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Enhancing Principal Effectiveness: A Meta-Analysis on the Roles of Academic Supervision and Instructional Leadership

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Abstract: School principal performance plays a crucial role in achieving institutional goals through effective leadership and academic supervision. While previous studies have demonstrated that both academic supervision and instructional leadership significantly influence principal performance, there remains a need for a comprehensive synthesis of empirical findings to clarify the strength and consistency of this relationship. This meta-analysis study focuses on supervision conducted by educational supervisors and instructional leadership as the primary factors affecting principal performance. A total of 27 empirical studies published between 2018 and 2025 were carefully selected based on predetermined inclusion criteria from the Google Scholar, SINTA, and Scopus databases. Meta-analytic procedures were implemented using JASP version 0.14.10, employing random-effects models to calculate effect sizes and test for heterogeneity and publication bias. The analysis revealed significant positive correlations between academic supervision ($r = 0.611$, $p < 0.01$) and instructional leadership ($r = 0.578$, $p < 0.01$) with principal performance. Results indicated moderate heterogeneity among studies, suggesting variability due to contextual factors, while no evidence of publication bias was detected. These findings affirm the critical influence of academic supervision and instructional leadership on principal effectiveness. The study highlights the importance of leadership development and the formulation of institutional policies that integrate supervisory and instructional dimensions to strengthen educational outcomes.

Keywords: Academic Supervision; instructional leadership; meta-analysis; principal performance

Introduction

In educational organizations, principal performance as school leadership is a cornerstone of institutional success, moreover it directly influences teacher effectiveness and the success of overall educational outcomes(Lijun & Te, 2024). It has been long recognized as one of the most significant in-school factors that shape the students' learning outcomes (Kemethofer et al., 2025). Among multiple dimensions of leadership practice, the performance of school principle stands out as a pivotal catalyst for sustained school improvement. It operates where people, teaching philosophies, and organizational structure intersect, cultivating environments for teachers to excel and students to thrive. Effective principals are more than managers; they envision academic aspirations, shape collaborative cultures, and champion continuous instructor development to align assets, foster educator growth on the job, and exemplify dedication to scholarship (Waters, 2025). In contexts undergoing rapid educational reform, expanding technological

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integration, and increased accountability pressure, the principal's role becomes ore complex and more central (Ruloff & Petko, 2025).

Within this expanded role, two domains of leadership practice, academic supervision and instructional leadership, emerge repeatedly in the literature as critical levers for enhancing principal performance. Academic supervision, when conceptualized as formative and criteria-based guidance, provides structured feedback and accountability mechanism that can directly influence schoolwide instructional quality (Handriadi et al., 2025). Instructional leadership focuses on articulating an instructional vision, monitoring teaching and learning, building teacher capacity, and using evidence to drive improvement (Isre, 2025; Magdaraog, 2025). Both areas are generally seen as crucial, but the strength and reliability of their connection to primary performance are still debated. Numerous factors contribute to the performance of school principal, and this study focuses on the impact of academic supervision conducted by supervisors. Effective academic supervision is essential in improving the leadership capabilities of principals, thereby facilitating the achievement of educational objectives (Rahayuningsih et al., 2023).

In today's dynamic educational landscape, principal performance is widely acknowledged as a pivotal determinant of teacher effectiveness and student achievement. As instructional leaders, principals must navigate complex challenges while fostering a learning environment that support growth, equity, and excellence. A growing body of research affirms that academic supervision plays an important role in improving principal performance, thus directly influencing the overall success of educational outcomes. This relationship underscores the urgency of designing targeted training and development programs that empower school leaders with the competencies required for effective supervision and instructional leadership. Through a meta-analysis approach, this study systematically examines the multifaceted dimensions of academic supervision and its influence on principal efficacy.

Empirical findings to date are varied. Some studies report substantial positive effects of academic supervision and instructional leadership on principal performance (Armiati et al., 2025; Ngatini et al., 2025; Sari et al., 2025), while others suggest more modest or context-dependent associations (Ma & Muhammad, 2025). Empirical studies consistently demonstrate a significant positive correlation between supervisory practices and employee performances (Syuaib et al., 2023) as it was also stated in research by Fauziyah et al., (2023), Magasi, 2021) and (Yusiana et al., 2024). Enhanced supervision practices not only elevate principal performance, but also foster the benefits of teacher effectiveness and student achievement (Suryantini et al., 2022). Consequently, professional development programs for supervisors are vital in maximizing their capacity to support school leaders or teachers (Efendi, 2024; Yunanda et al., 2024). Moreover, tightening supervisory protocols has been recommended as a strategic measure to boost performances across school personnel (Gandung, 2024; Hijrah et al., 2024). Beyond supervision, instructional leadership emerges as another critical determinant of principal performance (Elfira et al., 2024; Wahyuni et al., 2019). Instructional leadership encompasses targeted strategies such as setting clear pedagogical goals, providing ongoing support, and fostering a collaborative environment among teachers (Firdaus et al., 2022; Nellitawati et al., 2024).

