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The Effect of the RME Model with a Deep Learning Approach on the Mathematics Learning Outcomes of Grade IV Students

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Abstract

This study aimed to analyze the effect of the application of the Realistic Mathematics Education (RME) model with a Deep Learning approach on the mathematics learning outcomes of fourth-grade students at SDN Gugus XIV Kota Bengkulu. This study used a quantitative approach with a quasi-experimental method and employed a Matching Only Pretest–Posttest Control Group Design. The population of this study consisted of all fourth-grade students of SDN Gugus XIV Kota Bengkulu. The research sample consisted of class IVA of SDN 52 Kota Bengkulu as the experimental class and class IVC as the control class. The control class conducted learning activities using printed textbooks and assigned tasks through printed textbooks, while the experimental class applied the RME model with a Deep Learning approach that emphasized the connection between mathematical concepts and students' real-life contexts and encouraged active student participation in the learning process. The research instrument consisted of pretest and posttest in the form of multiple-choice questions totaling ten items, which had been tested for validity and reliability. Data analysis techniques included descriptive analysis to describe students' learning outcomes, prerequisite tests consisting of normality and homogeneity tests, and hypothesis testing using the t-test (independent sample t-test) at a significance level of 0.05. The results showed that the average posttest score of the experimental class was 79.66, which was higher than that of the control class at 62.41. The t-test results indicated that the value of t count was greater than t table ($4.240 > 1.673$) and the Sig. (2-tailed) value was less than 0.05 ($0.000 < 0.05$), so H_0 was rejected and Ha was accepted. Therefore, it was concluded that the application of the Realistic Mathematics Education (RME) model with a Deep Learning approach had a significant effect on students' mathematics learning outcomes.

Keywords: RME; Deep Learning; Learning Outcomes.

Abstrak

Penelitian ini bertujuan untuk menganalisis pengaruh penerapan model Realistic Mathematics Education (RME) dengan pendekatan Deep Learning terhadap hasil belajar matematika siswa kelas IV SDN Gugus XIV Kota Bengkulu. Penelitian ini menggunakan

pendekatan kuantitatif dengan metode eksperimen semu (quasi experiment) serta desain Matching Only Pretest–Posttest Control Group Design. Populasi dalam penelitian ini adalah seluruh siswa kelas IV SDN Gugus XIV Kota Bengkulu. Sampel penelitian terdiri atas kelas IVA SDN 52 Kota Bengkulu sebagai kelas eksperimen dan kelas IVC sebagai kelas kontrol. Kelas kontrol melaksanakan pembelajaran menggunakan buku cetak dan memberikan tugas melalui buku cetak, sedangkan kelas eksperimen menerapkan model RME dengan pendekatan Deep Learning yang menekankan keterkaitan konsep matematika dengan konteks kehidupan nyata siswa serta mendorong keterlibatan aktif dalam proses pembelajaran. Instrumen penelitian berupa tes pretest dan posttest dalam bentuk soal pilihan ganda berjumlah 10 butir soal yang telah diuji validitas dan reliabilitasnya. Teknik analisis data meliputi analisis deskriptif untuk mengetahui gambaran hasil belajar siswa, uji prasyarat yang terdiri atas uji normalitas dan uji homogenitas, serta uji hipotesis menggunakan uji-t (independent sample t-test) pada taraf signifikansi 0,05. Hasil penelitian menunjukkan bahwa nilai rata-rata posttest kelas eksperimen sebesar 79,66 lebih tinggi dibandingkan nilai rata-rata posttest kelas kontrol sebesar 62,41. Hasil uji-t menunjukkan bahwa nilai $t_{hitung} > t_{tabel}$, *(4,240 > 1,673) dan nilai Sig. (2-tailed) lebih kecil dari 0,05 (0,000 < 0,05), sehingga* H_0 *ditolak dan Ha diterima. Dengan demikian, dapat disimpulkan bahwa penerapan model Realistic Mathematics Education (RME) dengan pendekatan Deep Learning berpengaruh secara signifikan terhadap hasil belajar.*
Kata Kunci*: RME; Deep Learning; Hasil Belajar.*

