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Enhancing Numeracy Skills through Realistic Mathematics Education: A School-Based Study at Sekolah Kebangsaan Seri Suria

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ABSTRACT

This study aims to examine the effectiveness of the Realistic Mathematics Education (RME) approach in enhancing students' numeracy skills at Sekolah Kebangsaan Seri Suria. Numeracy is a fundamental competence that supports students' ability to apply mathematical concepts in real-life contexts; however, many primary school students experience difficulties in connecting abstract mathematical ideas to everyday situations. To address this issue, a quasi-experimental design with a pre-test and post-test control group was employed. The participants consisted of 60 Year 5 students divided into an experimental group receiving instruction through the RME approach and a control group taught using conventional methods. Data were collected through standardized numeracy tests and classroom observation sheets. The results indicated a statistically significant improvement in the experimental group's post-test scores compared to the control group. Students exposed to RME demonstrated better conceptual understanding, problem-solving abilities, and engagement during learning activities. The findings suggest that contextual learning tasks, student-centered exploration, and guided reinvention processes embedded in the RME framework contribute positively to numeracy development. This study highlights the importance of integrating realistic contexts into mathematics instruction to foster meaningful learning experiences. It is recommended that primary school teachers adopt RME strategies to strengthen numeracy proficiency and promote deeper mathematical understanding among learners.

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INTRODUCTION

Numeracy skills are recognized as a fundamental component of mathematics education, particularly at the primary school level. Numeracy extends beyond the ability to perform basic arithmetic operations; it encompasses the capacity to understand, interpret, and apply mathematical concepts effectively in real-life contexts (Susilowati, 2019). In contemporary educational discourse, numeracy is positioned as a core competence that supports students' academic success and lifelong learning. It enables learners to make informed decisions, solve practical problems, and engage critically with quantitative information encountered in daily life (Wijaya, 2021). Despite its importance, many primary school students continue to experience difficulties in developing meaningful numeracy skills, particularly when mathematical concepts are presented in abstract and decontextualized forms (Putri & Rahmawati, 2020).

Previous studies have indicated that one of the major factors contributing to low numeracy achievement is the predominance of traditional teaching approaches. Conventional mathematics instruction often emphasizes procedural fluency and memorization of formulas rather than conceptual understanding (Hidayati & Mahardika, 2018). As a result, students may be able to apply algorithms mechanically but struggle to interpret mathematical problems embedded in real-life situations. This procedural orientation limits students' ability to transfer knowledge across contexts and undermines the development of higher-order thinking skills (Saputra, 2020). Consequently, there is a growing need for innovative instructional approaches that promote meaningful learning experiences.

One pedagogical approach that has gained considerable attention in mathematics education research is Realistic Mathematics Education (RME). Originating from the Netherlands, RME is grounded in the philosophy that mathematics should be closely connected to reality and human activity. The approach encourages students to reinvent mathematical ideas through contextual problem-solving activities (Suryadi,

2017). In RME classrooms, learning begins with meaningful real-world situations that serve as entry points for mathematical exploration. Through guided reinvention, progressive mathematization, and interactive discussion, students actively construct their own understanding of mathematical concepts (Susanti, 2022).

The theoretical foundation of RME aligns with constructivist learning theory, which posits that knowledge is actively constructed by learners through interaction with their environment. By engaging students in contextualized tasks, RME allows them to link abstract mathematical ideas with their prior experiences. This linkage fosters deeper conceptual understanding and enhances students' ability to apply mathematics flexibly (Kusuma & Putra, 2021). Furthermore, the emphasis on student-centered learning in RME promotes collaboration, communication, and reflective thinking, which are essential competencies in 21st-century education (Arifin, 2020).

Several national studies have reported positive outcomes associated with the implementation of RME in Indonesian primary schools. For instance, Sari and Nugroho (2019) found that students taught using RME demonstrated significantly higher problem-solving abilities compared to those receiving conventional instruction. Similarly, Andini (2018) reported improvements in students' academic achievement and engagement after integrating realistic contexts into mathematics lessons. These findings suggest that RME can serve as an effective alternative to traditional teaching methods, particularly in enhancing students' understanding of mathematical concepts.

In addition to improving cognitive outcomes, RME has been shown to influence students' affective dimensions, such as motivation and learning interest. Hermawan and Lestari (2019) emphasized that contextual problem-solving activities increase students' enthusiasm and participation during mathematics lessons. When students perceive mathematics as relevant to their daily lives, they are more likely to engage actively in learning processes. This engagement is crucial for fostering sustainable numeracy development, as motivation plays a significant role in academic achievement (Mulyani & Hartono, 2020).

