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Mapping Research on Educational Supervision in Science Practicums to Improve Students' Science Process Skills

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ABSTRACT

Educational supervision plays a crucial role in improving the quality of instruction, particularly in science practicum activities aimed at developing students' science process skills. This study aims to describe research trends on the implementation of educational supervision in science practicums to enhance science process skills. The method employed is descriptive-analytical by reviewing 1,000 documents indexed in Google Scholar from 2016 to 2025 using Publish or Perish and Dimensions AI. The results show a dynamic pattern of publication growth, with a significant increase from 2016 to 2020 followed by fluctuations in subsequent years. Most publications are journal articles, indicating strong peer-reviewed scholarly attention in this field. Bibliometric mapping identifies four dominant themes: learning quality, laboratory management, teacher professional development, and the strengthening of science process skills. These findings confirm that well-planned and collaborative educational supervision in science practicum activities contributes to improving both teacher competence and students' scientific abilities. The implications suggest that the results of this study can serve as a reference for teachers, schools, and supervisors in designing supervision strategies that are more effective, relevant, and sustainable.

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Introduction

Educational supervision holds a strategic role in improving the quality of instruction, as it functions to guide teachers in planning, implementing, and evaluating the learning process professionally (Efendi, 2022). In science education, the need for supervision becomes increasingly important because laboratory activities require teachers to be well-prepared in managing equipment, designing experiments, and creating learning experiences that enable students to build understanding through scientific processes (Utami et al., 2025). Without proper supervision, practical activities often become merely demonstrative and fail to stimulate active student engagement (Syamsu, 2018).

Laboratory work serves as a key avenue for developing Science Process Skills (SPS), ranging

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from basic skills such as observing and measuring to integrated skills such as formulating hypotheses, controlling variables, and interpreting data (Irawan et al., 2024; Ramadhani et al., 2025). Practical activities provide opportunities for students to connect theoretical concepts with real-life experiences through observation and experimentation (Arini & Darmayanti, 2022), and numerous studies indicate that experiment-based learning can enhance students' scientific thinking abilities and learning autonomy (Amakraw & Kartika, 2022). However, the successful development of SPS largely depends on teachers' ability to apply scientific approaches in laboratory work, a process that can be strengthened through effective, collaborative, and continuous educational supervision (Murtyaningsih & Utami, 2024).

Despite its importance, the implementation of science practical activities in schools still faces various challenges, such as limited laboratory facilities and equipment (Arviani et al., 2024), variations in teachers' competence in designing inquiry-based practical activities (Nuai & Nurkamiden, 2022), and supervisory practices that emphasize administrative compliance rather than substantive professional guidance (Efendi, 2022). These conditions hinder the optimization of laboratory work and prevent students' SPS development from reaching its full potential. Meanwhile, research on educational supervision and science practicum continues to grow each year (Dewi et al., 2021; Karengga et al., 2025), but the findings remain scattered and have not been systematically mapped, making it difficult to identify common patterns, thematic focuses, and potential directions for future research.

Based on these issues, this study aims to map the development and trends of research on educational supervision in science practicum to enhance students' SPS through a Systematic Literature Review (SLR) approach. The novelty of this study lies in the integration of bibliometric and thematic analyses of publications from the last decade, enabling the presentation of a comprehensive overview of research directions and future development opportunities. The expected implication is the provision of an empirical foundation for supervisors, principals, and teachers in designing more effective supervision strategies that positively impact the quality of practical activities and students' scientific skills.

Method

This study employed descriptive and analytical methods aimed at understanding and outlining research trends on the implementation of educational supervision in science practicum activities to enhance students' science process skills in schools. The data used in this research were obtained from sources indexed in Google Scholar by utilizing analytical tools such as Publish or Perish and Dimensions.ai. To retrieve relevant studies from Google Scholar, the keywords used were "educational supervision," "science practicum," and "science process skills."

The analysis was conducted on 1,000 documents indexed in Google Scholar from 2016 to 2025. Google Scholar was selected as the primary database because it applies consistent standards in determining documents for inclusion in its index and provides broader coverage than other databases, particularly in the field of educational research (Mahelingga, 2021).

Result and Discussion

Trends in Publication and Distribution of Research Sources

This study aims to describe research trends related to the application of educational supervision in science practicums to improve science process skills during the period 2016–2025. The number of publications in this range is presented in Figure 1.