Academic supervision refers to structured guidance provided by supervisors with the aims of enhancing the competencies of school leaders and other school personnel in achieving institutional goals. School principals are expected to implement academic supervision both effectively and objectively, particularly in conducting performance assessment that directly influence teacher effectiveness (Tongli et al., 2005). As Sunaryo, (2020) underscores effective academic supervision not only elevates teacher performance but also fosters a collaborative and supportive educational climate, thereby contributing to overall school quality.

Academic supervision may also refer to formal performance appraisals conducted by supervisors, collegial mentoring arrangements, peer-review processes, or informal observation feedback cycle (Sugiar et al., 2024). Instructional leadership has been variously defined to encompass goal setting, curriculum oversight, direct coaching, fostering professional learning communities, or the integration of technology to support pedagogy (Gading, 2024; He et al., 2024). Principal performance has no universally accepted metric; it is assessed through instruments ranging from self-reports and supervisor ratings to complex key performance indicator (KPI) frameworks and external audits (Mwikali, 2023). These inconsistencies in definition and measurement make it difficult to synthesize findings and translate them into coherent, evidence-based policies. The effects of this unclear ideas and methods are very significant. Without clear and similar evidence, the policies, school leaders, and training organizations might create professional learning programs and evaluation methods that do not match what research shows or are too general to meet specific needs. This can result in monitoring systems that pay too much attention to following rules, training for leaders that ignores important teaching aspects, and

performance reviews that overlook the details of good practice. In systems with limited resources or those that change quickly, the cost of misalignment is very high because both money and people are in short supply.

Addressing these gaps requires a systematic approach that not only aggregates existing empirical evidence but does so with explicit attention to definitional clarity, transparent inclusion criteria, and reproducible analytic procedures. A meta-analytic synthesis offers a powerful method for achieving this. By pooling effect sizes from multiple studies, identifying sources of heterogeneity, and testing potential moderators, such an analysis can provide robust benchmarks for the strength of association between academic supervision, instructional leadership, and principal performance. Moreover, it can illuminate how contextual and methodological differences influence these relationships, offering guidance for tailoring interventions to specific educational environments. Professional learning less impactful in certain contexts, while supervisors may rely on evaluation tools that overlook critical aspects of instructional leadership or supervision quality (Taddese & Rao, 2022). In resource-constrained education systems, such as many in Southeast Asia, have heightened these inefficiencies consequences, potentially diverting scarce resources from strategies with proven impact.

The worldwide emphasis on competency based accountability and data-informed leadership has necessitated principals who can effectively merge supervisory and instructional roles. This is evident in Indoneisa's education policies (2019-2025), which focus on instructional quality and professional development. Consequently, research into the links between supervision. Leadership, and performance has grown. However, a systematic review of how contextual factors moderate these relationships is absent. This gap prevnets a holistic understanding thereby impeding the creation of coherent principal training and evaluation systems. Thus, a meta-analytic approach offers a robust methodological solution. By aggregating quantitative evidence, transforming diverse statistical metrics into a common effect-size framework, and examining potential moderators, it is possible to establish benchmark relationships and unpack the sources of variability. Such an approach "how much" supervision not only clarifies and instructional leadership matter for principal performance but also identifies "under what conditions" these relationships knowledge can inform are strongest. This policy design, refine leadership preparation curricula, and guide the development of targeted supervisory interventions

This study investigates the dual influence of academic supervision and instructional leadership on the principal performance through a systematic literature review of 27 scholarly articles. The review process includes topic identification, literature search, analytical synthesis, and critical evaluation. Findings indicates a clear relationship; optimal academic supervision strengthens instructional leadership, which, in turn, enhances overall leadership performances. Against this backdrop, the present study undertakes a systematic meta-analysis of research published between 2018 and 2025. It addresses three guiding questions: 1) What is the pooled correlation between academic supervision and principal performance? 2) What is the pooled correlation between instructional leadership and principal performance? 3) To what extent do study features—such as sample size, country context, educational sector, and measurement approach—explain heterogeneity in these relationships?

