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Analysis of the Effect of the Indonesian Realistic Mathematics Education Approach on the Mathematical Problem-Solving Ability of Grade 6 Students

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Abstract

The Indonesian realistic mathematics education approach offers a solution by creating a collaborative learning environment based on contextual problems relevant to students' experiences. The integration of local culture, namely Banjar traditional cakes, was chosen to make learning more meaningful and foster cultural appreciation. This study aims to analyze the effect of the mathematical problem-solving abilities of sixth-grade elementary school students through the application of the IRME approach. This study used a quasi-experimental one-group pretest-posttest design with 22 sixth-grade students at a public elementary school in Banjarmasin city, Indonesia as the sample. Data were collected through observation and pre- and post-tests. The results showed that the Indonesian realistic mathematics education approach was implemented very well, with a 92.11% implementation rate. The average post-test score of students increased to 71.91, which is considered good. There was a significant difference between the conditions before and after treatment using the Indonesian Realistic Mathematics Education approach, as indicated by a paired-samples t-test. The increase in problem-solving abilities, as measured by the N-Gain analysis, was in the moderate category (0.51). This means that the Indonesian realistic mathematics education approach affects the mathematical problem-solving abilities of sixth-grade elementary school students.

Keywords: Indonesian realistic mathematics education; mathematical problem-solving

Introduction

Education plays a crucial role in developing students' intelligence, skills, and character. Among the subjects taught, mathematics is a key one because it fosters logical, critical, and creative thinking and enhances problem-solving skills (Sidik et al., 2026). According to Hadi and Radiyatul (2014), problem-solving is the primary goal of mathematics learning, as through this activity, students not only learn concepts and procedures but also develop higher-order thinking skills. However, research by Rahmat and Arham (2022) found that students' ability to solve mathematical problems, particularly in probability, remains moderate. This demonstrates the importance of implementing more meaningful learning strategies.

Field research shows that, in elementary schools, mathematics instruction still generally uses traditional, teacher-oriented methods, such as explaining concepts, presenting examples, and practicing similar problems (Afsari et al., 2021). This learning pattern can foster passivity in students, diminish their interest in learning, and sometimes make it difficult for them to connect mathematical material to everyday experiences (Aryanti et al., 2026). Therefore, an approach that emphasizes active student involvement in constructing concepts through real-world situations is needed. One relevant approach is Indonesian Realistic Mathematics Education (IRME), which developed from Freudenthal's ideas and emphasizes that mathematics should be close to students' realities and be viewed as a human activity (Hadi, 2017). The main characteristics of IRME include the use of real-life contexts, student-developed models, interactivity, and interconnectedness between concepts (Sidik & Herman, 2025). With these characteristics, IRME is believed to be able to transform abstract mathematics learning into concrete, interactive, and meaningful ones.

Furthermore, the integration of regional cultural values into the mathematics learning process has the potential to be an important step in strengthening student motivation and understanding. Ismah et al. (2024) demonstrated that learning tools based on local wisdom are valid, practical, and effective in improving problem-solving skills. In this study, the chosen context was Banjarese traditional cakes, because, in addition to being close to students' daily lives in Banjarmasin, they also foster an appreciation for local culture. Utilizing local culture as a learning context not only makes mathematics easier to understand but also more meaningful.

Previous research also supports the urgency of using the IRME approach within a local cultural context. Vera et al. (2021) found that questions developed within a local cultural context through the PBL model significantly improved students' mathematical problem-solving skills. According to research by Ermawati and Riswari (2020), the IRME approach yielded significantly different results compared to conventional methods, with students taught with IRME demonstrating higher problem-solving abilities. Another study by Andriani et al. (2021) also confirmed the effectiveness of IRME. Although its focus was on mathematical communication skills, the results reinforced the positive impact of IRME on students' mathematical abilities.

Furthermore, according to Rahmat and Arham (2022), students demonstrated moderate problem-solving abilities in probability, supporting the importance of

implementing IRME at the elementary school level. Research by Ismah et al. (2024) found that implementing a teaching module based on local wisdom had a positive, effective impact on students' mathematical problem-solving abilities. Thus, these findings provide both theoretical and practical support for the effectiveness of IRME and local cultural integration in developing students' mathematical abilities. Based on this description, this study is crucial for analyzing the impact of implementing an IRME approach on elementary school students' mathematical problem-solving abilities in the context of Banjarese traditional cakes. This research is expected to contribute to the development of more meaningful and contextually relevant mathematics learning strategies, while simultaneously strengthening the integration of local culture into education. This study contributes to mathematics education research by emphasizing the integration of local cultural contexts within IRME to support meaningful mathematical problem-solving experiences for elementary school students.

