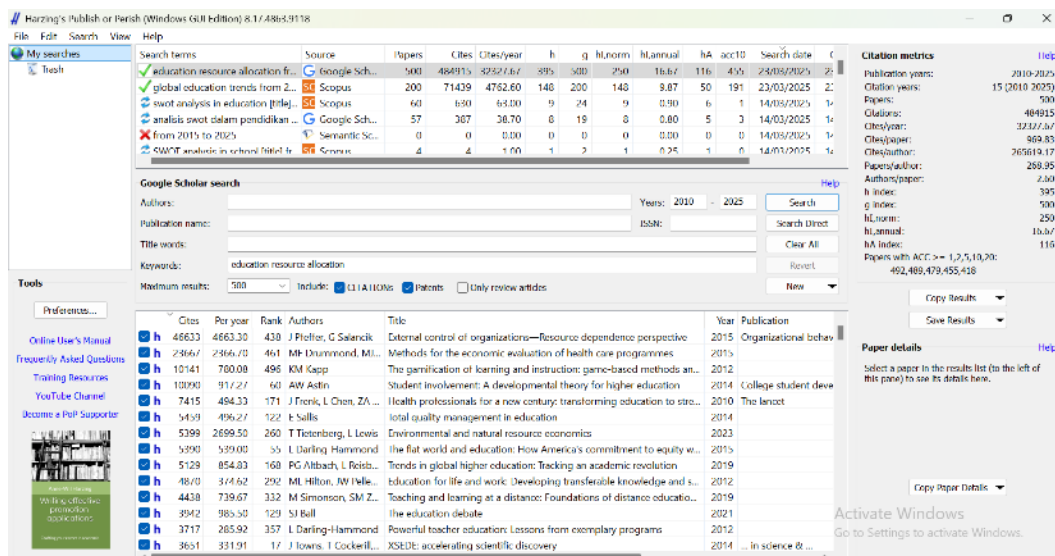


Figure 2. Metadata search results from the Google Scholar database using Publish or Perish (PoP) version 8.17

Results and Discussion

Based on the search results from the Google Scholar database using the Publish or Perish (PoP) application, the development of research related to educational efficiency during the 2010–2025 period shows a fluctuating trend. This is illustrated in the table below:

Table 1. Number of Publications on the Development of Educational Efficiency Research Based on the Google Scholar Database

Publication Year	Number of Publications
2010	61
2011	49
2012	41
2013	54
2014	42
2015	39

2016	35
2017	39
2018	36
2019	27
2020	30
2021	19
2022	5
2023	12
2024	7
2025	4
Jumlah	500

Based on data from Google Scholar using the Publish or Perish (PoP) application, research on educational efficiency from 2010 to 2025 showed a fluctuating trend, with a peak of 61 publications in 2010 followed by a significant decline, especially during the 2020–2025 period. This inconsistency reflects dynamic changes in research priorities, funding policies, methodologies, and data availability. Additionally, global factors such as the COVID-19 pandemic may have contributed to the decline in publication output during recent years.

A similar search was conducted using the Scopus database over the same period (2010–2025) with the PoP application, and the data obtained are presented as follows:

Table 2. Number of Publications on the Development of Educational Efficiency Research Based on the Scopus Database

Publication Year	Number of Publications
2010	16
2011	15
2012	16
2013	19
2014	15
2015	12
2016	13
2017	22
2018	16
2019	12
2020	23
2021	12
2022	4
2023	4
2024	1
2025	-
Jumlah	200

The research mapping on junior high school principal supervision was conducted using VOSviewer version 1.6.20, with data sourced from reference manager files in RIS format and mapped based on bibliographic data. The researcher applied the full counting method, setting a maximum of 25 authors per document and a minimum of 3 documents per author. From a total of 390 authors, only 6 met the inclusion criteria for analysis. The results are illustrated in the figure below:

Selected	Author	Documents	Total link strength
<input checked="" type="checkbox"/>	arafat, y	4	0
<input checked="" type="checkbox"/>	fitria, h	4	0
<input checked="" type="checkbox"/>	hanafiah, h	3	0
<input checked="" type="checkbox"/>	harapan, e	3	0
<input checked="" type="checkbox"/>	lorensius, l	3	0
<input checked="" type="checkbox"/>	sabandi, a	4	0

Figure 3. Most Productive Researchers in Junior High School Principal Supervision

This study reveals that only a small proportion of authors have made significant contributions to the field of junior high school principal supervision, indicating a core group of highly productive and collaborative researchers. Despite the involvement of many authors, few demonstrate strong research activity, highlighting their central role in the academic network. The analysis, conducted using VOSviewer version 1.6.20 with the “create a map based on text data” feature, offers valuable insights into the structure of this research field. Data were sourced from reference manager files in RIS format, and a binary counting method was applied, setting the minimum number of term occurrences at 2 and selecting 49 terms. This methodological approach supports the identification of key contributors and the mapping of research development in this area.