The result of this meta-analysis is expected to offer practical insights for policymakers and institutional stakeholders, particularly in developing evidence-informed academic oversight strategies aimed at bolstering school leadership. Notably, the effectiveness of academic supervision is not solely contingent upon the principal role; it is deeply intertwined with instructional leadership. Effective instructional leadership fosters a collaborative culture among educators, establish clear instructional goals, and facilitate reflective teaching practices that enhance overall school performance. The study's contributions are threefold. First, it synthesizes a dispersed and methodologically diverse body of work into a coherent, evidence-based account. Second, it enhances methodological transparency through explicit construct definitions, reproducible coding strategies, and standardized effect-size calculations. Third, it generates actionable implications for policymakers, leadership trainers, and evaluators—particularly in Indonesia and in comparable education systems undergoing transformation—seeking to align supervisory and instructional leadership practices with measurable performance improvement.

Ultimately, the findings highlight the symbiotic relationship between academic supervision and instructional leadership in driving continuous improvement in educational quality. Integrating these leadership dimensions is essential for cultivating high-performing school environment. As such, this study advocates for a holistic framework that strategically combines supervisory rigor with instructional vision – thereby enabling principals to lead with impact and elevate educational outcomes systematically.

Method

Research Design

This study employs a quantitative research meta analysis design to synthesize the empirical relationships between academic supervision, instructional leadership, and principal performance across independent studies. Meta-analysis converts diverse statistical outputs into a common effect-size metric and models sampling error explicitly, yielding more precise and generalizable estimates than narrative reviews alone (Dowdy et al., 2021; Hagger, 2022). This design is well-suited to the leadership literature, where operational definitions and measurement approaches vary widely and where single-site studies often lack power to detect stable effects across context (Harrer et al., 2021). To ensure transparancy and replicability, the review adheres to PRISMA standards for identification, screening, eligibility, and inclusion, with an a priori protocol that specifies construct, population, and analytic decisions. Inclusion criteria target studies that quantitatively examine academic supervision and or instructional leadership in relation to principal performance, while exclusion criteria remove designs lacking computable effects if focusing solely on teacher outcomes. Because relevant evidence spans English- and Indonesian language sources, the design incorporates bilingual database searchesand backward-forward citation tracing, alongside selective grey literature screening to mitigate publication bias.

Effect sizes are standardized as Pearson's r and meta-analyzed on Fisher's z scale before back-transformation for interpretation, allowing consistent treatment of correlations derived from diverse statistics. A random-effects model is adopted to acknowledge genuine variablity in population effects across studies, reflecting contextual differences in policy environment, school level, and measurement. Statistical heterogeneity is quantifies using Cochran's Q, between study variance and the incostistency index which guides the interpretation of pooled effects and the necessity of moderator analysis.

Moderator analyses and meta-regression probe whether study characteristicss-such as sector, geographic region, instrument type, or sample size-systematically influence observed relationships, thereby explaining part of the between study variance. Robustness checks include leave one out diagnostics and influence analyses to assess sensitivity to individual studies of pooled estimates. To evaluate small-study and publication biases, the design combines visual inspection of funnel plots with Egger's trim test, providing both detection and adjustment strategies when asymmetry is present.

Finally the design is attentive to conceptual alignment with the leadership domain, ensuring that operationalizations of instruction academic supervisional leadership, and principal performance are coded transparently and mapped onto established frameworks for comparability across contexts. By integrating procedures, defense rigorous identification modeling choices, and comprehensive bias and sensitivity assessment, this meta analytic design delivers effect estimates that are both statistically sound and practically meaningful for leadership development and policy in Indonesia and similar education systems.

Table 1. Criteria for Meta-Analysis Study Selection Based on Inclusion and Exclusion

Criteria	Inclusion	Exclusion
Access through global journal database	Available via Taylor & Francis, ScienceDirect, ResearchGate, or Google Scholar	Not available or accessible through this database
Publication country	Published only in different countries	Only published locally or in a single nation
Publication language	Composed in English	Written in a language other than English
Indexing status	indexed in Scopus, SINTA, or Google Scholar	Not indexed in any of the databases mentioned
Year of publication	Published between 2018-2025	Published outside the 2018-2025 range
Reporting statistics on appropriate variables	Report a correlation (r) or t-test value relevant to the variable being studied	Not reporting r or t
Sample size	Minimum 35 participants	Less than 35 participants in the sample

Table 1 outlines the inclusion and exclusion criteria used to screen studies for the meta-analysis, ensuring methodological rigor and relevance. Only articles accessible through reputable global journal databases—Taylor & Francis, ScienceDirect, ResearchGate, or Google Scholar—were considered, and publications had to originate from countries outside the local context to enhance cross-contextual applicability. Eligible studies were composed in English and indexed in Scopus, SINTA, or Google Scholar, published between 2018 and 2025 to ensure contemporary relevance. Furthermore, studies were required to report appropriate statistical values, specifically correlation coefficients (r) or t-test results, and to involve a minimum sample of 35 participants to maintain statistical robustness. Any research failing to meet these criteria—such as locally

confined publications, non-indexed sources, or studies lacking relevant statistics—was excluded. By applying these parameters, the selection process prioritized high-quality, comparable, and up-to-date evidence for synthesis.

