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A Systematic Literature Review on Research Gaps in the Pedagogical Competence of Junior High School Mathematics Teachers in Indonesia

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Abstract: The pedagogical competence of Junior High School (SMP) mathematics teachers is a crucial factor in the effectiveness of teaching and student learning outcomes. However, systematic reviews of research trends, findings, and gaps remain limited. This study aims to conduct a systematic literature review (SLR) on the pedagogical competence of SMP mathematics teachers in Indonesia, focusing on: (1) mapping research trends, methodologies, and geographical scope of previous studies; (2) analyzing key findings regarding teachers' mastery of pedagogical competence and influencing factors; (3) identifying research gaps, including the scarcity of longitudinal studies, long-term intervention evaluations, and integration of technology in teaching practices; and (4) providing an empirical basis for strategies to improve teacher competence and to guide future research in a more systematic, relevant, and impactful manner. The study employed the SLR method based on PRISMA guidelines, conducting a literature search on Google Scholar, DOAJ, ERIC, Garuda, and Scopus using relevant keywords, and applying inclusion criteria for peer-reviewed articles published between 2021 and 2025. Of the 109 identified articles, 13 met the inclusion criteria and were analyzed in depth. The results indicate that SMP teachers' pedagogical competence is multidimensional, encompassing teaching skills, content mastery, technology integration, student creativity development, and personal competencies. It is influenced by factors such as educational background, teaching experience, training, practical mentoring, certification, literacy, and technological capabilities. Effective strategies to enhance competence include academic supervision, MGMP (teacher working groups), practical mentoring, and innovative training. Nevertheless, longitudinal studies, long-term evaluations, comparisons of mentoring models, and cross-regional research remain limited. The study's implications emphasize the need to strengthen supervision, mentoring, and technology-based innovation to improve student learning quality and creativity, providing a foundation for more systematic and impactful future research.

Keywords: Indonesia, Junior High School, Mathematics Teachers, Pedagogical Competence, Research Gap, Systematic Literature Review

1. Introduction

Education is one of the main pillars for developing quality human resources. The success of education depends heavily on the quality of learning delivered in schools, particularly in subjects that play a strategic role in developing students' critical, logical, and analytical thinking skills, such as mathematics. Mathematics not only serves as a foundation for science and technology but also functions as a means to train students' analytical, problem-solving, and systematic thinking abilities (Goos, Carreira, & Namukasa, 2023; Just & Siller, 2022; Schoenfeld, 2016). Therefore, the mastery of mathematics is an important indicator of educational quality at the junior high school (SMP) level.

The quality of mathematics learning is greatly influenced by the roles of teachers as facilitators and guides (Coles, 2019; Isa et al., 2023; Yuniarti & Nguyễn, 2024). Pedagogically competent teachers can plan, implement, and evaluate

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learning effectively to ensure that objectives are achieved (Baskara & Sutarni, 2024; Rahmayani et al., 2022). Pedagogical competence of teachers includes the ability to understand student characteristics, design appropriate learning strategies, manage classrooms effectively, and employ methods and media that support the learning process (Talitha et al., 2021). Teachers with high pedagogical competence can deliver interactive, contextual, and relevant learning tailored to students' needs, ultimately enhancing students' conceptual understanding and critical thinking in mathematics (König et al., 2021; Schöer & Clavel, 2024; Shulman, 1986).

Kualitas pembelajaran matematika sangat dipengaruhi oleh peran guru sebagai fasilitator dan pembimbing (Coles, 2019; Isa et al., 2023; Yuniarti & Nguyễn, 2024). Guru yang kompeten secara pedagogik mampu merencanakan, melaksanakan, dan mengevaluasi pembelajaran secara efektif sehingga tujuan pembelajaran dapat tercapai (Baskara & Sutarni, 2024; Rahmayani et al., 2022). Kompetensi pedagogik guru mencakup kemampuan memahami karakteristik peserta didik, merancang strategi pembelajaran yang tepat, mengelola kelas secara efektif, serta menggunakan metode dan media yang mendukung proses belajar (Talitha et al., 2021). Guru yang memiliki kompetensi pedagogik tinggi mampu menghadirkan pembelajaran yang interaktif, kontekstual, dan relevan dengan kebutuhan siswa, yang pada akhirnya meningkatkan pemahaman konsep dan kemampuan berpikir kritis matematika peserta didik (König et al., 2021; Schöer & Clavel, 2024; Shulman, 1986).

