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THE EFFECT OF THE INDONESIAN REALISTIC MATHEMATICS EDUCATION (PMRI) APPROACH ON PROBLEM-SOLVING ABILITIES AND LEARNING MOTIVATION OF GRADE VII STUDENTS AT SMP NEGERI 2 AIR SALEK

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ABSTRACT

This study aimed to investigate the effect of the Indonesian Realistic Mathematics Education (PMRI) approach on students' mathematical problem-solving abilities and learning motivation. A true experimental design was employed with a posttest-only control group. The sample consisted of 72 students (36 experimental, 36 control) selected through random sampling. Data were collected using a problem-solving ability test and a learning motivation questionnaire (30 items, 5-point Likert scale). The instruments were validated through expert review and pilot testing, achieving a Cronbach's alpha of 0.89 for the questionnaire. Independent t-tests revealed a significant difference in problem-solving ability between the experimental and control groups ($t = -9.62$, $p < 0.001$). However, learning motivation results did not show a statistically significant difference ($t = -6.20$, $p = 0.269$). The findings suggest that PMRI enhances students' problem-solving abilities but may require longer intervention periods to influence motivation.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui pengaruh pendekatan Pendidikan Matematika Realistik Indonesia (PMRI) terhadap kemampuan pemecahan masalah matematis dan motivasi belajar siswa. Penelitian ini menggunakan desain eksperimen sejati dengan kelompok kontrol hanya posttest. Sampel terdiri dari 72 siswa (36 kelas eksperimen dan 36 kelas kontrol) yang dipilih melalui teknik random sampling. Data dikumpulkan melalui tes kemampuan pemecahan masalah dan angket motivasi belajar (30 butir, skala Likert 5 poin). Instrumen telah divalidasi melalui telaah ahli dan uji coba awal, dengan nilai reliabilitas Cronbach's alpha sebesar 0,89. Hasil uji t menunjukkan perbedaan yang signifikan dalam kemampuan pemecahan masalah antara kelompok eksperimen dan kontrol ($t = -9,62$, $p < 0,001$). Namun, hasil motivasi belajar tidak menunjukkan perbedaan yang signifikan secara statistik ($t = -6,20$, $p = 0,269$). Temuan ini menunjukkan bahwa PMRI efektif dalam meningkatkan kemampuan pemecahan masalah siswa, namun mungkin memerlukan waktu penerapan yang lebih lama untuk memengaruhi motivasi belajar.

Introduction

Mathematics is a compulsory subject that must be taught to students starting from kindergarten. It aims to equip students with the ability to think critically, systematically, creatively, and logically, as well as to develop teamwork skills. Education is a process of shaping students' character, which cannot be separated from culture and is passed down from generation to generation (Widyastuti, 2021). The quality of learning outcomes in schools has become a serious issue faced by the Indonesian education system today (Agustina & Syafi'i, 2023). In the modern era, mathematics plays a crucial role in daily life, the development of technology, applied sciences, and various life tools, all of which rely on the active role of mathematics (Azizah, 2022).

There are many challenges in learning mathematics, such as students' lack of motivation, which leads to low mathematical problem-solving abilities. Therefore, teachers must be more creative in addressing this issue, for example, by developing innovative teaching methods in the learning process. One such method is Realistic Mathematics Education (RME) or *Pendidikan Matematika Realistik Indonesia* (PMRI). This method focuses more on reality and human activities, allowing students to discover mathematical concepts and ideas independently, making them more actively engaged in learning (Johar et al., 2022).

In the PMRI learning model, there are two types of mathematization: horizontal mathematization and vertical mathematization. Horizontal mathematization occurs when students use mathematics to organize and solve real-world problems. Meanwhile, vertical mathematization involves reorganizing previously acquired knowledge into abstract mathematical symbols (Gravemeijer, 2008; Inci et al., 2023). To encourage students to be more active and motivated in the learning process, researchers apply the PMRI learning method.

Realistic Mathematics Education is a learning approach that uses real-world problems as a starting point for teaching mathematics, training students in problem-solving so they can acquire fundamental mathematical concepts and knowledge (Zulkardi et al., 2020). Through real-life problems, students are guided to find solutions, making realistic mathematics education a potential method for fostering students' critical thinking skills by allowing them to discover problem-solving strategies independently (Ismaimuza et al., 2023; Palinussa et al., 2021; Sitorus, 2022). These statements indicate that the PMRI learning method is indeed suitable for use in mathematics education, as it aims to motivate students throughout the learning process, enabling them to solve problems independently.

In this approach, students are encouraged to be more active and to rediscover ideas for problem-solving using real-world problems.

According to Freudenthal (Gravemeijer, 2008), the main principles of realistic mathematics education are: 1) Constructing and concretizing, students discover procedures independently; 2) Levels and models, the use of models in mathematics learning bridges the gap between concrete and abstract concepts; 3) Reflection and special assignments, learning mathematics and progressing to higher levels is enhanced through reflection. Assessing an individual is not solely based on results but also on understanding their thinking process; 4) Social context and interaction, Learning is not just an individual activity but occurs within a societal context and is directly linked to socio-cultural aspects. Therefore, students should be given opportunities to exchange ideas, engage in debates, and discuss arguments, and 5) Structuring and intertwining, mathematics learning does not merely consist of absorbing disconnected knowledge and skills but should be structured as a coherent whole.