Determining studies should be included was the aim of the meta-analysis (Ahn & Kang, 2018). In order to define inclusion and exclusion criteria that should be applied right away to find related papers, the hypothesis for meta-analysis research is therefore highly helpful (Johnson & Hennessy, 2019). A thorough literature study served as the foundation for this article's authoring process. Four significant academic databases provided the reviewed papers, as shown in Figure 1: (1) ScienceDirect, (2) ResearchGate, (3) Google Scholar, and (4) Taylor & Francis. A total of 27 pertinent papers were found by restricting searches to publications from the previous seven years (2018–2024) and using the Google Scholar database's "supervision" AND "instructional leadership" AND "performance" keywords.

The first step in the screening procedure is to find articles and assess their relevance to the study's topic. At this point, the author uses preset inclusion and exclusion criteria (shown in Table 1) to exclude any things that don't meet the requirements. There are still 27 articles after this replay. The last step is downloading and carefully reading these papers' entire contents. This step is crucial to ensuring that every article satisfies all inclusion requirements, particularly those related to methodological rigor, content relevance, and the availability of statistical values (like r or t) that explain the relationship between principal performance, instructional leadership, and supervision. Following a rigorous screening process, 27 papers were found to meet all criteria and were subsequently incorporated into the final analysis.

Data Coding

Facilitating data collection and comprehension presented in coding, is the most crucial precondition for meta-analysis (Kaufmann & Reips, 2024). The primary tool used in this meta-analysis is a coding sheet. Along with extra remarks, such as journal data from foreign sources, the coding offers a thorough explanation of the features of the included articles, including the year of publication, country of origin, sample size (n), correlation coefficient (r), t-value, z-score, and standard error (SE). Table 2 displays the distribution of publications.

Table 2. Comparison of 27 Studies Based on n, r, and t value, 2028-2024

Study	Country	n	r	t	Z	SE
Nuriyah et.al (2024)	Indonesia	96		5.646	0.553623	0.103695
Yunanda et al (2024)	Indonesia	53		5.386	0.696496	0.141421
Astuti et al (2025)	Indonesia	70		2.509	0.299752	0.122169
Hasibuan et al (2023)	Indonesia	48		2.711	0.389771	0.149071
Hijrah et al (2024)	Indonesia	102		1.671	0.166332	0.100504
Efendi (2024)	Indonesia	80		4.414	0.481021	0.113961
Suyarti (2022)	Indonesia	39		5.63	0.82775	0.166667
Purnama et al (2023)	Indonesia	79		0.595	0.067755	0.114708
Syuaib dkk (2022)	Indonesia	82		9.102	0.893788	0.112509
Abdullah et al (2022)	Indonesia	76		13.207	1.214176	0.117041
Sika et al (2024)	Indonesia	117		13.416	1.048248	0.093659
Noval et al (2025)	Indonesia	65		2.525	0.312985	0.127
Suryantini et al (2022)	Indonesia	49		2.459	0.351405	0.147442
Gandung et al (2022)	Indonesia	80		11.677	1.09189	0.113961
Andri et al (2023)	Indonesia	53		7.879	0.952552	0.141421
Daulay et al (2025)	Indonesia	22		1.686	0.368598	0.229416
Yahya et al (2018)	Indonesia	59	0.434		0	0.133631
Elfira et al (2024)	Indonesia	127		9.008	0.737113	0.089803
Tatlah et al (2019)	Pakistan	60		12.701	1.284339	0.132453
Nazim Dkk (2023)	Indonesia	361		17.207	0.814913	0.052852
Nurabadi et al (2024)	Indonesia	214	0.144		0	0.068843
Jimenez dkk (2023)	Philippines	256	0.122		0	0.062869
Nellitawati (2024)	Indonesia	133	0.279		0	0.087706
Bafadal et al (2018)	Indonesia	46	0.445	4.762	0.667268	0.152499
Wahyuni et al (2019)	Indonesia	120		6.795	0.590593	0.09245
Daing et al (2022)	Philippines	204	0.825		0	0.070535
Tongli dkk (2024)	Indonesia	675		3.412	0.131147	0.038576

