



## **Impact of PMRI on Teachers' Pedagogical Competence**

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### **Abstrak**

Kemampuan pedagogik guru merupakan faktor krusial dalam meningkatkan kualitas pembelajaran matematika. Pendidikan Matematika Realistik Indonesia (PMRI) telah diperkenalkan sebagai pendekatan inovatif untuk mengembangkan keterampilan mengajar guru dan pemahaman siswa terhadap konsep matematika. Kajian ini bertujuan untuk meninjau secara sistematis literatur terkait pengaruh PMRI terhadap peningkatan kemampuan pedagogik guru. Kajian ini menggunakan pendekatan Systematic Literature Review (SLR). Artikel diperoleh dari database akademik Google Scholar dengan kata kunci "PMRI and pedagogical competence of teachers". Hasil temuan terdapat 13 artikel yang menunjukkan bahwa PMRI berkontribusi positif terhadap peningkatan keterampilan pedagogik guru, terutama dalam aspek perancangan pembelajaran berbasis konteks, pengelolaan diskusi kelas, strategi diferensiasi, dan evaluasi autentik, pada penelitian ini hanya sebatas dampak PMRI terhadap kemampuan pedagogik. Hasil menunjukkan Investasi dalam penguatan pedagogik guru melalui PMRI akan memberikan dampak positif terhadap peningkatan kualitas pembelajaran matematika di Indonesia. Rekomendasi untuk pelatihan berkelanjutan bagi guru, peningkatan kolaborasi antar guru dan akademisi, serta dukungan kebijakan pendidikan yang lebih kuat dalam menyediakan sumber daya dan materi ajar berbasis PMRI.

**Kata kunci : Kemampuan Pedagogik, PMRI, Sytematic Literature Review**

### **Abstract**

*Teachers' pedagogical competence is a crucial factor in improving the quality of mathematics learning. Indonesian Realistic Mathematics Education (PMRI) has been introduced as an innovative approach to developing teachers' teaching skills and students' understanding of mathematical concepts. This study aims to systematically review the literature related to the influence of PMRI on improving teachers' pedagogical competence. This study uses the Systematic Literature Review (SLR) approach. Articles were obtained from the Google Scholar academic database with the keywords "PMRI and pedagogical competence of teachers". The findings showed that PMRI contributed positively to improving teachers' pedagogical skills, especially in the aspects of context-based learning design, classroom discussion management, differentiation strategies, and authentic evaluation, in this study only the impact of PMRI on pedagogical competence. The results indicate that investment in strengthening teacher pedagogy through PMRI will have a positive impact on improving the quality of mathematics learning in Indonesia. Recommendations for ongoing training for teachers, increased collaboration between teachers and academics, and stronger education policy support in providing PMRI-based resources and teaching materials.*

**Keywords: Pedagogical Ability, PMRI, Systematic Literature Review**

## INTRODUCTION

Education is one of the most effective ways to shape individuals into successful, respectable, and high-achieving members of society. It plays a crucial role in developing human morality. With quality education, individuals can improve their lives and enhance their well-being. Education influences many areas, including the economy, social development, culture, and technology. As a tool for character building, education significantly contributes to a nation's progress and societal development (Anugrahana, 2016).

Through education, we can create a smart, ethical, and spiritually conscious generation that contributes to a peaceful, safe, and prosperous society. Without quality education, Indonesia may face significant challenges in securing its future and developing skilled human resources. One crucial step in improving mathematics education is reforming the mathematics teaching system. According to (Sembiring, 2010), this reform requires improving teacher professionalism by updating teaching methods and student engagement strategies. A key factor in this improvement is teacher training, which is provided by Teacher Training Institutes (LPTK). These institutions play an essential role in preparing teachers with the necessary knowledge and skills to support societal development. This aligns with Indonesian Law No. 12, Article 1, Clause 12, which states: *"Learning is an interaction between students, teachers, and learning resources within an educational environment."* The quality of education is greatly influenced by the curriculum and academic culture. Therefore, the curriculum and teaching environment in LPTK should encourage the development of professional teachers (Agustiani, 2015). Teachers, as the main facilitators of education, play a significant role in the learning process and contribute directly to student success. For this reason, continuous teacher competency development is necessary to keep up with advancements in knowledge, technology, and societal needs. Improving teacher competencies can lead to a more professional workforce, improving education quality and meeting the demand for skilled individuals with strong character and ethical values (Cesaria, 2011).