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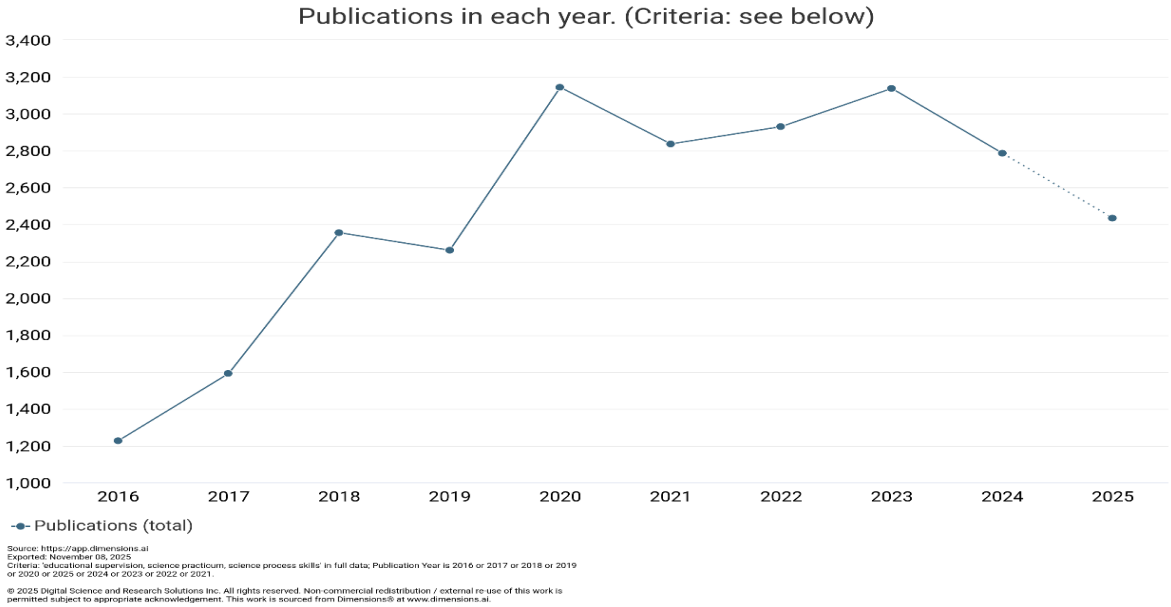

Figure 1. Number of studies on the Application of Educational Supervision in Chemistry Practicum to Improve Science Process Skills

Figure 1 illustrates the development of publication numbers related to educational supervision, science practicum, and science process skills from 2016 to 2025 based on Dimensions AI data. The initial trend shows a significant increase: the lowest number of publications appeared in 2016, rose in 2017, and then surged sharply in 2018. After a slight decline in 2019, publication numbers again reached their peak in 2020. Following 2020, the trend fluctuated, with a decrease in 2021, a rebound in 2022–2023, and another decline in 2024. Meanwhile, the dashed line in the chart indicates that the 2025 data represent projections or preliminary figures.

This pattern suggests that research interest in this field grew strongly up to the pandemic period (Wardhana, 2020), aligning with the increasing attention to learning innovations and the quality of supervision (Warhamni et al., 2024). Variations in subsequent years reflect shifting research priorities, post-pandemic transitions, and fluctuations in the number of studies indexed in the database. Following the explanation of the chart, Table 1 is presented to summarize studies related to the implementation of educational supervision in science practicum to enhance science process skills based on publication type

Table 1. Publication Type Research Trends in Educational Supervision in Science Practicum to Improve Science Process Skills 2016-2025

Publication Type	Publications
Article	9,638
Chapter	8,982
Edited Book	3,827
Monograph	1,788
Proceeding	412
Preprint	217

Table 1 shows that scientific articles are the most dominant type of publication, with 9,638 documents, indicating that topics related to educational supervision, science practicum, and science process skills are most frequently discussed through empirical studies that have undergone peer review. Book chapters occupy the second position with 8,982 publications, followed by edited books with 3,827 publications, reflecting the contribution of compiled works in expanding theoretical perspectives. Monographs total 1,788 publications, demonstrating the presence of in-depth works that examine specific issues in science education. Meanwhile, conference proceedings (412 publications) and preprints (217 publications) represent the smallest proportions, suggesting that preliminary studies or those presented in academic forums remain relatively limited. Overall, this distribution indicates that research in this field is dominated by reputable formal publications, thereby ensuring high academic credibility of the available findings. The dominance of scientific articles

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highlights the substantial contribution of peer-reviewed research, which strengthens the validity and credibility of the findings (Lutfi & Prasetiya, 2024; Jamin et al., 2025; Raharjo & Ariyanto, 2025).