Table 2 summarizes the primary studies included in the meta-analysis, detailing authorship, publication year, country of origin, sample size (n), and key statistical metrics used in effect size calculation. The dataset encompasses 27 studies, the majority conducted in Indonesia, with additional contributions from Pakistan and the Philippines, reflecting both local and regional perspectives on the variables under investigation. Sample sizes vary widely—from small-scale studies with 22 participants to large-scale surveys involving 675 participants—allowing for an assessment of effects across diverse population scopes.

The statistical columns present either the reported correlation coefficient (r) or the computed t-value, along with the derived Fisher's Z transformation and standard error (SE) for each study. Many rows show a blank r value, indicating that the original studies reported t-statistics rather than direct correlations, which were then converted into Z scores for meta-analytic synthesis. Variation in t-values and Z scores reflects differences in effect magnitude, while SE values demonstrate the degree of precision associated with each estimate—smaller SEs corresponding to larger, more stable samples. By presenting this information in a single table, readers can trace how individual study characteristics and reported statistics feed into the aggregated meta-analytic calculations, and better interpret the heterogeneity observed in the pooled results.

Data Analysis

The characteristics of the research sample, data coding, effect size heterogeneity testing, converting t-values to R correlation coefficients, calculating average or summary effect sizes, creating funnel and forest plots, testing hypotheses, and verifying publication bias are all part of the analysis in this study. A correlation-based meta-analysis was performed with information from 27 publications that were indexed by Scopus, SINTA, and Google Scholar. Using standard criteria, effect sizes were classified as very weak (< ±0.1), weak (< ±0.3), medium (< ±0.5), strong (< ±0.8), and very strong (≥ ±0.8) according to Cohen's criteria (Cohen et al., 2020). A flexible software program for statistical data analysis and interpretation, JASP version 0.14.1.0, was used to conduct the statistical study. JASP offers several features, including the option to apply Cohen effect size criteria, assumption testing, and compatibility with various computer operating systems. To ensure the reliability of data coding and thematic extraction, a two-phase coding protocol was implemented. Initial coding was conducted independently by two trained coders, followed by a blind cross-check to reduce subjective bias. Interrater reliability was calculated using Cohen's kappa, resulting in an agreement score of 0.87, indicating a high level of consistency.

Result and Discussion

Result

Supervision on Performance

Different r and t values were obtained from each of the 16 studies selected based on inclusion criteria. Prior to conducting the heterogeneity test, all studies that did not report an r-value had their t-value is converted into a correlation coefficient r. The results of the heterogeneity test are presented in Table 2, while the residual heterogeneity estimate is shown in Table 3.

Table 3. Test for Heterogeneity test

	Q	df	p
Omnibus test of Model Coefficients	44.897	1	< .001
Test of Residual Heterogeneity	142.156	15	< .001

Note. *p* -values are approximate.

Table 4. Residual heterogeneity estimates

		95% Confidence Interval	
	Estimate	Lower	Upper
τ^2	0.115	0.055	0.290
τ	0.340	0.234	0.539
I^2 (%)	88.380	78.331	95.027
H^2	8.606	4.615	20.108

The heterogeneity test yielded a Q value of 142.156 with $p < 0.001$, indicating significant heterogeneity among the ten effects measures analyzed. I^2 statistics are about 100%, further confirms substantial variability across studies, with $\tau^2 > 0$. Given this level of heterogeneity, a random effects models are used for further analysis. This model is also used to assess publication bias and to calculate summary or average effect size. The findings of the average impact measure or summary effect analysis are presented in Table 4.

Table 5. Summary effect or mean effect size

					95% Confidence Interval	
	Estimate	Standard Error	z	p	Lower	Upper
intercept	0.611	0.091	6.701	< .001	0.432	0.790

Note. Wald test.

The study discovered a significant positive relationship between supervision and performance using a randomized effects model (Z = 6,701; 95% CI [0.432; 0.790]). Hypothesis 1 (H1) is accepted since a p-value of less than 0.001 indicates that supervision and performance are significantly correlated. The relationship between supervision and performance was moderate-to-strong positive relationship (rRE = 0.611).