Numerous studies have emphasized the importance of mathematics teachers' pedagogical competence, both in theory and in teaching practice (Haryadi, 2023; Junaeti et al., 2023; Maula & Nalim, 2024; Nurhafizah et al., 2021; Rahman et al., 2024; Selviana et al, 2025; Telaumbanua & Dirgantoro, 2022). However, existing research remains fragmented, with diverse focuses, methodologies, and limited geographical scope. Some studies focus on classroom management, while others examine assessment strategies, technology integration, or the implementation of specific teaching models. This results in an incomplete understanding of mathematics teachers' pedagogical competence in Indonesia and limits comparisons with international standards (Chang et al., 2025; Darling-Hammond, 2000).

Furthermore, several significant research gaps exist regarding the pedagogical competence of mathematics teachers in Indonesia. First, longitudinal studies monitoring the long-term development of teachers' pedagogical competence remain scarce. Existing research mostly highlights the relationship between pedagogical competence and learning outcomes or student motivation over a specific period, as shown by Nurhafizah et al. (2021) and Rahmayani et al. (2022). Second, evaluations of continuing professional development (CPD) programs generally report short-term behavioral changes, while long-term impacts remain undocumented systematically. This is evident in studies by Junaeti et al. (2023); Rahman et al. (2024); Rahmanto, (2022), which focus primarily on short-term training or supervision outcomes. Third, research on the integration of innovative learning strategies, including technology use, is often fragmented and limited to specific contexts, such as distance learning (Telaumbanua & Dirgantoro, 2022) or certain regions (Aini, Hafizah, Syahira, & Irma, 2025; Anisa, Oktafia, Irma, & Azmi, 2024). Several studies also indicate that teachers continue to face challenges in implementing pedagogical competence, for example in literacy-based learning (Haryadi, 2023). These gaps highlight the limited empirical evidence available to inform effective strategies for improving teacher competence in the Indonesian context.

Given these conditions, this study aims to conduct a systematic literature review on the pedagogical competence of junior high school mathematics teachers in Indonesia by mapping research trends, methodologies, and the geographical scope of previous studies; analyzing key findings regarding mastery of pedagogical competence and influencing factors; and identifying research gaps, particularly in longitudinal studies, long-term intervention evaluations, and technology integration in learning. This study is expected to provide an empirical basis for strategies to enhance teacher competence and to guide future research that is more systematic, relevant, and impactful.

2. Methodology

2.1 Research Design

This study employs the Systematic Literature Review (SLR) method to examine the pedagogical competence of junior high school mathematics teachers in Indonesia, focusing on: (1) mapping research trends, methodologies, and geographical scope of previous studies; (2) analyzing key findings regarding teachers' mastery of pedagogical competence and its influencing factors; (3) identifying research gaps, including the scarcity of longitudinal studies, long-term intervention evaluations, and technology integration in teaching; and (4) providing an empirical basis for improving teacher competence and guiding future research in a more systematic and impactful manner. According to Putri & Juandi (2022), a systematic literature review identifies, examines, and synthesizes all relevant research findings on a study topic. This method was chosen for its ability to provide a comprehensive overview of research directions, approaches, main findings, and gaps, which can serve as a reference for future studies.

2.2 Data Sources and Search Strategy

The literature search was conducted across several leading scientific databases, including Google Scholar, DOAJ (Directory of Open Access Journals), ERIC (Education Resources Information Center), Garuda (Garba Rujukan Digital

Kemdikbudristek), and Scopus. These databases were selected for their broad national and international coverage and the quality of peer-reviewed articles.

The search strategy employed a combination of Indonesian and English keywords, such as "Pedagogical Competence of Junior High School Mathematics Teachers" and "Competence of Junior High School Teachers in Indonesia." Boolean operators (AND, OR) and quotation marks were used to enhance search precision. The search was iterative, with initial results reviewed and keywords refined to ensure the retrieval of the most relevant and comprehensive studies.