INTRODUCTION

Mathematics plays an important role in developing students' logical, analytical, systematic, and problem-solving skills. According to the Educational Standards, Curriculum, and Assessment Agency (BSKAP), mathematics learning aims to enable students to understand concepts, use reasoning, and apply mathematics in their daily lives (BSKAP, 2025). However, the mathematical ability of Indonesian students is still relatively low. The results of the Programme for International Student Assessment (PISA) in 2022 show that Indonesia obtained a mathematics score of 366, lower than the OECD average and a decrease compared to PISA 2018 (OECD, 2019; OECD, 2023). The results of the pre-research in grade IV of SD Negeri 52 Bengkulu City also showed that the average score of students' mathematics learning outcomes was 69.5. This condition is suspected to be influenced by learning that is still teacher-centered so that students are less active in building understanding of concepts (Sari, 2024).

One alternative to overcome this problem is the application of the Realistic Mathematics Education (RME) model. According to Fathurrohman (2020), RME uses real-life contexts as a starting point for learning to help students build an understanding of concepts. Agusdianita (2022) stated that RME is able to create active and student-centered learning, while Zetriuslita et al. (2025) prove that RME has a positive effect on mathematics learning outcomes.

In addition to the learning model, the deep learning approach also supports in-depth understanding of concepts through mindful, meaningful, and joyful learning (Amrullah, 2025). Deng (2024) explains that this approach helps students connect new knowledge with previous experiences, while Sitompul et al. (2025) state that deep learning can improve the understanding of mathematics concepts and learning outcomes of elementary school students.

Various studies have proven the influence of the RME model and the deep learning approach separately. However, research that integrates the two in elementary school mathematics learning, especially extensive measurement materials using non-standard units, is still limited. Therefore, this study aims to analyze the influence of the Realistic Mathematics Education (RME) model with a deep learning approach on the mathematics learning outcomes of grade IV students of SD Negeri 52 Bengkulu City.

RESEARCH METHODS

This study uses a quantitative approach with a quasi experiment method using the Matching Only Pretest–Posttest Control Group Design. The research population is all grade IV students of SDN Cluster XIV Bengkulu City. The sample was determined using cluster random sampling techniques, with class IVA SDN 52 Bengkulu City as an experimental class that applied the RME model with a deep learning approach, while class IVC as a control class used conventional learning. The implementation of learning in the experimental class refers to the RME model syntax combined with the principles of deep learning, namely understanding contextual problems (mindfull learning), explaining contextual problems (mindful learning), solving contextual problems (joyful learning), wembling and disculculating answers (meaningful learning, joyful learning) (Isrok'atun, 2019; Mu'ti, 2025; Mustapa, 2024; Akmal et al., 2025). The research instrument is in the form of learning outcome tests that are prepared based on learning outcome indicators and have gone through validity and reliability tests before being used (Winarni, 2021; Anderson & KraThwohl, 2015).

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RESULT AND DISCUSSION

Result

The results of the research were obtained from the data collection process using a written test instrument in the form of multiple choice as many as 10 questions, which were given twice, namely before (pretest) and after (posttest) in the learning process. This test is used to measure student learning outcomes after being given learning treatment using the RME model with *a deep learning approach*. After the data was obtained, a descriptive analysis, normality test, and homogeneity test were carried out as a prerequisite test before an inferential statistical analysis was carried out to test the research hypothesis. The following are the results of the data from the research obtained by the researcher.

1. **Descriptive Statistical Analysis Results**

   The results of the descriptive analysis showed that the average pretest score of the experimental class was 56.21 and the control class was 54.83, which shows that the initial ability of the two classes is relatively equivalent. After treatment, the average posttest score of the experimental class increased to 79.66, while the control class only reached 62.41. The increase in learning outcomes in the experimental class was higher than in the control class, which indicates that the application of the RME model with a *deep learning approach* has a positive impact on students' mathematics learning outcomes.