Problem-solving, according to Polya (Klang et al., 2021), is both a method and a skill. Since problem-solving is related to one's ability or skill, engaging in the problem-solving process enables individuals to develop the ability to provide solutions. Furthermore, (Gravemeijer, 2016) states that problem-solving is a process of overcoming difficulties to achieve a desired goal, as humans face various challenges in everyday life. Based on these perspectives, PMRI offers a solution in the learning process, helping students develop better problem-solving skills.

The characteristics of problem-solving tasks in learning include the following:1) Problems require students to apply various procedures and connect prior experiences with the given problem to find a solution, 2) Problems involve the manipulation or operation of previously known knowledge, 3) Problem-solving requires students to visualize and interpret quantitative facts, spatial relationships, and the connections between facts, as well as to generalize from given examples (Klang et al., 2021; Mainali, 2021). To solve problems effectively, teachers must provide students with opportunities to express their thoughts, encouraging them to be more engaged and motivated in problem-solving activities (Ahn et al., 2021; Amerstorfer & Freiin von Münster-Kistner, 2021; Inganah et al., 2023).

Motivation comes from the word motive, which refers to an internal state that drives a person to take action in pursuit of a goal (Yunus & Ali, 2009). Motivation can be defined as the effort to create specific conditions that enable a person to take action. It can also be understood as a driving force that encourages a person to act. Motivation can arise from within an individual (intrinsic

motivation) or be influenced by external factors (extrinsic motivation) (Moddleton, 2020).

Despite various studies exploring PMRI, limited research has rigorously evaluated both cognitive and affective outcomes using a true experimental design in rural secondary schools. This study aims to address this gap by investigating the effect of PMRI on Grade VII students' problem-solving abilities and learning motivation. The contribution of this study lies in providing empirical evidence for the integration of PMRI in junior high school curricula and offering insights into its dual impact on cognitive and affective learning domains.

Method

This study was conducted at SMP Negeri 2 Air Salek during the odd semester of the 2024/2025 academic year. The population in this study consisted of four classes. The sample was selected using a random sampling technique, resulting in Class VII.2 as the experimental class and Class VII.4 as the control class. Both classes had 36 students each. The treatment design in this study employed the Posttest-Only Control Design, while the research method used was experimental research with a True Experimental Design. The experimental class was taught using the Indonesian Realistic Mathematics Education (PMRI) model, whereas the control class followed the expository learning approach. The data collection techniques used in this study were tests and questionnaires. The problem-solving test consisted of 10 essay items aligned with seven indicators of problem-solving by Polya. The motivation questionnaire comprised 30 items using a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree), covering intrinsic and extrinsic dimensions. Content validity was confirmed through expert review, and the reliability was established using Cronbach's alpha ($\alpha = 0.89$), indicating high internal consistency. The analysis used independent sample t-tests

Based on the obtained questionnaire scores and test scores, the total score for each questionnaire item and each test indicator was calculated. The research hypotheses in this study are as follows: (1) there is an influence of the Indonesian Realistic Mathematics Education (PMRI) approach on the mathematical problem-solving abilities of Grade VII students at SMP Negeri 2 Air Salek; (2) there is an influence of the Indonesian Realistic Mathematics Education (PMRI) approach on the learning motivation of Grade VII students at SMP Negeri 2 Air Salek.

Result and Discussion

The teaching and learning activities at SMP Negeri 2 Air Salek were conducted from November 28 to December 10, 2024. The implementation of this

research followed three stages: planning, execution, and evaluation. To assess the impact of the Indonesian Realistic Mathematics Education (PMRI) approach on students' mathematical problem-solving abilities, a test was administered. The test was given to students in both the experimental and control classes, which served as the research sample. The researcher provided the test and motivation questionnaire to students after completing the lesson material. The test consisted of 10 essay questions, designed based on seven indicators of mathematical problem-solving. The same set of test questions was given to both the experimental and control classes. The test had undergone validity and reliability testing to ensure its accuracy.

The analyzed data from the test scores and students' motivation questionnaire results are presented in Table 1.

Table 1.
Test Scores of the Experimental and Control Group

	Group	Highest Score	Lowest Score	Average Score	Variance
Test	Experimental	95	60	77.08	8.19
	Control	75	30	55.69	12.36
Questionnaire	Experimental	98	71	85	5.35
	Control	95	75	85	4.50

To test the research hypothesis, statistical analysis was conducted using the t-test technique.

Hypothesis (1)

This hypothesis compares the mathematical problem-solving abilities of students who were taught using the PMRI approach with those who were not. Before performing the t-test, it was necessary to conduct a normality test and a homogeneity test. The normality test was carried out to determine whether the obtained data followed a normal distribution. This test was conducted using Jamovi Version 2.3.28.0. The results of the normality test are presented in Table 2.