2.3 Inclusion and Exclusion Criteria

This study applied inclusion and exclusion criteria to ensure that only publications relevant to the research focus were analyzed. Selected articles were peer-reviewed, indexed journal publications published between 2021-2025, specifically addressing the pedagogical competence of junior high school mathematics teachers in Indonesia. Only full-text articles in Indonesian or English were considered.

Articles were excluded if they focused on educational levels other than junior high school, examined other teacher competencies (e.g., professional, social, or personality) without a direct link to pedagogy, appeared as duplicates across databases, or were non-journal publications such as conference proceedings, undergraduate theses, or dissertations, which did not meet quality standards.

This approach ensured that the study included only relevant and credible articles, providing a solid foundation for understanding and evaluating the pedagogical competence of junior high school mathematics teachers in Indonesia.

2.4 Research Article Selection Process

The article selection process followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, consisting of four stages: identification, screening, eligibility, and inclusion. From the five databases, the identification stage yielded 109 articles. After removing duplicates and articles that did not match the keywords during screening, 56 articles remained. In the eligibility stage, these articles were evaluated based on inclusion and exclusion criteria, resulting in 27 articles meeting the requirements. Finally, 13 articles that satisfied all criteria were thoroughly analyzed and became the main focus of this study. The article selection process is illustrated in the PRISMA diagram below:

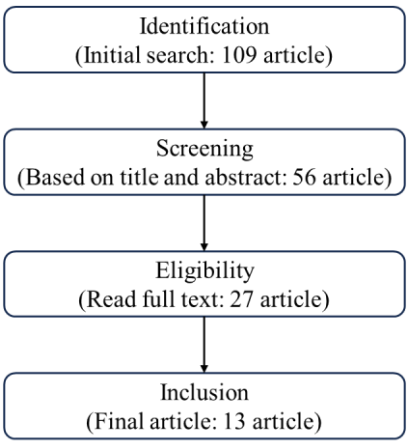

Fig. 1. Research article selection process

2.5 Data analysis

Data analysis was conducted in two stages: data extraction and data synthesis. During data extraction, each article was reviewed to obtain key information, including author, year, journal, research objectives, methodology, subjects and location, main findings, and identified research gaps. All information was recorded in a dedicated worksheet to facilitate comparison across articles. In the data synthesis stage, extracted data were grouped thematically to identify patterns, trends, and relationships among findings. Results were presented in narrative form, tables, and graphs, enabling readers to observe research trends, commonly used methods, geographic distribution, and remaining gaps, which can inform future studies.

3. Results

3.1 Scientific Articles That Meet the Inclusion Criteria

Selected scientific articles that met the inclusion criteria were indexed scientific articles that had undergone a peer-reviewed process, published within the last five years, available in full-text form and written in both Indonesian and English, and had direct relevance to the topic of pedagogical competence of mathematics teachers at the junior high school level. The list of articles that met these criteria is presented in Table 1.

Table 1. Scientific articles that meet the inclusion criteria

No	Author	Title
1	Maula & Nalim (2024)	The Influence of Teachers' Educational Background on Pedagogical Competence and Students' Mathematics Learning Outcomes.
2	Rahmanto (2022)	Developing Mathematics Teachers' Competence through Academic Supervision.
3	Telaumbanua & Dirgantoro (2022)	Teachers' Pedagogical Competence in Developing Students' Mathematical Creativity in Distance Learning.
4	Sari & Yulia (2023)	Mathematics Teachers' Personal Competence in Madrasah Tsanawiyah.
5	Rahman, Rosidah, & Fadya (2024)	Description of Mathematics Teachers' Pedagogical Competence as an Impact of Continuing Professional Development (MGMP) in Takalar.
6	Haryadi (2023)	Challenges in Mastering Pedagogical Competence in Literacy-Based Mathematics Learning.
7	Saftari & Yulianti (2025)	Mentoring Pre-service Teachers: Enhancing Pedagogical Competence and Understanding of Mathematical Concepts.
8	Aini et al. (2025)	Implementation of Mathematics Teachers' Pedagogical Competence in Junior High Schools in Pekanbaru.
9	Anisa et al. (2024)	Mathematics Teachers' Pedagogical Competence in the Teaching and Learning Process at SMPN Pekanbaru.
10	Rahmayani (2022)	The Relationship between Mathematics Teachers' Pedagogical Competence and Students' Mathematics Learning Outcomes.
11	Nurhafizah et al. (2021)	The Influence of Teachers' Pedagogical Competence on Students' Motivation and Mathematics Achievement.
12	Selviana et al. (2025)	A Study of Mathematics Teachers' Pedagogical Competence in Junior High Schools.
13	Junaeti et al. (2023)	Strategies for Improving Pedagogical Competence: Computational Thinking Training for Pre-service Mathematics Teachers.