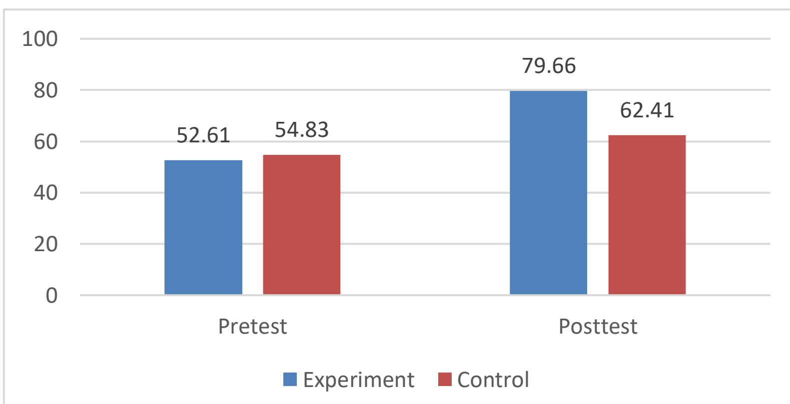

Figure 1. Pretest and Posttest Average Scores

Based on Figure 1. shows that the average value of the experimental class pretest and the control class are relatively equivalent. After learning, the average posttest score

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of the experimental class was higher, which was 79.66 compared to the control class, which was 62.41. This difference indicates an increase in students' mathematics learning outcomes after the implementation of the learning model.

2. Results of Prerequisite Test Analysis

a. Normality Test Results

The normality test was performed using *the Shapiro–Wilk test* because the sample count was less than 50. The test results showed that the significance value of the experimental class pretest was 0.098 and the control class was 0.053, while the significance value of the experimental class posttest was 0.082 and the control class was 0.058. All significance values are greater than 0.05, so that the student learning outcome data is normally distributed and is eligible for further statistical testing.

b. Homogeneity Test Results

The homogeneity test was performed to determine the similarity of variance between the experimental class and the control class. The test results showed that the significance value of the pretest was 0.322 and the significance value of the posttest was 0.112. All significance values are greater than 0.05, so it can be concluded that the variance of learning outcome data in both classes is homogeneous and eligible for further statistical testing.

3. Inferential Analysis Test Results

After the data is declared to be normally distributed and homogeneous, hypothesis testing is carried out using *an independent sample t-test*. The results of the pretest showed a significance value of 0.728 (> 0.05), so there was no difference in initial ability between the experimental class and the control class. Furthermore, the results of the posttest test showed a t-value of 4.240 with a significance of 0.000 (< 0.05), which indicates a significant difference in learning outcomes. Thus, the application of the RME model with *a deep learning approach* has a significant effect on the mathematics learning outcomes of grade IV students.

Discussion

This study uses a quantitative approach with a quasi experiment method and a Matching Only Pretest–Posttest Control Group Design design. The research was carried out at SD Negeri 52 Bengkulu City with class IVA as the experimental class and class IVC as the control class. During the learning process, students in the experimental class showed

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increased activity in asking, discussing, and expressing opinions. Mathematics learning in broad measurement materials using non-standard units is carried out through the RME model with a deep learning approach that relates mathematical concepts to the context of daily life.

The first step is to understand contextual problems (mindful learning). Teachers present problems that are close to daily life, such as measuring area using non-standard units. This activity encourages students to relate initial knowledge with real experience so that they are more active and understand concepts meaningfully. Thus, students not only memorize procedures, but build understanding through learning experiences.

This is in line with Mu'ti (2025) who states that mindful learning fosters learning awareness through active engagement, intrinsic motivation, and the ability to connect knowledge with real experiences. Therefore, the stage of understanding contextual issues helps students build a deeper understanding of concepts.