Method

This study employed a quantitative descriptive method with a quasi-experimental design, namely a One Group Pretest-Posttest Design. In this design, students were first given a pre-test, then participated in learning using the IRME approach, using the context of Banjarese traditional cakes. Finally, a post-test was administered. Comparison of pre-test and post-test scores was used to measure improvements in mathematical problem-solving skills. This research was conducted in one of the public elementary schools in Banjarmasin city, Indonesia. The sample was selected from class VIA, which has 34 students. However, only 22 students attended and participated in the research activities. The other 12 students were absent due to illness or permission to participate. Therefore, the researcher used a purposive sampling technique, taking into account student availability and attendance throughout the study.

The research procedure in this study was implemented through several stages, beginning with a pre-test to determine students' basic abilities. Next, the researcher administered a learning treatment using the IRME approach in the context of traditional Banjar cakes. During the learning process, observations were conducted to assess student engagement and the implementation of the learning. After the treatment was completed, the researcher administered a post-test to assess students' problem-solving abilities following the learning. The final stage was collecting and analyzing the research data. The research

instruments used in this study included a validation sheet, an observation sheet, and pre- and post-test questionnaires. The validation sheet was used to assess the feasibility of the test instrument and teaching module through expert assessment. The observation sheet was used to record student engagement, learning progress, and the implementation of the learning throughout the study. In addition, the instrument reliability was reviewed through internal consistency analysis before implementation.

Meanwhile, an expert-validated descriptive test was used to measure students' mathematical problem-solving abilities before and after the treatment. In this study, data were collected through observation, documentation, and testing. The observation process used observation sheets to record students' activities during learning and determine the extent of their individual and group participation. Documentation was conducted by recording various activities during the learning process to provide more objective supporting data regarding the learning atmosphere and implementation. Meanwhile, pre- and post-tests were administered to assess students' mathematical problem-solving abilities before and after the implementation of the IRME approach.

After the data from observations, documentation, and tests were fully collected, the next step was to analyze the data to address the research problem formulation and to assess the achievement of the research objectives. The data analysis process in this study consisted of several interrelated stages. First, an instrument validation test was conducted to assess the feasibility of the research instrument, based on the validator's input. Second, the learning implementation was analyzed as a percentage to determine the implementation category: very good, good, sufficient, poor, or very poor. In the third stage, students' mathematical problem-solving abilities were analyzed descriptively using a rating scale ranging from very poor to very good. Next, an N-Gain test was conducted to determine the level of improvement in students' abilities after the treatment. The next step was a normality test using the Shapiro-Wilk test to determine the appropriate type of statistical test. Finally, a difference test was performed: a paired-samples t-test if the data were normally distributed, or a Wilcoxon test if they were not.

Results and Discussion

The results of this study are presented systematically, starting with the validation test of the research instrument, observations of the implementation of the learning, and the

analysis of students' mathematical problem-solving ability test results. Furthermore, the results of statistical tests are presented to determine the effect of the IRME approach on improving their abilities. Before using the research instrument for data collection, the test items were tested for validity. The test instruments, consisting of pre-test and post-test items, were validated. The validation results showed an average validation score of 4.15. Based on validity criteria, this score is considered valid, making the items suitable for use in the study. In addition to the test instrument and the learning tool, the teaching module was also validated by experts to ensure its suitability before use in the learning process. The validation results showed an average score of 4.15. This value places the teaching module in the valid category, making it suitable for use in the learning process. After the instrument was declared valid, the study continued with the implementation of the learning using the IRME approach. During this process, observations were conducted to assess the implementation of the learning. The learning process using the IRME approach was observed using an observation sheet. Observations showed that the learning process was very successful, with an average score of 92.11%. This demonstrates the effectiveness of IRME in sixth-grade mathematics instruction. To measure students' mathematical problem-solving abilities, pre-tests and post-tests were administered. The summary results of these tests are presented in Table 1.

Table 1. Summary of pre-test and post-test results.

Test	Minimum Value	Maximum Value	Average
Pre-test	10.26	43.59	42.19
Post-test	69.23	92.31	71.91

Students' mathematical problem-solving abilities were measured using pre-tests and post-tests. Based on Table 1, the average pre-test score increased from 42.19 to 71.91 in the post-test. This result shows a significant improvement in students' understanding and ability to solve mathematical problems after the implementation of the IRME approach. The increase in scores indicates that students became more active and confident in analyzing and solving problems during the learning process. In addition, the IRME approach helped students connect mathematical concepts with real-life situations, making learning more meaningful and easier to understand. The collaborative and interactive activities in the IRME learning process also encouraged students to develop more effective critical thinking and

problem-solving strategies. This improvement indicates that students' abilities are in the good category after learning with the IRME approach.