In addition to reviewing the number and types of publications, it is also important to identify the most influential scientific sources or outlets publishing studies on educational supervision, science practicum, and science process skills. An analysis of the top ten publication sources provides insight into the journals and publishers that serve as key channels for disseminating knowledge in this field. This information not only reveals areas where research is concentrated but also helps in understanding the academic platforms through which this body of work is developing whether in general education, science education, or teacher professional development. The following list presents the ten sources with the highest numbers of publications and citations

Table 2. Top Ten Sources of Research Trends in Educational Supervision in Science Practicum to Improve Science Process Skills 2016-2025

Journal	Publications	Citations	Citations Mean
Education Sciences	207	2,026	9,79
Teaching and Teacher Education	189	4,985	26.38
Jurnal Penelitian Pendidikan IPA	121	255	2.11
Social Work Education	100	1,011	10.11
Sustainability	99	2,622	26.48
Frontiers in Education	90	566	6.29
Springer International Handbooks of Education	88	678	7.70
Journal of Social Work Education	74	836	11.30
Counselor Education and Supervision	66	534	8,09
PLOS ONE	65	911	14.02

The data in Table 2 show that the top publication sources are dominated by reputable international journals in the fields of education and teacher development, such as Teaching and Teacher Education and Sustainability, both of which have high average citation counts, indicating strong academic influence within the scholarly community. Education Sciences emerges as the outlet with the highest number of publications, reflecting sustained interest in topics related to supervision and science learning (Hinojo-Lucena et al., 2019).

Meanwhile, Jurnal Penelitian Pendidikan IPA holds an important position as a representation of national contributions in the field of science education. The diversity of publication sources demonstrates that studies on educational supervision and science practicum span a wide scope and receive attention from various educational disciplines, ranging from science education and teacher professional development to social education (Rappeh & Agustin, 2025). This indicates that the topic is cross-disciplinary and continues to develop across different research contexts (Mersendi et al., 2024).

The publication sources consist of both international and national journals relevant to supervision and science education, showing that this issue is significant in global and local contexts. This supports the view that supervision plays a vital role in improving the quality of practicum planning and implementation (Efendi, 2022), as well as in facilitating learning grounded in scientific processes (Syamsu, 2018).

Table 3. Top Ten Citations on Educational Supervision Research Trends in Science Practicum to Improve Science Process Skills from 2016 to 2025

Cities/ year	Year	Author	Title
22.50	2023	Wola et al.	Science Process Skills of Prospective Science Teacher's in Practicum Activity at The Laboratory
4.71	2018	Duda & Susilo	Science Process Skill Development: Potential of Practicum Through Problems Based Learning and Authentic Assessment

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6.50	2021	Firmansyah & Suhandi	Critical Thinking Skills and Science Process Skills in Physics Practicum
4.33	2022	Khan	Towards Developing Library and Information Science Practicum Supervision Competency Framework
5.29	2018	Astuti et al.	Developing Practicum Module of Particle Dynamics Based on Scientific Methods to Improve Students' Science Process Skills
3.67	2016	Al-Momani	Challenges of Practicum at College of Education: Supervisors & Students' Teachers Perspective
10.00	2024	Adiyanto et al.	Hybrid Android Interface Practicum Mode to Develop Students' Science Process Skills
11.43	2018	Callahan & Watkins	The science of training III: Supervision, competency, and internship training
17.20	2020	Inayah et al.	Analysis of Science Process Skills in Senior High School Students
9.75	2021	Febriansyah et al.	Developing Electronic Student Worksheet (E-Worksheet) Based Project Using Fliphtml5 to Stimulate Science Process Skills During the Covid-19 Pandemic

Keyword Analysis and Thematic Mapping of Research

Table 4 presents a summary of the most frequently occurring keywords in publications related to educational supervision in science practicum aimed at improving science process skills during the period 2016–2025. Keyword analysis is essential for identifying the main research foci, thematic patterns, and dominant conceptual relationships within the literature (Destari & Hidayat, 2024; Alif & Solihin, 2023; Hendri & Manongga, 2024). The frequency of occurrence and relevance values provide insights into which terms exert the greatest influence in shaping the research landscape in this field (Judijanto, 2025; Sophia et al., 2025; Widya et al., 2025).