According to (Uno, 2009), teachers are required to master various competencies to perform their duties effectively. Therefore, the Elementary Teacher Education Program (PGSD) at Sanata Dharma University prepares future teachers with the fundamental skills required for this profession. These competencies include: Pedagogical competence (teaching skills), Personal competence (professionalism and ethics), Social competence (communication and collaboration), and Professional competence (expertise in the subject matter). All these competencies are essential for teachers in guiding and educating students. To ensure that future teachers are well-prepared, these competencies are integrated into mathematics education courses. This allows students to explore various teaching models before entering the workforce as elementary school teachers. From the explanation above, it is clear that teachers must possess strong professional competencies, particularly in pedagogy.

Teachers' pedagogical competence is a key factor in improving mathematics education quality. Indonesian Realistic Mathematics Education (PMRI), adapted from the Dutch Realistic Mathematics Education (RME) approach, has been introduced as an innovative method to enhance teachers' teaching skills and improve students' understanding of mathematical concepts (Gravemeijer, 1994). PMRI encourages teachers to use real-world contexts as a bridge for learning mathematics, making lessons more meaningful and applicable (Putri, *et al.* 2023). This study aims to systematically review research on the impact of PMRI on teachers' pedagogical competence, focusing on: Lesson planning, Classroom management, Formative assessments, and Teacher-student interactions in mathematical discussions. PMRI is an innovative approach to teaching mathematics, adopting principles from the Dutch RME model. It emphasizes the use of real-life situations to help students develop a deeper understanding of mathematical concepts (Gravemeijer, 1994). Implementing PMRI requires a shift in teaching practices, particularly in teachers' pedagogical abilities. These skills include lesson design, classroom management, formative assessments, and facilitating mathematical

discussions (Darling-Hammond, 2020), different from previous studies that only focused on the implementation of PMRI in student learning, this study systematically reviews how PMRI contributes to the development of teachers' pedagogical competence. Therefore, understanding how PMRI contributes to improving teachers' pedagogical skills is essential. This study aims to conduct a Systematic Literature Review (SLR) on research related to PMRI and its impact on teachers' pedagogical development.

## METHOD

This study uses the Systematic Literature Review (SLR) approach, following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol. Articles were obtained from the Google Scholar database with the keywords "PMRI and pedagogical competence of teachers" and analyzed using descriptive statistics.

### Selection Criteria :

#### 1. Inclusion Criteria:

- Articles that have been published.
- Studies that examine the impact of PMRI on teachers' pedagogical competence.
- Articles written in English or Indonesian.

#### 2. Exclusion Criteria:

- Studies that do not specifically discuss PMRI and teachers' pedagogical skills.
- Research with methods that are not relevant to the study's objectives.
- Articles that do not provide full-text access.

After the initial selection, the articles were further evaluated using the Critical Appraisal Skills Programme (CASP) to ensure their quality and relevance.

## RESULTS AND DISCUSSION

In this study, data search was conducted using Google Chrome. The data searched were articles on pedagogical skills with the PMRI approach through Google Scholar. Based on the search results, there were 13 articles relevant to pedagogical skills with the PMRI approach. Below is Table 1 of several research articles on pedagogical skills with the PMRI approach that have been analyzed.