Furthermore, the analysis's findings are displayed through the use of forest plots, a graphical method that shows the estimated combined impacts. Plots, which are shown by dots at predetermined intervals, make cross-study comparisons easier and enhance the clarity of the results. Figure 1 displays the forest plots for the 20 research that were part of this analysis. The plot showed that the effect size of the studies studied ranged from 0.00 to 1.44. After this, a funnel plot is created. In meta-analysis, Begg's funnel plot, a scatter diagram, is typically used to visually assess the bias of a potential publication, indicating whether the research sample is symmetrically or asymmetrically distributed. The funnel plots for the ten studies under investigation are shown in Figure 2. However, the model's symmetry or asymmetry, it is challenging to conclusively identify publication bias using funnel plots alone. Consequently, additional study utilizing the Egger test is required. Table 6 and Figures 1 and 2 present the Egger test results.

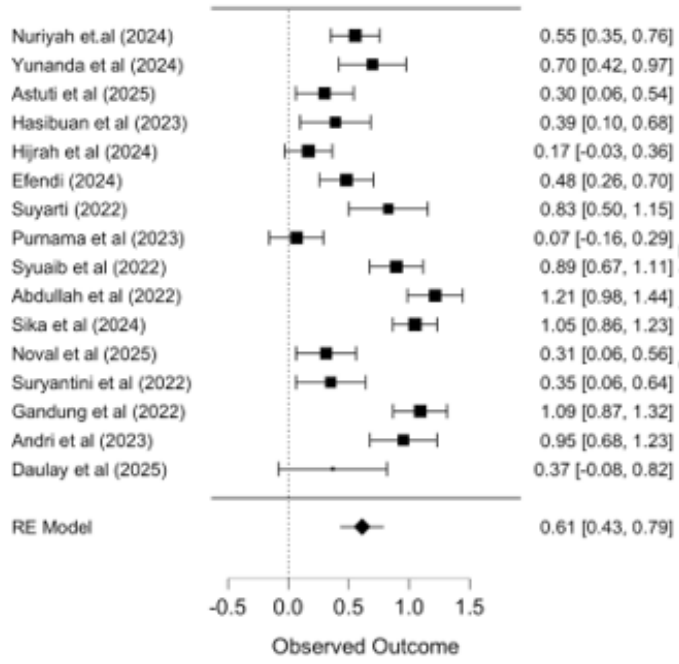

Figure 1: Meta-analysis forest plot

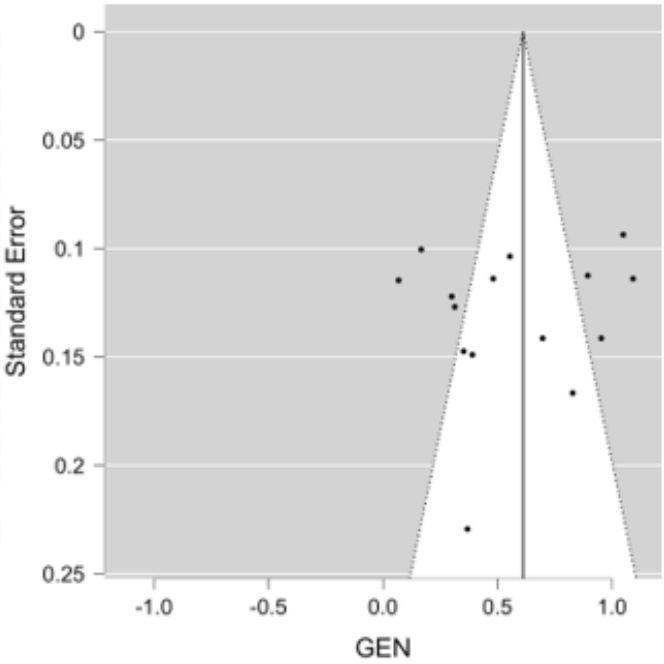

Figure 2: Funnel plot after trim-fill diagnosis

Tabel 6. Regression test for Funnel plot asymmetry ("Egger's test")

	z	p
sei	- 0.538	0.591

Table 5 shows that Z = -0,538, with a significance level of p > 0.05. Symmetry of funnel plots Confirmed. As a result, this meta-analysis study was not affected by publication bias.

Instructional Leadership on Performance.

In Table 7, the results of the heterogeneity test are presented, while Table 7 estimates the residue heterogeneity.