3.2 Analysis of research trends, methods, and subjects and geographical coverage

This section presents the analysis of publication trends, research methods, study subjects, and geographic coverage of the selected articles. The results are summarized in Table 2.

Table 2. Research trends, research methods, study subjects, and geographic distribution

No	Author	Research Trends	Research Methods	Research Subjects	Geographic Coverage
1	Maula & Nalim (2024)	Correlation between Pedagogical Competence and Educational Qualifications	Quantitative (correlational)	Math teacher & junior high school students	Pekalongan, Central Java
2	Rahmanto (2022)	Supervision as a Means to Strengthen Pedagogical Competence	Descriptive qualitative	Junior high school math teacher	Pringsewu, Lampung
3	Telaumbanua & Dirgantoro (2022)	Pedagogical Competence in the Era of Distance and Digital Learning	Mixed methods	Junior high school math teacher and student	Tanggerang, Banten
4	Sari & Yulia (2023)	Personality Competence as a Component of Pedagogical Competence	Qualitative	Junior high school math teacher	Kerinci, Jambi
5	Rahman, Rosidah, & Fadya (2024)	Impact of Teacher Working Groups (MGMP) on Pedagogical Competence	Qualitative descriptive	Junior high school math teacher	Takalar, South Sulawesi
6	Haryadi (2023)	Challenges Faced by Teachers in Mastering Literacy-Based Pedagogy	Qualitative (case study)	Junior high school math teacher	West Lombok,

					West Nusa Tenggara
7	Saftari & Yulianti (2025)	Strategies to Enhance Competence for Prospective Teachers	Experiment/Quasi-experiment	Prospective mathematics teacher (PPL student)	Central Bangka, Bangka Belitung
8	Aini et al. (2025)	Implementation of Pedagogical Competence in Teaching Practices	Descriptive qualitative	Junior high school math teacher	Pekanbaru
9	Anisa et al. (2024)	Pedagogical Competence in Classroom Instruction	Descriptive qualitative	Junior high school math teacher	Pekanbaru
10	Rahmayani (2022)	Correlation between Teacher Competence and Learning Outcomes	Quantitative (correlational)	Junior high school teacher and student	Pinrang, South Sulawesi
11	Nurhafizah et al. (2021)	Influence of Teacher Pedagogical Competence on Motivation and Learning Outcomes	Quantitative (regression)	Junior high school teacher and student	Mataram, NTB
12	Selviana et al. (2025)	Pedagogical Competence of Junior High School Teachers: A General Overview	Qualitative descriptive	Junior high school math teacher	Pekanbaru
13	Junaeti et al. (2023)	Improving Teacher Competence through Computational Thinking Innovations	Experiment/Training	Prospective mathematics teacher	Sukabumi, West Java

3.3 Analysis of Research Focus, Key Findings, Gaps, and Factors Affecting Competence

This section presents an in-depth analysis of the research focus, key findings, and gaps in the selected articles. The analysis aimed to provide a comprehensive understanding of research trends related to the pedagogical competence of junior high school mathematics teachers over the past five years. Examining the research focus allows identification of the most studied topics, while analysis of findings highlights each study's main contributions. Reviewing research gaps further reveals underexplored areas, offering opportunities for future research.