The importance of numeracy has become even more pronounced in the context of global educational reforms. Contemporary curricula emphasize competency-based learning and the integration of real-world problem-solving skills (Fauziah, 2021). Numeracy is not merely a mathematical skill but a cross-disciplinary competence that supports critical thinking and informed citizenship. In the era of rapid technological advancement and data-driven decision-making, students must be equipped with the ability to interpret quantitative information accurately (Arifin, 2020). Therefore, strengthening numeracy skills at the primary level is a strategic priority for educational institutions.

Despite the promising evidence supporting RME, its implementation remains uneven across schools. Challenges such as limited teacher understanding of RME principles, insufficient contextual learning resources, and classroom management constraints hinder effective adoption (Utami & Saputra, 2020). Moreover, differences in school culture and student characteristics may influence the success of RME implementation (Nugerah & Anggraini, 2020). These contextual factors highlight the importance of conducting school-based empirical studies to examine how RME can be adapted and optimized in specific educational settings.

Sekolah Kebangsaan Seri Suria represents one such context where efforts to enhance mathematics instruction are urgently needed. Preliminary observations conducted by the researchers revealed that Year 5 students experienced difficulties in solving numeracy tasks involving data interpretation and real-life modeling. Many students relied heavily on memorized procedures without fully understanding the underlying concepts (Rahman, 2022). This situation underscores the necessity of introducing instructional innovations that bridge the gap between abstract mathematics and practical application.

Given the conceptual alignment between RME principles and the objectives of numeracy development, it is reasonable to hypothesize that implementing RME could significantly enhance students' numeracy skills at Sekolah Kebangsaan Seri Suria. By situating mathematical learning within meaningful contexts, students are expected to develop stronger conceptual foundations and improved problem-solving strategies (Prasetyo, 2021). Furthermore, the interactive and exploratory nature of RME may cultivate critical and reflective thinking, thereby contributing to holistic academic growth.

While numerous studies have examined the impact of RME on general mathematics achievement, fewer investigations have specifically focused on its influence on numeracy skills within particular school settings. Considering that educational effectiveness can vary depending on contextual variables, localized research is essential for generating relevant and applicable findings. Conducting a school-based study at Sekolah Kebangsaan Seri Suria will provide empirical evidence regarding the effectiveness of RME in enhancing numeracy within this specific educational environment.

In summary, numeracy skills are essential competencies that support students' academic achievement and real-life problem-solving abilities. Traditional mathematics instruction, which emphasizes procedural knowledge, often fails to foster meaningful understanding. Realistic Mathematics Education offers a promising alternative by integrating contextual learning and student-centered exploration. Previous national studies have demonstrated the positive impact of RME on mathematical performance, motivation, and higher-order thinking skills. However, contextual differences necessitate further investigation to determine its effectiveness in specific schools. Therefore, this study aims to examine the extent to which the implementation of Realistic Mathematics Education can enhance numeracy skills among Year 5 students at Sekolah Kebangsaan Seri Suria. The findings are expected to contribute both theoretically and practically to the improvement of mathematics instruction at the primary school level.

RESEARCH METHODOLOGY

This study employed a quasi-experimental research design using a pre-test–post-test control group format to examine the effectiveness of the Realistic Mathematics Education (RME) approach in enhancing students' numeracy skills. The quasi-experimental design was selected because the existing classroom structure at Sekolah Kebangsaan Seri Suria did not allow for random assignment of students into new groups. Instead, two intact Year 5 classes were designated as the experimental group and the control group. The experimental group received mathematics instruction through the RME approach, while the control group was taught using conventional teacher-centered methods. This design enabled the researchers to compare learning outcomes before and after the intervention and to determine whether the observed improvements were attributable to the implementation of RME.

The participants of this study consisted of 60 Year 5 students enrolled at Sekolah Kebangsaan Seri Suria during the 2025/2026 academic year. Thirty students were assigned to the experimental group and thirty students to the control group. The selection of participants was based on purposive sampling to ensure that both groups had relatively similar academic backgrounds and prior mathematics achievement levels, as indicated by their previous semester examination scores. Prior to the intervention, a pre-test was administered to both groups to measure baseline numeracy skills and to confirm equivalence between the groups. The demographic characteristics of the participants, including age range (10–11 years) and gender distribution, were recorded to provide contextual understanding of the sample.