Table 4. Keyword Trends in Educational Supervision in Science Practicum to Improve Science Process Skills 2016-2025

Terms	Occurrences	Relevance
Student's science process skill	5	2.69
Clinical practicum	7	2.16
Site supervisor	5	2.08
Practicum course	5	1.56
Internship supervisor	10	1.40
Clinical supervision	10	1.12
Practicum supervisor	6	1.01
Supervision process	6	0.88
Science process skill	24	0.69
Academic supervisor	18	0.39

Based on Table 4, it is evident that the term science process skills has the highest frequency, indicating that science process skills constitute the central focus of research in this domain. Keywords such as clinical supervision, internship supervisor, and academic supervisor also appear with high frequency, highlighting the importance of supervisory roles within the practicum context. Meanwhile, terms like clinical practicum, practicum supervisor, and site supervisor reflect the diversity of supervisory contexts examined in the literature. The combination of frequency and relevance suggests that research over the past decade has not only focused on enhancing science process skills but has also explored the mechanisms, actors, and supervisory practices involved in the implementation of science practicum.

Furthermore, Figure 2 presents a visualization of keyword co-occurrence mapping generated using VOSviewer, illustrating the thematic structure of research on educational supervision in science practicum and science process skills during the 2016–2025 period. This visualization helps identify major clusters, conceptual relationships, and the ways in which research themes have evolved and interconnected over time. Each color represents a distinct thematic cluster, indicating relatively homogeneous research focuses within each cluster while also showing

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connections across clusters, thereby providing a comprehensive overview of the research landscape in this field.

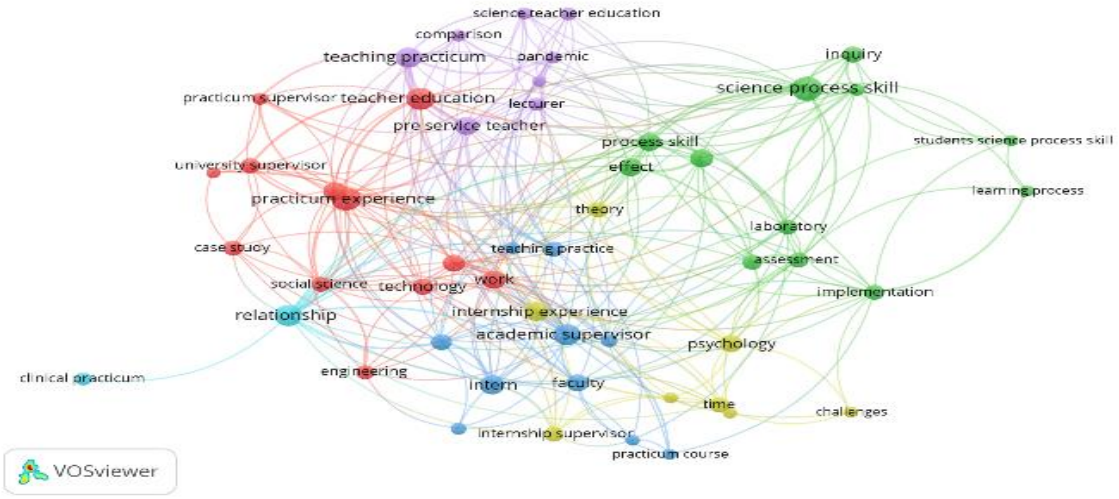

Figure 2. Network visualization in the implementation of educational supervision in science education to improve science process skills.

From the visualization in the figure, it can be seen that the keyword science process skills forms a major cluster that is closely connected with terms such as inquiry, laboratory, assessment, and implementation, indicating that much of the research focuses on developing science process skills through practicum activities. Another prominent cluster is practicum experience and teaching practicum, which illustrates the important role of practicum experiences and supervision within the context of teacher education. Meanwhile, the blue cluster reveals strong links among academic supervisor, internship supervisor, and practicum course, indicating the diverse forms of supervision involved in practical learning.