Table 3. Analysis of Research Focus, Key Findings, Gaps, and Factors Affecting Competence

No	Penulis	Research Fokus	Key Findings	Research Gaps	Factors Affecting Competence
1	Maula & Nalim (2024)	Correlation among Educational Background, Pedagogical Competence, and Learning Outcomes	Significant Influence Not Consistently Evident Across Studies	Additional factors, including teaching experience, participation in training programs, and teacher certification, were not examined in this analysis.	Educational Qualifications of Teachers
2	Rahmanto (2022)	Functions of Academic Supervision in Enhancing Teacher Competence	Academic supervision has been demonstrated to improve teachers' pedagogical competence.	Few studies have examined innovative supervision models, including lesson study and peer coaching.	Teacher Academic Supervision
3	Telaumbanua & Dirgantoro (2022)	The Role of Distance Learning in Fostering Student Creativity	Educators continue to encounter difficulties in stimulating student creativity in remote/online	Few studies have examined post-pandemic developments and the integration of interactive digital	Implementation of Remote Learning and Integration of Digital Technologies

			learning environments.	technologies in teaching.	
4	Sari & Yulia (2023)	Teachers' Personal Competence, Separate from Pedagogical Skills	Teachers' personal competence contributes to facilitating student learning.	The direct link between teachers' personality and pedagogical competence remains underexplored.	Teachers' Personality Competence
5	Rahman, Rosidah, & Fadya (2024)	Professional Development Programs (PKB) and Mathematics Teacher Working Groups (MGMP)	Participation in MGMP has been shown to enhance teachers' pedagogical competence.	Longitudinal studies and cross-regional generalizations are currently lacking.	Teacher Working Groups (MGMP) and Professional Development (PKB) Programs
6	Haryadi (2023)	Challenges in Integrating Literacy into Pedagogical Practices	Teachers' integration of literacy into pedagogical practices remains limited.	Research on solutions and innovative strategies for integrating literacy into mathematics instruction remains limited.	Mathematical Literacy
7	Saftari & Yulianti (2025)	Practicum (PPL) and Instructional Mentoring	Effective guidance and mentoring have been shown to significantly improve the pedagogical competence of pre-service teachers.	There is a scarcity of comparative research on various models of teaching practice (e.g., microteaching, field practice, and peer teaching).	Supervision and Mentoring during Teaching Practice (PPL)
8	Aini et al. (2025)	Practical Applications in Teaching	The implementation of pedagogical competence among teachers varies considerably.	An in-depth analysis of the factors that facilitate or hinder the implementation of pedagogical competence is still lacking.	Actual teaching practice
9	Anisa et al. (2024)	General descriptive	Competence is classified as medium-high	Minimal analysis of differences between subjects or teacher gender	Teaching practices and school context
10	Rahmayani (2022)	Pedagogical correlation and learning outcomes	Positive and significant relationship	Failure to explain causal mechanisms and mediating factors (motivation, interest in learning)	Teacher background and experience
11	Nurhafizah et al. (2021)	Pedagogical influence and motivation & achievement	Significant influence is present	Failure to consider the role of moderating variables (learning environment, parental support)	Student motivation, parental support
12	Selviana et al. (2025)	General descriptive study	Teachers are at an intermediate competency level	Minimal intervention-based research for competency improvement	Teaching experience and teacher training

13	Junaeti et al. (2023)	Innovative training (Computational thinking)	Computational thinking has the potential to improve pedagogical competence	No evidence of long-term implementation in real schools (real classroom practice)	Computational thinking-based training

4. Discussion

An analysis of 13 scientific articles that met the inclusion criteria indicates that research on the pedagogical competence of junior high school mathematics teachers in Indonesia has received increasing attention over the past five years. The research trends emphasize efforts to develop teachers' competence through various strategies, such as academic supervision, teaching practicum mentoring, innovative training, and the development of personal competence. These studies not only measure pedagogical competence descriptively but also explore the factors influencing its mastery, including educational background, teaching experience, training, practicum mentoring, certification, literacy, and technological proficiency. These factors have been shown to affect both teaching effectiveness and student learning outcomes.