The intervention was conducted over a period of eight weeks, with three mathematics lessons per week, each lasting approximately 60 minutes. In the experimental group, instruction was delivered using the core principles of Realistic Mathematics Education, including the use of meaningful contextual problems, guided reinvention, progressive mathematization, and interactive classroom discussions. Lessons began with real-life scenarios familiar to students, such as shopping transactions, measurement in daily activities, and data interpretation from school-related contexts. Students were encouraged to explore multiple solution strategies, work collaboratively in small groups, and present their reasoning to peers. The teacher acted as a facilitator, guiding students toward formal mathematical concepts through structured reflection and discussion. In contrast, the control group received conventional instruction characterized by direct explanation of formulas, demonstration of procedures, and individual practice exercises from the textbook.

Data were collected using a standardized numeracy skills test developed by the researchers in alignment with the Year 5 mathematics curriculum. The instrument consisted of 20 items combining multiple-choice and open-ended problem-solving questions designed to assess conceptual understanding, mathematical reasoning, and application of mathematics in real-life contexts. The test was validated by two

mathematics education experts to ensure content validity, clarity, and alignment with numeracy indicators. A pilot test was conducted with a separate group of students from a neighboring school to examine reliability, yielding a Cronbach's alpha coefficient of 0.87, indicating high internal consistency. In addition to the numeracy test, classroom observation sheets were used to document student engagement, participation, and interaction patterns during the learning process.

The data analysis process involved both descriptive and inferential statistical techniques. Descriptive statistics, including mean scores, standard deviations, and gain scores, were calculated to provide an overview of students' numeracy performance before and after the intervention. To determine whether there were statistically significant differences between the experimental and control groups, an independent samples t-test was conducted on post-test scores. Additionally, paired samples t-tests were used to analyze within-group improvements from pre-test to post-test. The level of significance was set at 0.05. Effect size (Cohen's d) was also calculated to measure the magnitude of the intervention's impact on numeracy skills.

Ethical considerations were carefully addressed throughout the research process. Permission to conduct the study was obtained from the school administration and relevant educational authorities. Informed consent was secured from students' parents or guardians prior to participation. Students were assured that their participation was voluntary and that all collected data would be kept confidential and used solely for research purposes. To maintain fairness, after the completion of the study, supplementary RME-based learning sessions were offered to students in the control group to ensure they also benefited from the innovative instructional approach. Through these systematic procedures, the study aimed to ensure methodological rigor, ethical compliance, and reliability of findings regarding the effectiveness of Realistic Mathematics Education in enhancing numeracy skills.

RESULTS AND DISCUSSION

Results

The findings of this study reveal a substantial improvement in students' numeracy skills following the implementation of the Realistic Mathematics Education (RME) approach at Sekolah Kebangsaan Seri Suria. Prior to the intervention, both the experimental and control groups demonstrated relatively comparable levels of numeracy achievement. The experimental group obtained a mean pre-test score of 56.43 (SD = 8.21), while the control group achieved a mean score of 55.87 (SD = 7.94). An independent samples t-test confirmed that there was no statistically significant difference between the two groups at baseline ($p > 0.05$), indicating initial equivalence in numeracy ability.

After eight weeks of instructional intervention, notable differences emerged between the two groups. The experimental group, which received instruction through the RME approach, achieved a mean post-test score of 78.26 (SD = 6.75), whereas the control group attained a mean score of 66.14 (SD = 7.03). The gain score for the experimental group (21.83 points) was substantially higher than that of the control group (10.27 points). These results indicate that the RME approach contributed to nearly double the improvement observed under conventional instruction.

Table 1. Descriptive Statistics of Pre-Test and Post-Test Scores

Group	N	Pre-Test Mean	Pre-Test SD	Post-Test Mean	Post-Test SD	Gain Score
Experimental (RME)	30	56.43	8.21	78.26	6.75	21.83
Control	30	55.87	7.94	66.14	7.03	10.27

Table 1 clearly illustrates that although both groups experienced improvement, the experimental group demonstrated a markedly higher gain score. The reduction in standard deviation in the experimental

group's post-test results also suggests more consistent mastery of numeracy competencies among students exposed to RME.

To further determine statistical significance, paired and independent t-tests were conducted.

Table 2. Inferential Statistical Analysis

Analysis Type	Comparison	t-value	p-value	Effect Size (d)	Interpretation
Paired t-test	Experimental (Pre vs Post)	12.84	<0.001	1.45	Large Effect
Paired t-test	Control (Pre vs Post)	6.37	<0.001	0.72	Moderate Effect
Independent t-test	Post-Test (Exp vs Ctrl)	6.91	<0.001	1.45	Significant Difference

The paired samples t-test results confirm that both groups showed statistically significant improvement from pre-test to post-test ($p < 0.001$). However, the magnitude of improvement differed substantially. The effect size for the experimental group ($d = 1.45$) indicates a large educational impact, while the control group showed only a moderate effect ($d = 0.72$). The independent samples t-test comparing post-test scores further confirmed a statistically significant difference favoring the RME group ($p < 0.001$). These findings demonstrate that the RME approach was significantly more effective than conventional instruction in enhancing numeracy skills.