Table 2. Average and interval score of each indicator.

Indicator	Average value per indicator	Category
Understanding the problem	75	Good
Planning the settlement	49	Not good
Solve the problem	88.33	Very good
Re-examine/make conclusions	74.33	Good

A more detailed analysis of each indicator in Table 2 shows that the problem-solving indicator received the highest score (88.33), categorized as excellent, while the planning a solution indicator received the lowest score (49), categorized as poor. This indicates that students tend to immediately attempt to solve problems without first devising a solution strategy, even though they are quite skilled in calculations and solving procedures. Next, a statistical analysis was conducted to determine the effect of implementing the IRME approach on improving students' mathematical problem-solving abilities. The effect of the IRME approach on students' problem-solving abilities was analyzed through a series of statistical tests, as shown in Table 3.

Table 3. N-Gain test results.

Information	Average
Post-Pre Score	29.72
Ideal Score	57.81
N-Gain	0.51

The N-gain test results showed a value of 0.51, which is in the moderate category. This means that the implementation of IRME successfully improved students' mathematical problem-solving abilities at a moderate level. Furthermore, based on the normality test, the significance values for the pre-test and post-test were greater than 0.05, indicating the data were normally distributed and allowing hypothesis testing with a paired-samples t-test. The t-test results showed a significance value of 0.000, indicating a significant difference between the pre-test and post-test. Thus, the IRME approach was proven to have a positive effect on students' mathematical problem-solving abilities. The study's results indicate that the implementation of the IRME approach to learning was highly successful. During the

three learning sessions, students demonstrated active participation, both individually and in groups, while the teacher acted as a guide, facilitating the solution-finding process. This finding aligns with Dewi (2018), who emphasized that teachers need to act as discussion facilitators and guides to encourage students to be more open in developing concepts. Furthermore, teachers also serve as facilitators, guiding students in understanding the material and providing motivation (Mokoagow, 2021). The collaborative learning atmosphere within the IRME approach also encouraged students to exchange ideas and construct mathematical understanding collectively.

Administering the IRME approach resulted in improved students' mathematical problem-solving abilities. The average post-test results showed a fairly good score, with the highest score being on the problem-solving indicator. Meanwhile, the solution-planning indicator remained relatively low because students tended to solve problems directly, without a systematic strategy. These results are consistent with the findings of Nindyakomalig et al. (2019) that the implementation of IRME can improve mathematical problem-solving abilities, and align with Vera et al. (2021), who emphasized that integrating local cultural contexts can facilitate students' understanding of problems. Further analysis using the N-Gain test showed a moderate increase, while a paired sample t-test indicated a significant difference between pre- and post-learning abilities. This strengthens the evidence that IRME has a positive effect on students' problem-solving abilities. The results of this study are consistent with those of Andriani et al. (2021), who found that IRME effectively improves mathematical communication skills, although the studies differed in focus. Therefore, the use of Banjarese cakes in this study can be considered a new contribution that strengthens the effectiveness of IRME in mathematics learning in elementary schools. However, because this study used a one-group pretest-posttest design without a control group, the findings should be interpreted carefully and cannot yet be generalized broadly. This finding suggests that teachers need to provide more scaffolding activities that encourage students to formulate solution strategies before performing calculations.

Conclusion

The IRME approach was implemented effectively. During the learning process, students actively participated both individually and in groups, while the teacher served as a facilitator, guiding them in finding answers or solutions to the problems. In addition,

students' ability to solve mathematical problems increased after participating in learning with the IRME approach. This can be seen in the average post-test results, which were in the fairly good category, with the highest score on the problem-solving indicator and the lowest on the solution planning indicator. The results of the statistical analysis also showed an increase in students' mathematical problem-solving abilities in the moderate category on the N-Gain test, and a significant difference between the pre- and post-treatment conditions based on the t-test. Thus, it can be stated that the IRME approach positively influences students' mathematical problem-solving abilities. Future studies are recommended to involve larger samples and experimental control groups to strengthen the validity of the findings.

Ethical Considerations

Permission to conduct this research was obtained from the school. All participants were informed about the purpose of the study, and student confidentiality was maintained throughout the research process.

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