

IMPROVING MATHEMATICS LEARNING PROCESSES AND OUTCOMES USING THE REALISTIC MATHEMATICS EDUCATION MODEL IN GRADE IV SDN 027/II SUNGAI ARANG

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Abstract

This research was motivated by the low mathematics learning process and outcomes at SDN 027/II Sungai Arang due to the lack of optimization of learning models and material contextuality. This Classroom Action Research (CAR) aims to improve the quality of learning through the Realistic Mathematics Education model. Implemented in two cycles with stages of planning, action, observation, and reflection, the research involved 15 fourth-grade students. The results show that the application of the RME model by utilizing real-world contexts creates a meaningful and interactive learning atmosphere. A significant increase is seen in the classical completion rate which increased from 53% in Cycle I to 87% in Cycle II, exceeding the target indicator of 80%. It is concluded that the RME model is effective in improving the mathematics learning process and outcomes by linking concepts to everyday life situations.

Keywords: Mathematics Learning, Outcomes, RME

Abstrak

Penelitian ini dilatarbelakangi oleh rendahnya proses dan hasil belajar matematika di SDN 027/II Sungai Arang akibat kurangnya optimalisasi model pembelajaran dan kontekstualitas materi. Penelitian Tindakan Kelas (PTK) ini bertujuan meningkatkan kualitas pembelajaran melalui model Realistic Mathematics Education. Dilaksanakan dalam dua siklus dengan tahapan perencanaan, tindakan, observasi, dan refleksi, penelitian melibatkan 15 siswa kelas IV. Hasil menunjukkan bahwa penerapan model RME dengan memanfaatkan konteks dunia nyata menciptakan suasana belajar yang bermakna dan interaktif. Peningkatan signifikan terlihat dari tingkat ketuntasan klasikal yang meningkat dari 53% pada Siklus I menjadi 87% pada Siklus II, melampaui target indikator 80%. Disimpulkan bahwa model RME efektif meningkatkan proses dan hasil belajar matematika melalui pengaitan konsep dengan situasi kehidupan sehari-hari.

Kata Kunci: Hasil Belajar Matematika, RME

INTRODUCTION

Mastery of numeracy literacy is a key pillar for students to understand mathematical concepts in depth and systematically (Hidayat et al., 2024). This ability requires students to connect mathematical abstractions with functional logic in facing various life problems (Sari & Wijaya, 2023). This aligns with constructivism theory, which emphasizes that effective learning occurs when students are able to explore solutions through structured and independent reasoning (Ramadhani, 2023). However, the reality on the ground shows significant challenges, with international surveys placing Indonesian students' mathematical competency low compared to global partner countries. This phenomenon emphasizes the constraints in teaching methods that have not been able to bridge conceptual

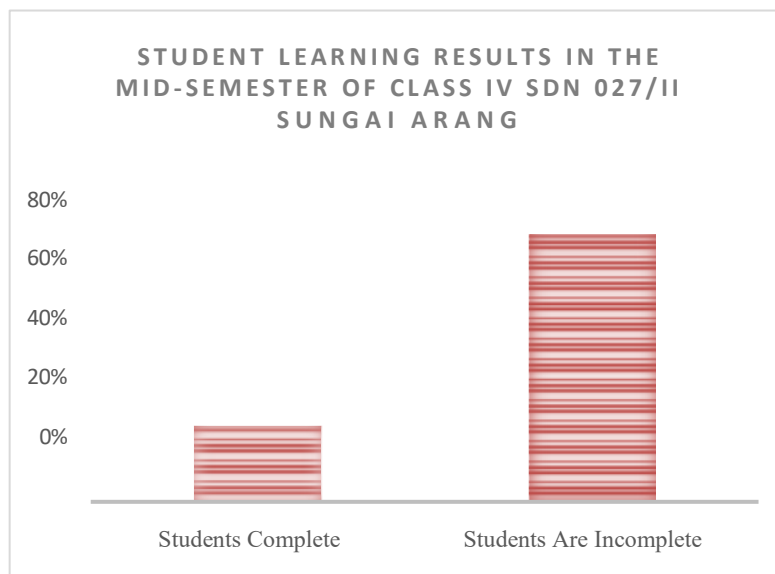
understanding with practical application in students' social environments (Pratama et al., 2024).