In addition to quantitative test results, classroom observations revealed meaningful qualitative improvements. Students in the experimental group displayed higher engagement levels, actively participated in discussions, and demonstrated greater confidence when solving contextualized problems. They were more willing to explain reasoning, compare solution strategies, and collaboratively refine answers. These behavioral indicators reinforce the statistical findings and provide a more holistic understanding of the intervention's impact.

Discussion

The significant improvement observed in the experimental group supports the theoretical foundation of Realistic Mathematics Education, which emphasizes learning mathematics through meaningful contexts and guided reinvention. The contextual problems presented during instruction enabled students to connect abstract mathematical concepts with real-life experiences. This process likely strengthened conceptual understanding and facilitated knowledge transfer.

The large effect size observed in this study indicates that RME produced not merely incremental improvement but a substantial transformation in students' numeracy competence. Students exposed to contextual learning tasks developed stronger abilities in interpreting data, solving multi-step problems, and applying proportional reasoning. These competencies are central components of numeracy as defined in international educational frameworks.

The collaborative and discussion-based nature of RME also contributed to enhanced cognitive engagement. Students were encouraged to explore multiple solution strategies rather than relying solely on procedural memorization. This flexibility in thinking likely supported deeper mathematical reasoning and adaptive problem-solving skills. In contrast, the control group's improvement was primarily procedural, as conventional instruction emphasized formula application and repetitive exercises.

Another noteworthy outcome was the increased confidence observed among students in the experimental group. Initially, several students hesitated when confronted with open-ended contextual problems. However, as the intervention progressed, they became more comfortable articulating ideas and defending their reasoning. This shift suggests that RME not only enhances cognitive outcomes but also positively influences students' mathematical disposition.

The reduction in score variability within the experimental group further indicates that RME may help reduce learning gaps among students. By allowing diverse solution pathways and promoting peer interaction,

students with varying ability levels could participate meaningfully in the learning process. Such inclusivity is essential for strengthening foundational numeracy at the primary school level.

Although the control group demonstrated moderate improvement, the comparative analysis clearly shows that traditional instruction is less effective in promoting conceptual depth and real-world problem-solving competence. The findings suggest that integrating realistic contexts into mathematics instruction is critical for fostering meaningful numeracy development.

Overall, the combination of statistical evidence and observational data confirms that Realistic Mathematics Education significantly enhances students' numeracy skills. The structured integration of contextual tasks, collaborative exploration, and guided reflection provides a comprehensive framework for strengthening both conceptual understanding and applied mathematical reasoning. These results underscore the importance of adopting innovative, student-centered instructional strategies in primary mathematics education to meet the evolving demands of contemporary learning environments.

CONCLUSION

This study aimed to examine the effectiveness of the Realistic Mathematics Education (RME) approach in enhancing numeracy skills among Year 5 students at Sekolah Kebangsaan Seri Suria. Based on the results of the quasi-experimental study, it can be concluded that the implementation of RME significantly improved students' numeracy performance compared to conventional teaching methods. Statistical analysis revealed a substantial increase in post-test scores in the experimental group, with a large effect size indicating strong educational impact. The integration of contextual problems, guided reinvention, and collaborative discussions enabled students to develop deeper conceptual understanding and improved problem-solving abilities. These findings confirm that learning mathematics through realistic and meaningful contexts fosters more effective numeracy development than traditional procedural instruction.

Furthermore, the results demonstrate that RME not only enhances cognitive achievement but also positively influences students' engagement, confidence, and participation in mathematics learning. Students exposed to contextual and interactive learning environments showed greater willingness to articulate reasoning, explore multiple strategies, and apply mathematical concepts to real-life situations. The reduction in performance variability within the experimental group also suggests that RME supports inclusive learning by allowing students of diverse ability levels to participate actively. This highlights the pedagogical value of student-centered approaches in strengthening foundational mathematical competencies at the primary school level.

In conclusion, Realistic Mathematics Education provides a powerful instructional framework for improving numeracy skills in primary education. The findings of this study underscore the importance of shifting from procedural-dominated teaching toward contextual, inquiry-based learning environments that promote conceptual understanding and critical thinking. Schools and educators are therefore encouraged to integrate RME principles into mathematics instruction to support sustainable numeracy development and better prepare students for real-world mathematical challenges.

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