**Table. Pedagogical Capabilities Using the PMRI Approach**

No	Autor	Research Results
1	Anna Fauziah dkk.	Research by Anna Fauziah et al. showed that there was strong collaboration between researchers and lecturers, lecturers and students, as well as among students themselves during the plan-do-see-redesign phase of lesson study. This collaboration contributed to the development of pedagogical skills among prospective elementary school teachers (Fauziah, <i>et al.</i> 2022).
2	Rini Herlina Rusiyanti dkk	This research conducted a data analysis that revealed how a learning environment using the LSLC (Lesson Study for Learning Community) model based on RME (Realistic Mathematics Education) significantly helped high school math teachers in understanding the learning process, designing teaching materials, implementing learning activities, and evaluating students' progress (Rusiyanti, R. H., & Putri, 2022)

3	Andri Anugrahana	Andri Anugrahana's study found that, based on interviews, students perceived mathematics as a difficult subject. To improve their motivation and competence in mathematics, the researcher used innovative teaching methods such as Realistic Mathematics Education (RME), the Van Hiele model, the jigsaw method, and problem-solving approaches. This classroom action research aimed to enhance four key teacher training competencies: pedagogical skills, professional skills, personal skills, and social skills. The results showed an increase in all four competencies after the implementation of these methods (Anugrahana, 2016).
4	Edwar dkk	This study aimed to train teachers to improve their professionalism in developing Higher-Order Thinking Skills (HOTS) questions using the PMRI approach. The research applied a design-based approach consisting of two phases: a preliminary evaluation and formative assessment. The workshop results indicated a steady increase in teachers' competency scores in developing HOTS questions, with scores rising from 45.70% before the workshop, to 77.14% after the first workshop, and reaching 85.70% after the second workshop. Teachers successfully created HOTS questions that investigated numerical content within real-life contexts, such as the local sale of duku (langsat) fruit, a well-known product of Ogan Komering Ulu (OKU) Timur. This study also had a positive impact on students, stimulating their critical thinking abilities (Edwar; <i>et al.</i> 2023).
5	Zulkardi dkk	This study conducted a community service program using a mentoring model to enhance teachers' professionalism in preparing teaching and learning activities, particularly in developing lesson plans, which required a solid understanding of theoretical concepts and their applications. A total of 33 mathematics teachers from Musi Rawas district participated in this program. Overall, the implementation went smoothly without significant obstacles, except for a few participants who were disconnected from the Zoom meeting during synchronous sessions due to signal disruptions. The analysis of satisfaction survey responses showed positive results (Zulkardi, <i>et al.</i> 2022).
6	Anna Cesaria	The data analysis results indicate that: (1) teachers' competence in planning and implementing learning using the RME approach improved through the RME Workshop. This improvement was driven by the continuous and structured nature of the workshop process. (2) One of the significant challenges in planning and implementing learning with the RME approach was the design and use of mathematical teaching media that aligned with the core mathematical topics. These challenges could be minimized through discussions and simulations conducted during the workshop (Cesaria, 2011).
7	Anisa Fatwa Sari and Agustin Ernawati Zainal Abidin	This study found prospective mathematics teachers must have both professional and pedagogical competence. One of the intersections between these two competencies is teaching skills. A total of 12 students from the mathematics education program were involved in the implementation of the Indonesian Realistic Mathematics Education (PMRI) course design. The course design was developed using a design research model. It was structured to focus on teaching skills while incorporating the five key

characteristics of PMRI. A response questionnaire was given to students to assess their feedback on the course process. The response items were analyzed using a descriptive quantitative approach. The results showed that six out of ten statements received very strong support, while the rest received strong support from students. The strongest support was for three aspects: the use of Hypothetical Learning Trajectory (HLT) in lesson planning, the use of teaching aids, and the overall course design, which was considered effective in enhancing students' teaching skills (Sari, *et al* 2018).