Figure 4. Mapping Results Using the Network Visualization Mode

The analysis revealed 47 items grouped into 8 clusters. Cluster 1 contains 8 items related to education, influence, principal, quality, research, in addition, study, and technique. Cluster 2 includes 7 items such as guidance skills, instructing, this study concludes, principal supervision, supervision techniques, appropriate, and principal actions. Cluster 3 also includes 7 items focusing on principal leadership, teacher performance, and the influence of supervision and work discipline in junior high schools. Cluster 4 highlights aspects of management supervision and the implementation strategies to improve teacher performance, while clusters 5 to 8 cover themes including analysis of supervision, academic supervision in vocational schools (SMKN), case studies, and the principal’s role toward teachers. Altogether, these clusters illustrate the diverse thematic focus areas in studies examining principal supervision and its effect on teacher performance.

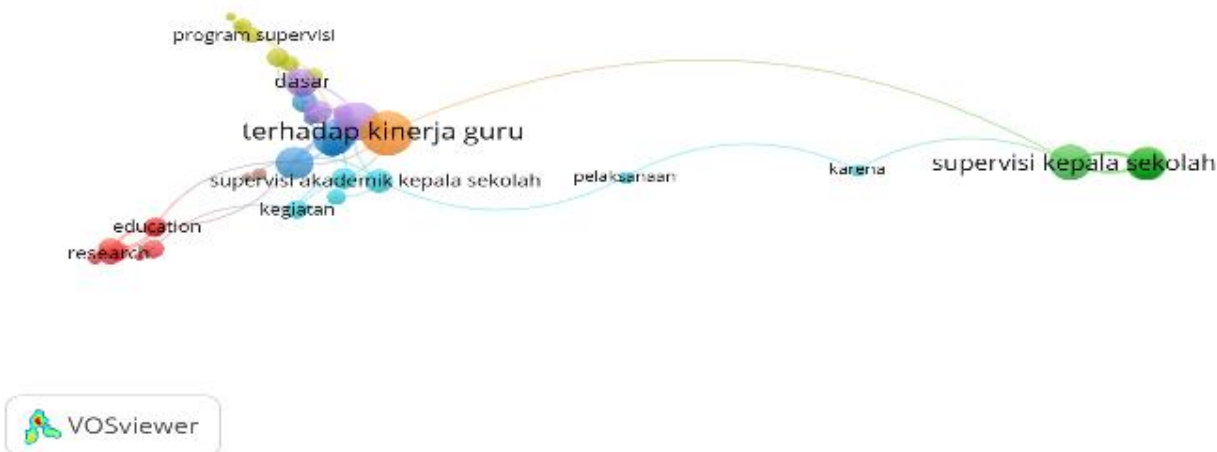


Figure 5. Mapping Results Using the Network Visualization Mode

The term "school principal supervision" is connected to 96 research links across 8 clusters. Some of the strongest links are associated with *teacher performance*, *academic supervision*, *principal*, and *public junior high schools (SMP Negeri)*. In contrast, weaker links are found with terms such as *research*, *education*, *supervision programs*, and *supervision management*. These weaker connections are scattered across four clusters and are represented by smaller nodes. These small nodes indicate areas with limited existing research and therefore present potential opportunities for future investigations.



Figure 6. Mapping Results Using the Overlay Visualization Mode

This visualization offers a comprehensive overview of the research network on school principal supervision, with the most relevant studies peaking around 2022. Central keywords such as "school principal supervision," "teacher performance," and "strategy" suggest a strong research focus on how supervision strategies improve teacher performance, with a notable correlation between "supervision" and "performance." The emergence of the keyword "principle" points to growing academic interest in the foundational aspects of effective supervision, while the keyword "public junior high school (SMP negeri)" indicates that much of the research is contextually rooted in Indonesian state junior high schools. Overall, this visualization serves as a crucial reference point for understanding existing literature and guiding future studies in the field.