Mathematical reasoning competence is a vital element that determines the extent to which students are able to master mathematics comprehensively (Fathani et al., 2024). Beyond simply calculating, students are challenged to transform abstract logic into practical solutions relevant to life (Sujadi & Kurniawati, 2023). In line with Ausubel's principle of meaningful learning, this process demands active cognitive engagement so that students can construct useful knowledge (Handayani, 2023). However, the portrait of national education still shows serious obstacles, with Indonesian students' mathematical literacy scores on the international scale remaining stuck at a low level (UNESCO, 2023). This gap confirms that most students remain trapped in procedural memorization and struggle to apply mathematical concepts to solve real-world problems (Putra et al., 2024).

Mathematics learning in elementary school plays a vital role as a foundation for honing students' reasoning, logical skills, and analytical abilities. This phase provides a crucial opportunity for students to internalize a deep conceptual understanding so that mathematics can function as a tool in solving practical problems. Unfortunately, objective conditions in the classroom often demonstrate a contradiction, where mathematics is still viewed as a tedious and intimidating cognitive burden. This phenomenon of low interest and mathematical anxiety is still clearly found among fourth-grade students at SDN 027/II Sungai Arang, which hinders the creation of an optimal learning process.

Initial identification results revealed that the limited quality of the mathematics learning process and outcomes are influenced by several crucial variables. The first root of the problem lies in the dominance of one-way instructional methods that position educators as the primary source of information, thus limiting the space for active student participation in class. Furthermore, the lack of collaboration between students has resulted in an uneven distribution of understanding of the material, leading to decreased self-efficacy for students with slow learning speeds. Another contributing factor is the reliance on static learning resources with minimal innovation, resulting in a failure to present mathematical concepts as visual, dynamic, and relevant material for students.

In relation to this, the following researcher displays the learning outcomes of students in the mid-semester of class IV SDN 027/II Sungai Arang in the following table:



Based on the results of the mid-semester grades of class IV SDN 027/II Sungai Arang, it shows that many students' mathematics learning outcomes are still below the Learning Objectives Achievement Criteria (KKTP), out of 15 students only 3 students or (20%) students passed the KKTP, while 12 (80%) other students have not reached the KKTP. The KKTP of SDN 027/II Muara Bungo is 70, there are still many students who have not reached the KKTP due to several problems such as the implementation of less interesting learning models, facilities and infrastructure and various other problems.

This situation underscores the urgency of pedagogical transformation in line with the spirit of the Independent Curriculum, which prioritizes independent exploration, teamwork, and the creation of an inspiring classroom atmosphere. As a relevant solution, the Realistic Mathematics Education (RME) model presents itself with the core principle of integrating mathematics into real-life contexts, enabling students to construct understanding through real-world situations rather than simply memorizing algorithms. This approach enables students to meaningfully rediscover mathematical concepts through a process of progressive mathematization. However, the effectiveness of RME will be far more optimal if supported by interactive learning tools to maintain consistent student interest and cognitive engagement throughout the learning process.

The implementation of the Realistic Mathematics Education (RME) strategy will be strengthened by the integration of concrete media capable of interactively visualizing real-

world problems. The use of specially designed teaching aids as real-world representations is expected to eliminate the barrier between the abstraction of numbers and students everyday phenomena. Through this activity-based approach, students are invited to explore mathematical concepts independently in a dynamic and non-intimidating atmosphere. The synergy between the contextual RME philosophy and the use of innovative learning media creates a collaborative classroom ecosystem, which ultimately systematically strengthens conceptual understanding and significantly improves student learning outcomes.

Therefore, an in-depth study is needed to measure the extent to which the Realistic Mathematics Education (RME) Model contributes to optimizing the dynamics of learning in elementary schools. This research is crucial because it can provide concrete references regarding alternative learning strategies that are more applicable and relevant to students' needs, so that teachers can use them as a reference in creating more innovative teaching and learning activities. Based on this urgency, the author is motivated to conduct a study with the title: "Improving the Process and Outcomes of Mathematics Learning through the Realistic Mathematics Education (RME) Model in Grade IV of SDN 027/II Sungai Arang."

METHODS

Theoretically, Classroom Action Research (CAR) is a synergy of three fundamental components: research, action, and classroom. The research aspect is understood as a systematic and methodical effort to investigate a phenomenon in the learning environment to obtain accurate data for improving educational practices. The action component reflects the presence of planned treatments or improvements implemented to progressively address learning obstacles. The classroom is defined as a dynamic pedagogical environment where educational interactions between educators and a group of students take place over a period of time (Kusumah & Dwitagama, 2023).