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**8** Anna Fauziah dkk This study found teachers' pedagogical competence plays a significant role in the learning process and their overall teaching performance. To enhance this competence, a development process is needed while teachers are still in training or studying in teacher education programs. This study aims to develop a valid and practical PMRI learning environment through lesson study, which has the potential to improve the pedagogical skills of prospective elementary school teachers. The study employs a development study research design, consisting of three stages: the preliminary stage, the development or prototyping stage, and the assessment stage. The research subjects consisted of 32 students from the Elementary Teacher Education Program at Universitas Sriwijaya. Data collection was conducted through walk-throughs, observations, documentation, questionnaires, interviews, and tests. The study resulted in a Campus-School (CS) learning environment model, which was both valid and practical and had the potential to enhance pre-service teachers' pedagogical competence. This learning environment included training sessions on campus and implementation in schools. Based on data analysis, the model effectively prepared prospective elementary school teachers to understand PMRI through lesson study and to design PMRI-based learning materials using lesson study. (Fauziah *et al*. 2020)

**9** Dhiniaty Gularso Gularso and Kristina Warniasih The analysis results indicate that teachers experienced changes after participating in the academic seminar. Their understanding of elementary school teacher professionalism improved, particularly in areas such as scientific writing, classroom action research, and numerical literacy, using the PMRI approach. (Gularso, D. G., & Warniasih, 2024).

**10** Hermina Disnawati and Farly Oktriany Haning The research results show that the PMRI workshop provided new insights and motivation for teachers, particularly regarding the PMRI approach and its implementation in schools. Teachers' understanding of the hierarchy of quadrilaterals, their properties, and different forms of parallelograms significantly improved. Initially, many teachers had misconceptions, believing that a quadrilateral must be a square and that a parallelogram has only one specific shape. However, after participating in the PMRI workshop, their understanding became more comprehensive, as reflected in the post-test results, which showed improvement compared to the pre-test.(Disnawati, H., & Haning, 2018).

**11** Evangelista Lus Windyana Palupi dkk Mathematics learning should be taught meaningfully by using problem contexts that facilitate reasoning, modeling, collaboration, and connections with other mathematical concepts.

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This community service program aimed to train elementary school teachers in developing the Realistic Mathematics Education (PMR) iceberg using local cultural contexts from Magetan. A total of 12 elementary school teachers in Magetan participated in the PMR training, which focused on developing the PMR iceberg through exploratory and contextual approaches. The research method included face-to-face sessions, group discussions, and individual assignments to design relevant teaching materials. The training results showed a significant improvement in teachers' understanding and application of PMR. Before the training, teachers struggled to engage students in grades 4-6 and incorporate local contexts into mathematics lessons. After the training, 67% of teachers showed positive changes in their teaching approach, shifting from lecture and drill methods to a PMR-based approach. Additionally, 50% of participants successfully developed PMR icebergs that integrated local cultural contexts from Magetan. Training evaluations showed that more than 50% of participants responded positively, demonstrating an increase in knowledge of realistic mathematics and the application of culturally contextualized mathematical problems. This study concludes that PMR, especially when combined with local cultural contexts, is effective in enhancing mathematics teaching skills and improving numerical literacy among elementary school teachers. The research findings suggest that PMR should be integrated into the elementary mathematics curriculum to develop students' critical thinking, creativity, and collaboration skills, in line with 21st-century learning demands. (Palupi *et al.* 2023)

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12 Ratnawati Susanto

The success of learning is influenced by teachers' abilities and skills in managing the learning process while continuously improving their pedagogical competence. This study aims to analyze the mapping of pedagogical competence in relation to pedagogical knowledge dimensions and teachers' initial characteristic profiles. The study involved 265 teachers from Region II, West Jakarta Municipality, under the Jakarta Provincial Education Department. A quantitative research method with a survey approach was used. Data collection was conducted online using Google Forms. The research instrument consisted of questionnaires designed to measure pedagogical competence, pedagogical knowledge, and teachers' characteristic profiles, all of which had been tested for validity and reliability. The data were analyzed using descriptive analysis, simple regression, and network analysis. The results showed that teachers' pedagogical competence, pedagogical knowledge, and initial characteristic profiles were categorized as very good. Furthermore, pedagogical knowledge contributed 62.1% to teachers' pedagogical competence, while teachers' initial characteristic profiles contributed 49.7%. Network analysis indicated that pedagogical knowledge and teachers' initial characteristic profiles have a strong correlation in building pedagogical competence. Moving forward, further development and training are needed to optimize teachers' pedagogical competence in order to improve the quality of education in Indonesia. (Susanto, 2021).