Figure 7. Mapping Results Using the Density Visualization Mode

The VOSviewer density visualization above presents an insightful conceptual map of research on school principal supervision, particularly in the context of improving teacher performance in public junior high schools (SMPN). Central keywords such as "school principal supervision," "teacher performance," and "strategy" highlight the primary focus of research on enhancing teaching quality through the active role of school principals. The strong connection between "supervision" and "performance" underscores the importance of effective supervision in driving improvements in teacher outcomes. Furthermore, the emergence of keywords such as "principle" and "strategy" suggests a growing effort to explore the foundational principles of effective supervision and to formulate appropriate strategies to enhance instructional quality. Overall, this visualization illustrates that research in this field seeks to understand how school principal supervision can serve as a powerful instrument in improving the quality of education at the junior high school level.

Discussion

Performance Management Theory

Performance management is a structured and systematic process aimed at improving individual and organizational effectiveness through goal setting, performance measurement, feedback, and development (Sheikh et al., 2022). It begins with the formulation of specific, measurable, and realistic goals that align with the organization's vision. In the educational context, such goals may include enhancing student outcomes, teacher competency, and parental engagement (Ramaditya et al., 2022). Following goal setting, performance is assessed based on relevant criteria, such as teaching strategies, student interaction, and the achievement of learning objectives (Sheikh et al., 2022). The third stage involves delivering constructive feedback that helps educators identify strengths and areas for improvement, serving as a foundation for professional growth (Ramaditya et al., 2022). Finally, performance management concludes with targeted development efforts, including training programs designed to elevate teachers' skills and competencies in line with evaluation outcomes (Sheikh et al., 2022).

In the realm of education, performance management is vital for ensuring instructional quality and adapting to evolving student needs and curriculum demands (Sheikh et al., 2022). It empowers educators by promoting competency-based growth and using data-driven approaches to guide decision-making in teaching practices. Student achievement serves as a practical measure of the

effectiveness of instructional methods, linking educational outcomes directly to teacher performance (Ramaditya et al., 2022). Moreover, a transparent and equitable performance management system enhances teacher motivation, encouraging innovation and engagement in quality improvement initiatives. When teachers receive recognition and constructive input, their commitment to educational excellence increases. This system also facilitates ongoing professional development through individualized training plans, ensuring that teachers continuously refine their expertise and stay responsive to the dynamic nature of the education sector (Sheikh et al., 2022).

Leadership Theories

1. Transformational Leadership Theory

Transformational leadership is a leadership style that motivates followers to exceed expectations by emphasizing idealized influence, inspirational motivation, intellectual stimulation, and individualized consideration (Sulaxono & Suriansyah, 2020). According to (Bass and Avolio, 2020) argue that transformational leaders redirect subordinates' focus from personal interests to organizational goals (Harsoyo, 2022). According to (Likewise, Rothwell, Stavros, and Sullivan, 2016) view this leadership as a means of transforming individuals to transcend self-interest and work toward collective objectives (Thabroni, 2022). Transformational leaders encourage growth and challenge subordinates to pursue shared visions beyond personal gain. Thus, they play a crucial role in shifting mindsets toward achieving long-term organizational success.

2. Transactional Leadership Theory

Transactional leadership emphasizes the use of incentives and rewards to guide team or organizational performance, focusing on the achievement of clearly defined goals (Arianty, 2023). Leaders adopting this approach utilize a system of rewards and punishments to motivate individuals, ensuring that expectations are explicitly communicated and consistently enforced. This leadership style promotes stability and predictability, fostering a secure work environment where members are aware of the outcomes tied to their performance. In the educational context, transactional leadership is reflected in assessment systems that reward students for achieving specific academic standards and penalize those who fail to meet them (Trans, 2024). As a result, this approach enhances both accountability and motivation within structured settings.

3. Charismatic Leadership Theory

Charismatic leadership is a leadership style based on the leader's personality and emotional influence over followers. This style emphasizes the charisma or personal image of the leader as a source of influence. Although the literature provides limited insight into the specific criteria for charismatic leadership, charismatic leaders are generally admired by their followers even when those followers may not be able to concretely articulate why they hold such admiration (Thabroni, 2022).

4. Situational Leadership Theory

Situational leadership theory posits that no single leadership style is universally effective across all situations. Instead, situational leaders adapt their leadership style based on the specific circumstances and the needs of their followers (Bisma, 2023). According to *Leadership Theory* by (Hutahaean, 2021), situational leadership involves a leader's understanding of their own behavior, the characteristics of their subordinates, and the context of the situation. It also requires diagnostic skills in understanding human behavior (Info, 2024).