The research design used in this scheme refers to the Kemmis and McTaggart model (Pradana & Syarifuddin, 2024). This model was chosen because of its systematic and continuous research flow, which broadly includes the following stages:

1. Planning.
2. Carrying out actions.
3. Observing.
4. Conducting reflection/analysis.

This classroom action research was conducted from March 2 to March 16, 2026, in the fourth grade of SDN 027/II Sungai Arang, Bungo Dani District, Bungo Regency, on the subject of Decimal Numbers and Fractions. The fourth grade students, comprising 15 students (8 boys and 7 girls), were taught the subject of Decimal Numbers and Fractions. The research activities consisted of the following stages: planning, implementation, observation, and reflection. Data were collected through observation, learning achievement tests, and documentation.

Observations served as instruments to monitor the dynamics of student interactions within the real-world context, teacher effectiveness in facilitating concept discovery, and student involvement in the mathematization process during the learning process. To verify the development of these competencies, an evaluation was conducted through a written learning achievement test consisting of 10 multiple-choice questions administered at the end of each cycle to objectively measure mastery of the material. In line with Gravemeijer's (2023) thinking, evaluation in RME is not simply about measuring final results, but rather validating the extent to which students are able to transform realistic situations into formal mathematical models. This entire series of activities is supported by visual documentation in the form of photos and video recordings during the implementation of the Realistic Mathematics Education (RME) Model, supported by contextual media as supporting data to ensure the accuracy of the research results.

To ensure data quality, the research instrument was validated using expert judgment techniques with collaborators. Furthermore, data reliability was maintained by involving observers in direct classroom observations, ensuring that the data recording process was objective and consistent from beginning to end.

The indicator of success in this classroom action research was an improvement in student learning processes and outcomes in mathematics in each cycle. This research established high success standards to ensure the quality of learning outcomes:

1. The Learning Process is declared successful if learning activities achieve indicators of $\geq 90\%$. This target was set to ensure that the RME model syntax has been fully implemented in the classroom.

2. The Learning Outcome is declared successful if students' classical mastery level reaches $\geq 80\%$ (at least 12 out of 15 students) with a score of $\geq 70\%$ according to the Learning Objective Achievement Criteria (KKTP) applicable at SDN 027/II Sungai Arang. The justification for the 80% target is based on efforts to exceed the initial condition, where the pass rate was only 20%.

Data analysis was conducted in an integrated manner using qualitative and quantitative approaches. Qualitative analysis was used to process data from observations of teacher and student activities through data reduction, systematic data presentation, and drawing conclusions. Quantitative analysis used descriptive statistics to measure the level of mastery of student learning outcomes. The mastery percentage was calculated using the formula:

$$P = \frac{F}{N} \times 100\%$$

Where:

P = Percentage sought (relative frequency).

F = Frequency (score obtained).

N = Number of cases (sum of maximum scores/total individuals).

RESULTS AND DISCUSSION

After the instrument was declared valid and all the equipment was ready, the implementation phase was immediately implemented during classroom teaching and learning activities. Each cycle was followed by a simultaneous observation phase to document the dynamics of student interactions. The collected data was then described, analyzed, and reflected upon to evaluate the effectiveness of the intervention in solving the problem (Zulkardi & Putri, 2024).

Field findings related to success indicators were collected as primary data for formulating conclusions. This research was designed in two continuous cycles, encompassing the stages of planning, acting, observing, and reflecting (Arikunto, 2021). The primary focus of this planning was optimizing mathematics learning through the application of the Realistic Mathematics Education (RME) model, which prioritizes the use of real-world contexts to improve conceptual understanding and student learning outcomes (Hadi, 2022).

Data analysis from Cycle I showed that the average classical achievement was only 55%, meaning the minimum completion target of 80% was not met. Therefore, corrective actions were needed in Cycle II, focusing on two main pillars. First, strengthening classroom management, requiring teachers to be more assertive in directing students to maintain a conducive learning environment. Second, reconstructing material delivery, namely presenting complex concepts through simpler, more communicative, and systematic language to optimize student understanding.

The modules in Cycle II were nearly identical to those in Cycle I, but the learning phase emphasized more active participation by students, both in the learning process and in the use of Realistic Mathematics Education (RME). The use of the Realistic Mathematics Education (RME) model was effective, as evidenced by the increase in student grades, reaching 87%.