Table 7. Heterogeneity test

	Q	df	p
Model Coefficients Omnibus test	22.277	1	< .001
Test of Residual Heterogeneity	325.318	10	< .001

Tabel 8. Estimation of Residual heterogeneity

		95% Confidence Interval	
	Estimate	Lower	Upper
τ^2	0.156	0.072	0.072
τ	0.395	0.268	0.268
I^2 (%)	96.684	93.058	93.058
H^2	30.160	4.404	4.404

Fifteen effect measures from the studies considered were found to be heterogeneous, such as shown by the results of the heterogeneity test: Q = 325.318, p < 0.001, τ^2 > 0, and I^2 (%) about 100%. Furthermore, the publication bias test was carried out using a random, and average effect approach. The size of the effect or summary effect is estimated. The results of the summary effect analysis are presented in Table 9.

Tabel 9. Summary effect or mean effect size

					95% Confidence Interval	
	Guess	Standard Error	z	p	Lower	Upper
intercept	0.578	0.122	4.720	< .001	0.338	0.818

Tabel 9. Summary effect or mean effect size

					95% Confidence Interval	
	Guess	Standard Error	z	p	Lower	Upper

Note. Wald test.

Research employing random-effects models shows that performance and instructional leadership are strongly positively correlated (Z = 4.720; 95% CI [0.338; 0.818]). This substantial association is further supported by a p-value of less than 0.001, which means that Hypothesis 2 (H2) is accepted. The relationship between performance and instructional leadership was classified as medium (rRE = 0.578). Furthermore, the data were visually displayed using forest plots, which made cross-study comparisons easier by providing estimates of cumulative effects through dot plots at particular intervals. The forest plots for the six research that are part of this study are shown in Figure 3. The effect size of the studies studied ranged from 0.00 to 1.54, as illustrated on the forest plot. Funnel plots are then created. Begg's funnel plot, a scattering diagram commonly used in meta-analysis, visually identifies potential publication bias by revealing whether the study population is symmetrically or asymmetrically distributed. Figures 3 and 4 display the funnel plots for the 15 research that were examined. However, it is challenging to assess the publishing bias just based on the funnel plot because of the final model's symmetry or asymmetry. Consequently, additional study utilizing the Egger test is required. Table 10 displays the outcomes of the Egger test.

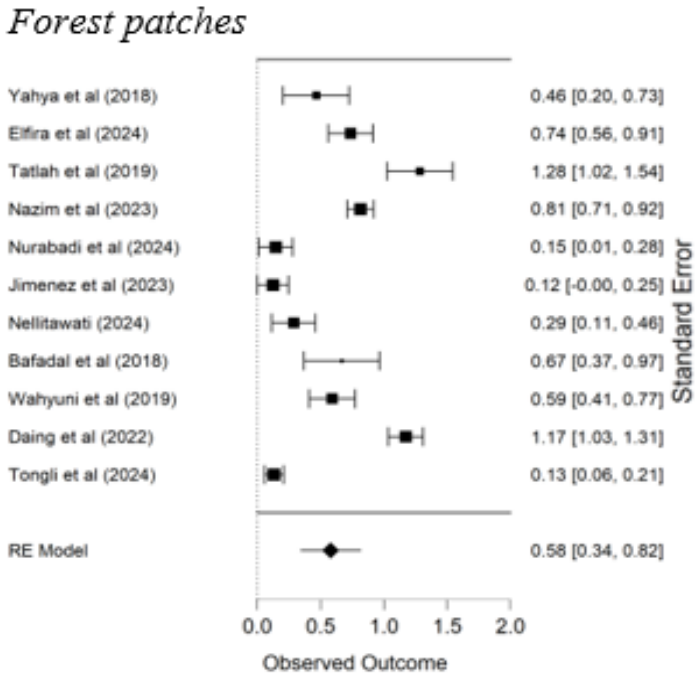

Figure 3. Meta-analysis forest plot

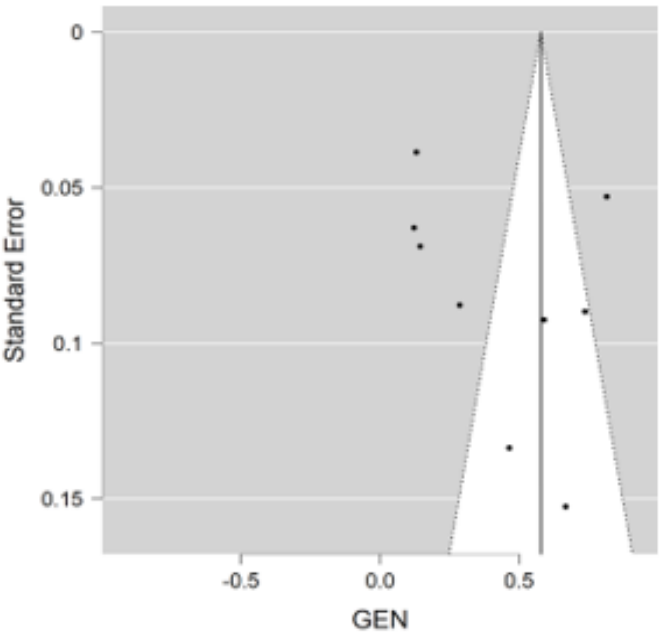

Figure 4. Funnel plot after trim-fill diagnosis

Table 10. Regression test for Funnel plot asymmetry ("Egger's test")