From a methodological perspective, the analyzed studies employed diverse approaches. Quantitative approaches were widely used to examine the relationship between pedagogical competence and learning outcomes, student motivation, and achievement, as demonstrated by Maula & Nalim (2024), Nurhafizah et al. (2021), and Rahmayani et al., (2022). Qualitative studies focused on understanding teaching practices, pedagogical challenges, and evaluations of professional development programs, as seen in Aini et al. (2025), Rahmanto (2022) Sari & Yulia (2023). Mixed-methods and experimental/quasi-experimental approaches were employed to assess the interaction between distance learning, teaching practicum mentoring, and the implementation of pedagogical innovations, as reported by Junaeti et al. (2023) Saftari & Yulianti (2025), and Telaumbanua & Dirgantoro (2022). This methodological diversity provides a comprehensive picture of pedagogical competence, although long-term intervention-based research remains relatively scarce.

The findings affirm that the pedagogical competence of junior high school mathematics teachers is multidimensional. The key aspects highlighted include teaching ability, subject-matter mastery, technology integration, student creativity development, and personal competence. Strategies such as academic supervision and teacher working group (MGMP) programs have proven effective; however, innovative supervision models, such as lesson study or peer coaching, remain underexplored. Practicum mentoring for pre-service teachers, including computational thinking-based training, has shown positive effects on pedagogical competence, yet comparative studies across different mentoring models are still limited. Research on distance learning has revealed that teachers face challenges in stimulating student creativity through online platforms, and the integration of interactive digital technologies remains insufficient. Furthermore, although teachers' personal competence supports the learning process, its direct connection to pedagogical practice has not been extensively studied.

Geographical coverage analysis shows that most studies were conducted in Java (Pekalongan, Tangerang, Sukabumi) and Sumatra (Pekanbaru, Bangka), with some research in Sulawesi (Takalar, Pinrang) and Nusa Tenggara (West Lombok, Mataram). No studies comprehensively cover eastern Indonesia, limiting the generalizability of findings. This highlights the need for cross-regional studies to capture the variations in pedagogical competence among junior high school mathematics teachers across Indonesia.

Other identified research gaps include the lack of longitudinal studies mapping the development of pedagogical competence over time, limited evaluations of long-term interventions, and insufficient analysis of supporting and inhibiting factors in implementation. Mediating mechanisms, such as motivation, learning interest, learning environment, and parental support, have also received little attention. Evaluations of interventions whether practicum programs, MGMP activities, or innovative training remain short-term, offering limited insight into their sustained implementation in real classroom settings.

Practically, these findings highlight the importance of supervision, mentoring, and teacher training as key strategies for enhancing pedagogical competence. Strengthening literacy and digital technology integration is essential to make mathematics learning more effective, engaging, and conducive to fostering student creativity. Future research should prioritize longitudinal studies, long-term intervention evaluations, cross-regional investigations, and the development of technology-based innovations and pedagogical practices to ensure sustainable improvements in teachers' pedagogical competence and tangible impacts on mathematics education quality in junior high schools.

5. Conclusion

A systematic analysis of the literature reveals that the pedagogical competence of junior high school mathematics teachers in Indonesia is multidimensional, encompassing teaching skills, subject-matter mastery, technology integration, student creativity development, and personal competence. The mastery of these competencies is influenced by factors such as educational background, teaching experience, training, practicum mentoring, certification, literacy, and technological proficiency. The most frequently studied strategies for enhancing competence include academic supervision, teacher

working groups (MGMP), practicum mentoring, and innovative training programs. However, longitudinal studies, long-term evaluations, comparative analyses of different mentoring models, and cross-regional research remain limited.

These findings not only synthesize existing empirical evidence but also provide a theoretical foundation for understanding the determinants of teachers' pedagogical competence. Practically, the results underscore the need to strengthen supervision, mentoring, and innovation-based training, as well as technology integration, to enhance the effectiveness of mathematics learning and foster student creativity. Future research is recommended to broaden geographical coverage, conduct long-term evaluations of interventions, and develop technology-based innovations, thereby ensuring sustainable improvements in teachers' pedagogical competence with tangible impacts on the quality of mathematics education in junior high schools.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this research.

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