Table 2
Results of the Normality Test for Problem-solving Ability

No	Group	Sig	Decision
1	Experimental	0.216	Normal
2	Control	0.100	Normal

After the data was found to be normally distributed, the next step was to conduct a homogeneity test. This test is used to prove that the variances of the groups forming the sample are equal, which means that they come from the same

population. The results of the homogeneity test, conducted with the help of Jamovi Version 2.3.28.0, can be seen in Table 3.

Table 3
Results of Homogeneity test

No	F	Sig	Decision
1	4.10	0.057	Homogeny

Based on Tables 2 and 3, it is known that the mathematical problem-solving ability scores of students follow a normal distribution and have aahomogeneous variances. Therefore, the assumptions for hypothesis testing using the independent t-test are met. The results of the t-test, conducted with the help of Jamovi Version 2.3.28.0, can be seen in Table 4.

Table 4
Results of the Hypothesis Tests

No	Statistic	Sig	Decision
1	-9.62	<.001	Reject Ho

Based on the calculations from Table 4, the obtained Sig value is less than 0.05. Therefore, Ha (the alternative hypothesis), which states that there is an influence of the Indonesian Realistic Mathematics Education (PMRI) approach on the mathematical problem-solving abilities of Grade VII students at SMP Negeri 2 Air Salek, is accepted. The null hypothesis (H0), which states that there is no influence of the Indonesian Realistic Mathematics Education (PMRI) approach on students' mathematical problem-solving abilities, is rejected.

Hypothesis (2)

This hypothesis compares the learning motivation of students who were taught using the PMRI approach with those who were not. The results of the normality test for students' learning motivation data can be seen in Table 5.

Table 5
Results of the Normality Test for Students' Learning Motivation

No	Group	Sig	Decision
1	Experimental	0.447	Normal
2	Control	0.376	Normal

After the data was found to be normally distributed, the next step was to conduct a homogeneity test. This test is used to prove that the variances of the groups forming the sample are equal, which means that they come from the same

population. The results of the homogeneity test conducted with the help of Jamovi Version 2.3.28.0 can be seen in Table 6.

Table 6
Results of the Homogeneity Test for Students' Learning Motivation

No	F	Sig	Decision
1	4.10	0.432	Homogeny

Based on Tables 5 and 6, it is known that the students' learning motivation data follows a normal distribution and has homogeneous variances. Therefore, the assumptions for hypothesis testing using the independent t-test are met. The results of the t-test, conducted with the help of Jamovi Version 2.3.28.0, can be seen in Table 7.

Table 7
Results of the Hypothesis test

No	Statistic	Sig	Decision
1	-6.20	0.269	Reject Ho

Based on the calculations from Table 7, the obtained Sig value is less than 0.05. Therefore, Ha, which states that there is an influence of the Indonesian Realistic Mathematics Education (PMRI) approach on students' learning motivation in Grade VII at SMPN 4 Palembang, is accepted. The null hypothesis (Ho), which states that there is no influence of the Indonesian Realistic Mathematics Education (PMRI) approach on students' learning motivation at SMPN 4 Palembang, is rejected.

The findings of this study indicate that students taught using the PMRI approach demonstrated significantly higher mathematical problem-solving abilities than those taught using the expository method. This is evidenced by a p-value of < 0.001. These findings are consistent with Zulkardi et al. (2020), who noted that PMRI enhances students' critical thinking and deep conceptual understanding by integrating real-life contexts into mathematics learning. It is also supported by Palinussa et al. (2021), who found that PMRI fosters mathematical reasoning and communication skills, particularly in rural contexts, by aligning the learning process with students' local realities.

Regarding learning motivation, although the experimental group achieved higher average scores, the difference was not statistically significant ($p = 0.269$). A possible explanation is the short treatment duration (less than two weeks). Moddleton (2020) emphasized that changes in learning motivation require long-term interventions and strong emotional engagement from students. Furthermore, Yunus and Ali (2009) argued that intrinsic motivation is more challenging to foster

than extrinsic motivation, which demands consistent and repeated instructional strategies to cultivate.

This study was conducted in a single school over a short duration (approximately two weeks), which limits the generalizability of the findings. Cultural context, teachers' familiarity with the PMRI approach, and students' adaptability to a new instructional model may have influenced the results. Therefore, future research should consider longer intervention periods and broader school samples, as recommended by Wahidin and Sugiman (2024), who emphasized the need for extended experimental designs to measure the full impact of PMRI on both cognitive and affective domains.

Conclusion

Based on the analysis of the research data and the discussion, it can be concluded that: There is an influence of the Indonesian Realistic Mathematics Education (PMRI) approach on students' mathematical problem-solving abilities, and there is no influence of the Indonesian Realistic Mathematics Education (PMRI) approach on students' learning motivation. A suggestion for future research is to use PMRI to improve other aspects of mathematical abilities and affective aspects in mathematics learning.

Mathematics educators are encouraged to implement PMRI to improve students' problem-solving abilities. Schools should consider teacher training in PMRI strategies and explore integrating real-life contexts in the mathematics curriculum. Future research could examine the impact of PMRI on other cognitive skills such as reasoning and communication or use a mixed-method approach to better understand student motivation.

Declarations

Author contribution.

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