	z	p
sei	1.219	0.223

Table 9 shows that z = 1.219 and p > 0.05. It illustrates the symmetry of the funnel plot. So this meta-analysis study was not affected by publication bias.

Based on an analysis of 27 studies using meta-analysis, it was shown that supervision and instructional leadership significantly affected on principal performance. For academic supervision, the pooled correlation coefficient indicates a moderate-to-strong positive relationship. This finding suggests that principals who receive structured, formative, and criteria-based supervision tend to demonstrate higher levels of professional effectiveness. Heterogeneity analysis confirms considerable variability across studies, justifying the application of a random-effects model and prompting further examination of contextual moderators such as school level, geographic setting, and supervision model. Instructional leadership exhibited a comparable but slightly smaller overall effect, underscoring its role as a critical driver of school leadership quality. The high heterogeneity reflects diversity in how leadership practices are conceptualized and enacted across different educational contexts.

The meta-analysis revealed that both academic supervision and instructional leadership exert substantial, statistically significant effects on principal performance. In particular, high levels of instructional leadership correlate with improved work performance among principals, highlighting the importance of effective leadership practices in educational settings. The study emphasizes the need for school leaders to adopt comprehensive supervision strategies that integrate academic supervision and instructional leadership to maximize their effectiveness and improve educational outcomes. The findings suggest that strengthening instructional leadership practices is essential for improving overall principal performance and improving educational outcomes in various settings (Tongli et al., 2024). In both domains, Egger's regression tests yielded non-significant results, suggesting no publication bias. Collectively, these findings affirm that the integration of strong academic supervision and effective instructional leadership creates a synergistic framework for enhancing principal performance, thereby reinforcing school improvement efforts and, ultimately, student learning outcomes (Mulyadi;, 2023).

The study advocates for the implementation of targeted training programs that equip principals with essential skills in academic supervision and instructional leadership to drive improved educational outcomes (Bafadal et al., 2018) The integration of academic supervision and instructional leadership is essential to fostering a culture of continuous improvement within educational institutions (Nellitawati et al., 2024). This approach not only improves the performance of school leaders but also fosters an environment conducive to continued educational excellence. Findings suggest that a synergistic approach that combines academic supervision and instructional leadership can lead to significant advances in educational quality and principal effectiveness. In conclusion, this meta-analysis underscores the critical need for educational institutions to prioritize the development of academic supervision and instructional leadership to improve overall school performance (Bafadal et al., 2018) This research highlights the critical role of effective academic supervision and instructional leadership in driving educational excellence, ultimately leading to improved outcomes for students and teachers. This study reinforces the idea that effective instructional leadership, alongside strong academic supervision, serves as a catalyst for improving teacher performance and overall school effectiveness (Gading, 2024). Given these findings, it is critical for education leaders to recognize the diverse nature of supervision and instructional leadership in driving school improvement. This comprehensive analysis illustrates an important relationship between effective instructional leadership and the overall performance of educational institutions, ultimately fostering a thriving learning environment for all stakeholders.

Conclusion

This meta-analysis investigates the role of academic supervision and instructional leadership in enhancing principal performance. The findings demonstrate that both variables significantly influence performance, with instructional leadership exerting a stronger effect than academic supervision. This indicates that efforts to improve principal performance should prioritize instructional leadership practices, while still recognizing the supportive role of academic supervision. The absence of publication bias affirms the reliability of the included studies, which, although from diverse academic fields, share a consistent sample focus. These results not only validate prior research but also offer new insights into the strategic development of principal performance.

Future research is encouraged to broaden the sample base and explore deeper theoretical frameworks, particularly by incorporating potential moderating variables such as gender, academic rank, and institutional type. Examining these moderators can provide a more nuanced understanding of how leadership and supervision impact performance across different academic contexts. This study advances the understanding of human resource strategies in academic settings and highlights leadership as a crucial determinant of sustainable excellence. Practically, it provides valuable implications for educational leaders and policymakers in optimizing principal performance through effective leadership and supervision.

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The authors declare no conflict of interest

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