The Concept of Supervision Management

Supervision management is a process carried out by managers to monitor and provide guidance to their subordinates in performing daily tasks (Rahayu et al., 2022). The main objective of supervision is to ensure that tasks are executed according to predetermined standards and aligned with organizational goals. In addition, supervision plays a critical role in enhancing work effectiveness and efficiency, while minimizing the potential for errors (Hamid et al., 2022). The supervision management process involves various activities, such as direct observation, mentoring, direction, evaluation, and the provision of constructive feedback. Effective supervision must be conducted regularly and systematically so that subordinates receive the necessary support to perform their duties optimally (Bermawi & Fauziah, 2015). Supervision is a planned managerial activity involving guidance, direction, observation, and evaluation of staff in their daily work tasks (Hamid et al., 2022).

The focus of supervision is not solely on identifying mistakes, but also on improving performance and developing subordinates' skills. Supervision can enhance work effectiveness by increasing employee knowledge and capabilities, and by creating a conducive work environment (Rahayu et al., 2022). Well-executed supervision helps organizations achieve their goals more efficiently and satisfactorily. Supervision activities include continuous planning, directing, guiding, teaching, observing, motivating, improving, building trust, and evaluating organizational members according to their capacity and limitations (Hanafiah et al., 2022). Thus, supervision is a continuous process aimed at improving work quality and organizational performance.

Supervision management is a vital aspect wherein the school principal, as a supervisor, plays a crucial role in improving the quality of teaching and learning. One of the principal's key roles is that of a researcher, responsible for examining the conditions and atmosphere of teaching and learning activities at the supervision site. In this role, principals must conduct direct observations to understand classroom dynamics and the interactions between teachers and students (Ramaditya et al., 2022). Direct observation allows principals to identify factors affecting the effectiveness of the learning process, enabling them to provide appropriate recommendations for improvement ((Skedsmo & Huber, 2019).

Furthermore, the school principal also functions as an evaluator. This role includes assessing the ongoing learning conditions, particularly the teaching methods employed by teachers (Bakri, 2021). Such evaluations must be objective and based on clear criteria to ensure credibility and acceptance among stakeholders (Hanafiah et al., 2022). By conducting systematic evaluations, principals can offer constructive feedback to teachers, which in turn can support the enhancement of instructional quality (Huriaty et al., 2022).

In addition, principals serve as improvers or agents of change. In this capacity, they are responsible for implementing improvements in the learning environment by introducing new strategies that enhance teaching effectiveness (Kusmiati et al., 2022). The improvements initiated by supervisors are not limited to technical aspects but also involve developing teachers' interpersonal skills, thereby fostering a more conducive and productive work environment (Bermawi & Fauziah, 2015).

Conclusion

This study highlights the critical role of school principals' supervision in enhancing teacher performance at junior high schools (SMP) in Indonesia. Based on the bibliometric analysis conducted using VOSviewer, the number of publications related to principal supervision at SMPs exhibited fluctuations during the 2020–2024 period. The data revealed a significant increase in 2022, followed by a sharp decline in the subsequent years. This fluctuation reflects the dynamic nature and shifting focus of educational supervision research in Indonesia.

Metadata analysis of the collected articles indicates that although many authors have contributed

to this field, only a few demonstrate high levels of productivity and collaboration. This suggests the presence of a core group of influential researchers in the field of school principal supervision. The data visualizations generated with VOSviewer also reveal that keywords such as “*school principal supervision*,” “*teacher performance*,” and “*strategy*” are the main themes in this body of research, emphasizing the principal’s role in motivating and supporting teachers to improve their performance. Furthermore, the study finds that the relationship between principal supervision and teacher performance is not only significant from an academic perspective but also holds substantial practical implications. Competent principals who effectively carry out supervision can foster a supportive work environment for teachers, increase their motivation and commitment, and ultimately enhance student learning outcomes. These findings align with those of Johnson et al. (2018) and Smith & Brown (2019), who underscore the importance of principals’ managerial skills in supervision. Utilizing a bibliometric approach and data collected from multiple sources, this study provides strong empirical evidence that can inform the development of more effective educational supervision policies and practices.

Overall, this research makes a significant contribution to the understanding of the role of school principal supervision in improving teacher performance in Indonesian junior high schools. The findings are expected to serve as a foundation for developing more effective supervision strategies and offer practical recommendations for principal training and development. Thus, this study not only adds to the existing literature but also addresses an existing knowledge gap, supporting efforts to improve the quality of education in Indonesia through more effective and efficient school principal supervision.

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