Overall, the cluster structure shows that research over the past decade has centered around three main axes: enhancing science process skills, strengthening the quality of supervision, and developing practicum experiences as an integral part of science education. This aligns with Hidayatullah et al. (2025), who emphasize that schools must strive to provide adequate infrastructure and academic supervision that support active learning.

Development of Research Focus and Density based on Bibliometric Visualization

Figure 3 presents an overlay visualization used to map the temporal development of research on educational supervision in science practicum aimed at improving science process skills. This visualization illustrates how research foci have shifted over time through a color gradient, where blue represents earlier studies, while green to yellow indicates more recent and emerging themes. Accordingly, the map provides a dynamic overview of the evolution of the research topic, helping to identify issues that are gaining increased attention as well as areas with potential for further growth.

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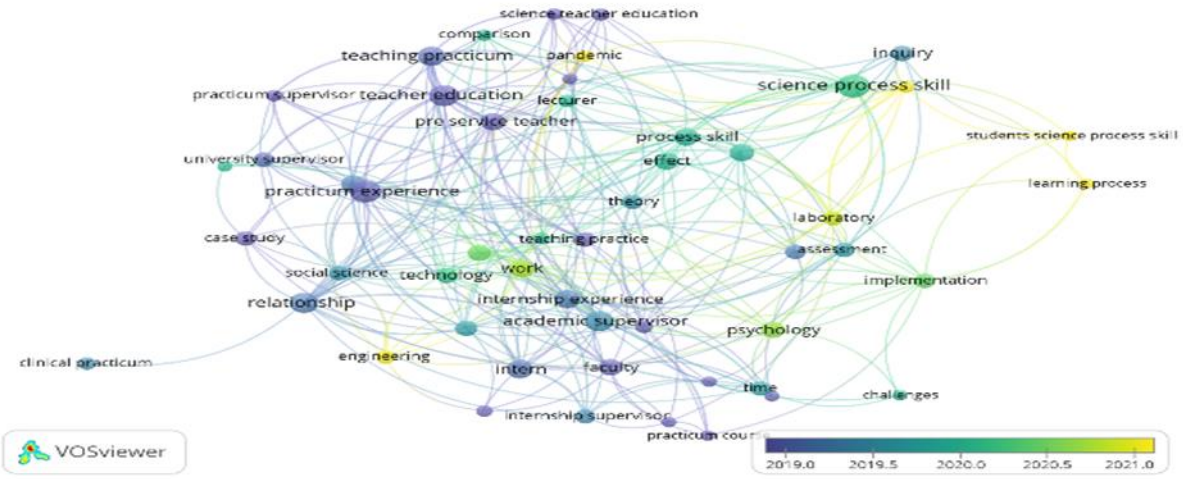

Figure 3. Overlay visualization of research trends in supervised science education in science practicums to improve science process skills

Based on the color patterns in the overlay visualization, it is evident that early studies (represented in blue) focused heavily on themes such as practicum experience, teacher education, relationship, and the role of the academic supervisor. Over time, research attention shifted toward more applied issues, including internship supervisor, teaching practicum, and the strengthening of supervisory processes within the practicum context. Meanwhile, the green-to-yellow color range highlights newer and increasingly popular topics, such as science process skills, inquiry, learning process, and laboratory implementation, indicating growing interest in the development of science process skills through inquiry-based practicum approaches. Overall, Figure 3 reflects a shift from supervision-centered and practicum-experience topics toward reinforcing pedagogical aspects and scientific processes, marking a new direction in research over the past decade.

Furthermore, Figure 4 presents a density visualization that displays the concentration and intensity of research focuses related to educational supervision in science practicum aimed at improving science process skills during the 2016–2025 period. This visualization highlights the terms or themes most frequently examined by researchers, represented through a color gradient: the brighter the color (yellow), the higher the frequency of its occurrence in the literature. Thus, this map helps identify the most prominent areas of research while also revealing the topics that have become central to scholarly attention in the last decade