The success of mathematics learning in this study was significantly influenced by the implementation of the Realistic Mathematics Education (RME) model, which synergizes student interests with the material being taught. Based on data analysis in Cycle II, it appears that the use of contextual problems as a starting point for learning has been very effective. Through the RME approach, mathematics is no longer seen as a collection of abstract formulas, but rather as the result of students' own construction through horizontal and vertical mathematization processes. Students are actively involved in reinventing mathematical concepts, so that the understanding formed is concrete and stored in long-term memory. The significant improvement in learning outcomes in Cycle II confirms that the RME model has achieved the success indicators set for fourth-grade students at SD Negeri 027/II Sungai Arang.

Cycle I

The learning implementation in Cycle I was carried out systematically, referring to the predetermined plan, divided into two meetings, each with a time allocation of 4 x 35 minutes. The learning process was conducted using the steps of the Realistic Mathematics Education (RME) Model, which begins each learning stage by presenting contextual (real-life) problems as a bridge for students to understand mathematical concepts. At the end of the cycle, the researcher conducted a collaborative reflection with the classroom teacher as observer. This reflection stage was crucial for objectively analyzing field findings, including evaluating the accuracy of the planning, the effectiveness of the mathematization stage (the transition from

real-life problems to formal concepts), the validity of the evaluation instruments, and student learning outcomes. Discussions with the observer focused on developing improvement strategies to optimize the use of realistic media or teaching aids and strengthen interaction between students in the next cycle. Based on observations of learning behavior and formative test data, the learning objectives set in Cycle I did not achieve the desired success indicators. Details of this data collection can be seen in the table below:

Table 1. Learning Test Results in Cycle I

No	Description	Information
1	Total Number of Students	15 Students
2	Number of Students Who Took the Test	15 Students
3	Average Student Score	65.7
4	Number of Students Who Completed the Test	8 Students
5	Number of Students Who Did Not Complete the Test	7 Students
6	Learning Completion (%)	53%

Based on table 1 above, it is known that Realistic Mathematics Education (RME) has not been able to meet the set completion targets. Of the 15 students, only 8 students reached the KKTP or 53%, while 47% have not reached the set KKTP. Thus, the use of the RME Model can be planned with the steps of the learning process that will be implemented in cycle II. Thus, the improvement plan is targeted at the obstacles encountered in cycle I and will be implemented in cycle II.

Cycle II

The learning implementation in Cycle II was carried out systematically, referring to the predetermined plan, divided into two meetings, each with a time allocation of 4 x 35 minutes. The learning process was carried out using the Realistic Mathematics Education (RME) Model, which integrates the use of contextual problems as a starting point for learning to strengthen students' understanding of mathematical concepts. Through this approach, students were guided to carry out independent mathematization processes based on real-life situations familiar to their environment. At the end of the cycle, the researcher conducted a collaborative reflection with the classroom teacher as observer. This reflection stage was crucial for objectively analyzing field findings, including evaluating the accuracy of the planning, the effectiveness of the mathematization stages (horizontal and vertical), the validity of the evaluation instruments, and student learning outcomes. Discussions with the

observer focused on developing improvement strategies to optimize the use of realistic media and strengthen student interactivity in constructing concepts in the next stage.

However, based on observations of learning behavior and formative test data, the learning objectives set in Cycles I and II indicated that learning outcomes had not yet met the desired classical success indicator targets. Based on data analysis in Cycle II, the implementation of the Realistic Mathematics Education (RME) model was declared successful, achieving very good results. This success encompassed all dimensions of the research, from thorough planning in formulating contextual problems, consistent implementation of the mathematization stages, to achieving maximum learning outcomes through students' independent concept construction.

Reflection activities were conducted collaboratively between the researcher and the classroom teacher (observer) at the end of each meeting to thoroughly analyze the findings and field observations. Reflection in Cycle II included a comprehensive evaluation of the effectiveness of the real-world context-based planning, the smooth implementation of the interactivity principle in engaging students, and the appropriateness of the use of realistic media in bridging students' understanding from concrete phenomena to abstract formal mathematical concepts.

However, greater emphasis was placed on systematic implementation and adherence to the planned steps. The results of the Cycle II test showed that students' responses met expectations. More details can be seen in Table 2 below:

Table 2. Learning Test Results in Cycle II

No	Description	Information
1	Total Number of Students	15 Students
2	Number of Students Who Took the Test	13 Students
3	Average Student Score	84
4	Number of Students Who Completed the Test	13 Students
5	Number of Students Who Did Not Complete the Test	2 Students
6	Learning Completion (%)	87%

Table 2 shows that the implementation of the Realistic Mathematics Education (RME) model improved the learning process, resulting in students achieving an average score of 84.20, with a learning completion rate of 87%.