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13 Rusmaida

This study is based on the need for teachers to have strong

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professional and pedagogical competence, particularly Islamic Education (PAI) teachers. The success of education delivery is determined by the readiness of teachers. One of the tactical steps to support teacher competence in determining and implementing teaching strategies is through supervision. The supervision was conducted by the head of the madrasah using a workshop technique, which allowed teachers to collaborate and discuss problems openly without fear or anxiety. The purpose of this study is to determine the effect of the workshop-based supervision technique carried out by the head of the madrasah on improving the professional and pedagogical competence of PAI teachers. This research is quantitative and uses the ex post facto method. The study population consisted of all six PAI teachers at MTsN 6 Kota Solok. The data used included primary and secondary data. The data collection instruments consisted of observation forms for the madrasah environment and questionnaires, including a supervision questionnaire on teachers' professional competence, a supervision questionnaire on teachers' pedagogical competence, and a questionnaire on teacher competency improvement. The data analysis included descriptive analysis and inferential statistical analysis. The inferential statistical analysis used normality tests, linearity tests, and hypothesis testing with simple regression and multiple correlation tests. The results showed that the supervision carried out by the head of the madrasah influenced the improvement of teachers' professional and pedagogical competence. The effect of supervision on the professional competence of PAI teachers at MTsN 6 Kota Solok had a product moment value of 0.018 with a correlation coefficient of 0.735, indicating a strong correlation. The effect of the head of the madrasah's supervision on the improvement of teachers' pedagogical competence at MTsN 6 Kota Solok had a product moment value of 0.011 with a correlation coefficient of 0.791, also indicating a strong correlation. In addition, the workshop-based supervision technique conducted by the head of the madrasah had an impact on the improvement of both professional and pedagogical competence simultaneously at MTsN 6 Kota Solok. This effect was demonstrated through multiple correlation tests, with a value of  $0.016 < 0.05$ , indicating a relationship between the variables with a correlation coefficient of 0.781, meaning that the relationship between the variables was strong (Rusmaida, 2022).

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#### Study Limitations:

Although this study has conducted a comprehensive analysis of the influence of PMRI on teachers' pedagogical skills, there are still several limitations that need to be acknowledged:

1. Data source limitations: This study only uses data sources published in scientific journals and does not include other data sources such as theses, dissertations, or research reports.
2. Time limitations: This study only analyzes research published within a certain period of time, so it may not include the most recent research.
3. Location limitations: This study only analyzes research conducted in Indonesia, so it may not include research conducted in other countries.

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 DOI : <https://doi.org/10.31004/edukatif.v7i1.8017>

4. Research method limitations: This study only analyzes research using quantitative research methods, so it may not include research using qualitative research methods.
5. Limitations on interpretation of results: This study only conducts statistical analysis of the research results, so it may not include a more in-depth interpretation of the results.

Thus, the results of this study need to be interpreted with caution and further research is needed to expand the scope and deepen the research results.

## CONCLUSION

Based on the results of the Systematic Literature Review, it can be concluded that the Development of Instructional Design Models (PMRI) has a significant influence on teachers' pedagogical abilities. PMRI can improve teachers' abilities in designing learning, developing teaching materials, and improving the quality of learning. In addition, PMRI can also improve teachers' abilities in managing classes and increasing students' learning motivation. Therefore, PMRI can be an effective strategy to improve teachers' pedagogical abilities and improve the quality of learning in schools. However, there are still challenges in its implementation that need to be addressed with the right strategies.

Recommendations:

1. Further research is needed to test the effectiveness of PMRI in different educational levels and cultural contexts.
2. Ongoing training for teachers to apply PMRI effectively.
3. Stronger collaboration between teachers and researchers to share best practices in implementing PMRI.
4. Better education policies to provide more resources and teaching materials based on PMRI.

Investing in teacher training and pedagogical development through PMRI will have a positive impact on improving the quality of mathematics education in Indonesia.

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