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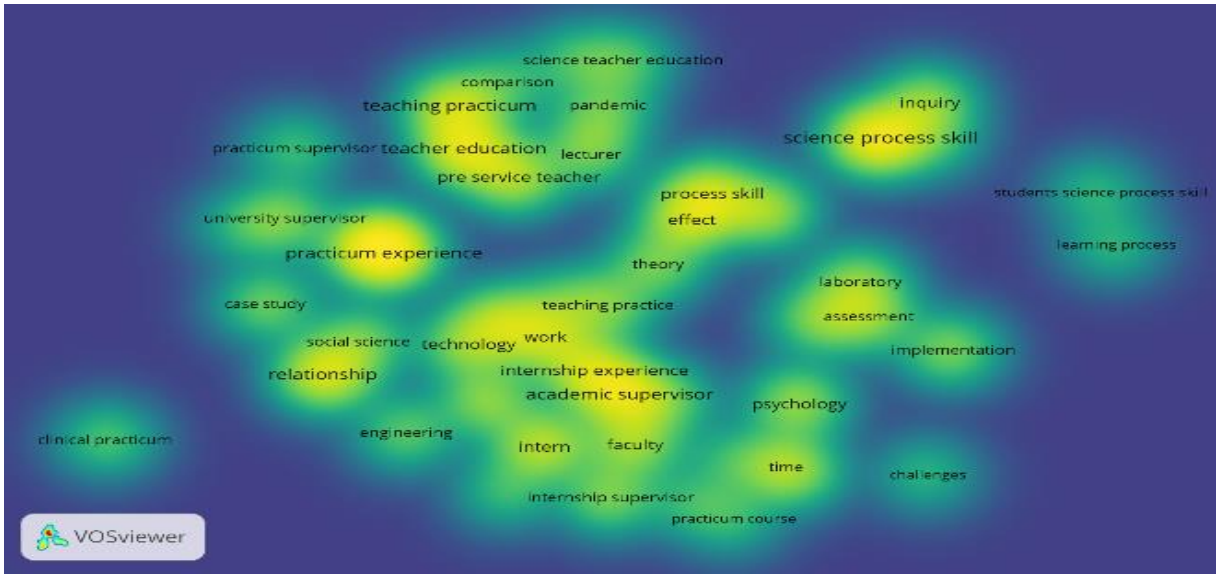

Figure 4. Density visualization of research trends in science education supervision to improve science process skills from 2016 to 2025

The visualization results indicate that the term science process skills occupies the brightest area, signifying that the development of science process skills is the dominant focus in related research. Surrounding this central area is a high density of terms such as teaching practicum, practicum experience, and academic supervisor, demonstrating a strong relationship between practicum implementation and the supervisory roles that contribute to enhancing students' scientific abilities. Several other terms—inquiry, laboratory, learning process, and implementation—also appear with high intensity, indicating that research increasingly emphasizes the application of scientific approaches within the practicum context. Overall, the map shows that studies on educational supervision in science practicum strongly focus on developing science process skills through structured, reflective, and inquiry-based learning practices (Fajarianingtyas & Hidayat, 2020; Saputra, 2025; Wahyudi, 2025; Adnan & Annisa, 2025).

Conclusion

Research on trends in educational supervision in science practicum activities to enhance science process skills holds strong urgency due to its crucial role in improving the quality of 21st-century science learning. An analysis of publications indexed in Google Scholar and Dimensions AI from 2016 to 2025 reveals a fluctuating development pattern, with a significant increase during 2016–2020, followed by inconsistent movements and a decline in 2024. Various document types—including journal articles, conference proceedings, book chapters, monographs, and preprints—discuss this topic extensively, with journal articles dominating, indicating strong academic attention through peer-reviewed empirical studies.

Bibliometric mapping identifies four major themes: learning quality, laboratory management, teacher professional development, and the strengthening of science process skills. Frequently appearing keywords such as science process skill, clinical supervision, and practicum experience demonstrate a strong focus on students' scientific abilities as well as the supervisory mechanisms embedded within practicum activities. Overall, the findings confirm that well-planned, collaborative, and continuous educational supervision in science practicum settings significantly contributes to improving teacher competence and students' scientific skills, making it an important reference for designing more effective and relevant supervision strategies in schools.

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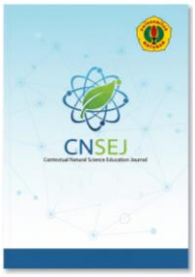

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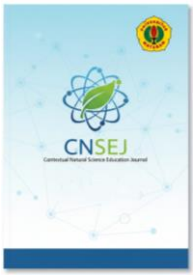

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