The significant improvement in student learning outcomes from Cycle I (53%) to Cycle II (87%) demonstrates that the implementation of the Realistic Mathematics Education (RME) model is highly effective in overcoming the bottlenecks of conventional learning, which tends to be abstract. Analytical, this success is driven by three main factors that align with the characteristics of RME:

1. Utilization of Contextual Problems as a Starting Point: Learning no longer begins with formal formulas, but rather with real-world situations familiar to students. This helps students understand why mathematical concepts are needed, fostering intrinsic learning motivation from the beginning of the material transformation process.
2. Gradual Mathematization Process: Students do not simply memorize but engage in guided reinvention, transitioning from model-of (models from real situations) to model-for (models for formal problem solving). This systematic transition makes previously daunting mathematical concepts more plausible and easier to accept by students' logical thinking.
3. Visualizing Concepts through Realistic Media: The use of realistic media in the learning process helps students visualize abstract mathematical operations (such as adding and subtracting fractions) into concrete phenomena. By seeing the real-world relationships between numbers through these media, concepts are more firmly embedded in students' long-term memory.

These findings reinforce Constructivist Learning Theory, where knowledge is not passively imparted by teachers, but actively constructed by students through horizontal mathematization (connecting real-world problems to the mathematical world) and vertical mathematization (developing concepts within the mathematical system itself). This aligns with Polya's view that problem-solving is the heart of learning, triggering higher-order thinking skills.

Empirically, the results of this study support Gravemeijer's (1994) main principle in RME regarding guided reinvention, which states that integrating realistic contexts into the learning process significantly increases students' enthusiasm and long-term memory for mathematical concepts. The use of real-world problems as cognitive bridges has been shown to help students construct more meaningful understandings than simply memorizing procedures. The increase in completion rates, exceeding the 80% performance indicator, also confirms the

effectiveness of the Kemmis and McTaggart model in providing a systematic improvement path through the stages of planning, action, observation, and rigorous reflection in each cycle.

Despite achieving the target indicators of success, researchers recognized several limitations in implementing this RME model intervention:

1. **Time Management in the Mathematization Process:** The stage where students reinvent mathematical concepts from contextual problems requires a very loose and flexible time allocation. If not strictly managed by the teacher as facilitator, the discussion phase to explore real-world problems risks dominating time that should be used for reinforcing formal mathematical concepts (vertical mathematization).
2. **Conduciveness in the Interactivity Phase:** The principle of interactivity in RME, which encourages students' freedom to argue and present their problem-solving strategies, sometimes triggers excessive enthusiasm. This has the potential to cause noise that can disrupt the concentration of other classes, requiring firm managerial skills from teachers to maintain order without stifling students' creative thinking.
3. **Generalization of Context to Other Materials:** The effectiveness of using real-world contexts in this study is still limited to specific materials (such as fractions). Greater teacher creativity is required to design or modify relevant contextual problems if it is to be applied to other mathematical materials with a higher level of abstraction or different characteristics.

CONCLUSION

The lesson plan has been developed and implemented in accordance with the principles of the Realistic Mathematics Education (RME) Model, which integrates the use of contextual problems as a starting point for learning. The use of the RME model has been proven to encourage students to actively participate, express opinions, and construct their own mathematical understanding through real-life situations. This creates a more memorable learning atmosphere, relevant to everyday life, and meaningful for students. The knowledge construction process is carried out through mathematization activities, where students exchange ideas in groups to solve given real-life problems. The teacher acts as a facilitator who stimulates students' curiosity through guided reinvention, so that the understanding of mathematical concepts obtained can be stored well in long-term memory. The effectiveness of the RME model is clearly seen in the significant improvement in student learning outcomes.

In Cycle I, the application of the Realistic Mathematics Education (RME) model based on real-world contexts showed initial potential in changing classroom dynamics. Although the learning atmosphere began to relax and interaction between students increased in exploring problems, learning outcomes in the classroom only reached 53%. This achievement fell short of the 80% target for success indicators. Based on reflections from Cycle I, strategic improvements were made in Cycle II, focusing on strengthening the teacher's role in bridging students' understanding from concrete to formal models, as well as simplifying the instructional language on student worksheets. As a result, there was a drastic improvement, with the average class score rising to 84, with a classical completion rate of 87%. This achievement exceeded the established performance indicator targets, thus declaring this research a success.

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