Figure 2 and 3. Activities on syntax understanding contextual problems in mindful learning

The second step is to explain contextual problems (mindful learning). The teacher gave directions and concrete examples, such as demonstrating how to measure the area using pieces of origami paper as a non-standard unit. Through this activity, students understand broad concepts in a concrete way by connecting learning experiences to mathematical concepts. The activity also encourages students to be actively involved and build understanding independently in accordance with the principles of RME. This is in line with Amrullah (2025:38) who states that mindful learning encourages students to learn consciously, actively, and connect with the material learned.

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Figure 4 and 5. Activities on the syntax explain contextual problems in mindful learning

The third step is to solve contextual problems (joyful learning). Students work in groups using LKPD to measure the area of objects with non-standard units. This activity creates an active, fun, and contextual learning atmosphere so that students are more enthusiastic, collaborative, and understand concepts through hands-on experience. This is in line with Amrullah (2025:58) who states that joyful learning creates a comfortable learning environment, increases motivation, and has a positive impact on learning outcomes.

Figure 6 and 7. Activities on syntax solving contextual problems in joyful learning

The fourth step is to compare and discuss the answers (meaningful learning and joyful learning). Each group presents the measurement results, then students discuss the differences in the results obtained so that they understand that the use of non-standard units can produce different measurements. This activity helps students build understanding of concepts through hands-on experience while creating an active and fun learning atmosphere. This finding is in line with Rahmawati et al. (2025) who stated that meaningful learning helps students connect new concepts with previous knowledge so that learning is more meaningful, while joyful

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learning increases student motivation and engagement. These results are also supported by Jeet and Pant (2023) who state that the integration of meaningful and joyful learning can increase students' engagement, collaboration, and communication skills.


Figure 8 and 9. Activities on syntax compare and discuss matching answers for meaningful learning and joyful learning

The last step is to conclude the learning outcomes (meaningful learning). The teacher and the students concluded that the area of an object can be measured using non-standard units, but the results can be different because the measuring tools used are not the same. Through this activity, students understand the importance of using standard units so that the measurement results can be compared appropriately. This stage reflects meaningful learning because students build an understanding of concepts based on the learning experiences that have been carried out. This is in line with Kusuma et al. (2026) who stated that meaningful learning emphasizes the active involvement of students in connecting the learning experience with the concepts learned so that learning becomes more meaningful.

Figure 10. Activities on syntax conclude meaningful learning

In group discussion activities when working on LKPD, students are facilitated using non-standard unit measuring tools (leaves, banknotes, and books). This activity took place with enthusiasm and the students worked together so that all tables were covered. During the table measurement activity, students work together in groups to arrange objects that are used as non-standard units One of the groups is seen trying two ways of arranging, namely horizontally and vertically. At first, some students arrange objects horizontally in a horizontal position following the sides of the table. However, after trying, there are still parts of the table that have not been evenly covered.


Figure 11 and 12. Student looking for a way to get the table covered

Seeing these conditions, one of the group members expressed his opinion that vertical arrangement would be better because it could cover the table surface more tightly and without gaps. This opinion was then discussed with other members of the group. Other students agreed to the proposal and they tried again by arranging the unit objects vertically. After trying, students realized that the vertical method did make the table surface closed more optimally and the measurement results became neater and easier to calculate.

This process shows that there is good cooperation and communication between students. Each group member dares to express their opinions and respect each other's input. Students learn that in completing assignments, discussion and mutual agreement are needed to obtain more appropriate results. Then the measurement results obtained by students are not consistent. Because of the difference in the size of the money used, the number of units obtained is not the same. Through this activity, students gain a meaningful learning experience because they realize that the use of non-standard units that are not the same size can produce differences in measurement results.

In addition, in the activity of measuring the area of the table with leaves, it was found that some students were not fully able to apply the measurement concept correctly. This can be seen when students measure the surface of the table using leaves, where there are still gaps so that the table surface has not been completely covered This condition shows that students' understanding of the principle of area measurement, which is to cover the entire surface of objects without gaps, is still in the development stage.

After all groups have completed the preparation and counting activities, the measurement results are then compared together. The group that used leaves obtained 33 leaves, the group that used books obtained 16 books, and the group that used banknotes obtained 57 sheets of banknotes. These differences in results are again the subject of class discussion, so that students can understand that the measurement results are influenced by the non-standard unit measuring tool used. This activity provides a meaningful learning experience for students. They not only understand broad concepts through theory, but also through the process of trying, discussing, and working together directly in a group

Based on the results of the research that has been carried out, it was found that there was a significant difference in mathematics learning outcomes between the experimental class using the RME learning model and the control class using the conventional learning model. This is evidenced by an increase in the average score of learning outcomes (posttest) in the experimental class, which was 79.66 compared to the control class, which was 62.41. In addition, the results of the analysis of independent samples t-test data showed a significance value (Sig.) < 0.05 or (0.000 < 0.05) which showed a significant difference in learning outcomes between the two classes. This difference in learning outcomes is caused by the different treatment in the two classes. This means that the use of the RME learning model with a deep learning approach has been proven to improve student learning outcomes compared to conventional learning.

In line with the results of the research, Agusdianita (2025) stated that the RME model relates mathematics learning to students' real lives so that students are more active, understand concepts meaningfully, and learning outcomes improve. This can be seen in learning activities in experimental classrooms, where students are directly involved in measurement and discussion activities so that broad concepts are not understood in the abstract, but through real experience. This result is also in line with the research of Landong et al. (2025) who stated that the application of the real-experience RME model can make learning more interesting and meaningful, thus having a positive impact on the student learning process. In this study, although Landong researched learning interests, these increased interests contributed to student engagement which ultimately supported improved learning outcomes.

The findings of this study are also in line with the research of Dorisno et al. (2024) which shows that the RME model has a positive effect on students' understanding of mathematical concepts, because students are actively involved in learning and do not only receive information directly. This can be seen in students in the experimental class who are more active in discussing, expressing opinions, and being directly involved in the learning process. This activeness has an impact on increasing understanding of concepts and student learning outcomes. In addition, the results of this study are in line with the research of Munhwati et al. (2025) which proves that the application of RME can improve students' mathematical problem-solving skills, which is one of the important indicators in mathematics learning outcomes.

This activity also represents the principles of deep learning that emphasizes active engagement, deep thinking, and fun learning. According to Barokah & Mahmudah (2025), deep learning-based learning fosters learning motivation because students are directly involved in finding concepts. This can be seen from the students' expressions of pleasure and curiosity during the process of measuring and discussing. Furthermore, this research is also supported by research by Maharani et al. (2025) who stated that the deep learning approach is able to increase conceptual understanding, active participation, and students' critical thinking skills. In addition, according to (Linda, 2025), it states that learning that involves active participation, collaborative activities, and a fun learning atmosphere has been proven to strengthen students' cognitive learning outcomes. Meanwhile, according to (Putri, 2026), this deep learning approach emphasizes an active, reflective, and meaningful learning process so that it has a positive impact on improving learning outcomes.

Meanwhile, in the control class that uses conventional learning, students' activities tend to be passive and only listen to the teacher's explanation. Overall, the results of the study show that the use of the RME model with a deep learning approach is able to significantly improve students' mathematics learning outcomes. This model encourages students to be active, think critically, and understand concepts deeply through real, meaningful and enjoyable learning experiences. This kind of learning is effective in improving student learning outcomes.

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CONCLUSION

The application of the RME model with a deep learning approach has been proven to have a significant effect on students' mathematics learning outcomes. This is shown by the average posttest score of the experimental class of 79.66 which is higher than the control class of 62.41, as well as the results of the independent sample t-test with a significance value of 0.000 (< 0.05). Thus, the RME model with a deep learning approach has been proven to improve the mathematics learning outcomes of grade IV students. The results of this study imply that elementary school teachers can use the RME model with a deep learning approach as an alternative to mathematics learning strategies to improve student learning outcomes.

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