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Implementation of RME learning model supported by culture-based student worksheets in second-grade elementary schools to enhance mathematical understanding

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Abstrak

Penelitian ini bertujuan untuk mengetahui pengaruh model RME berbantuan LKPD berbasis budaya terhadap pemahaman matematis pada materi perkalian dan pembagian di kelas II SD. Jenis penelitian menggunakan kuantitatif quasi eksperimen dengan desain pretest-posttest. Penelitian ini melibatkan peserta didik kelas II dari sekolah unggulan terpilih di Kecamatan Rancakalong, dengan dua sekolah dipilih sebagai sampel penelitian. Dalam menganalisis data digunakan uji asumsi (normalitas dan homogenitas), uji hipotesis serta uji N-Gain. Instrumen yang digunakan yaitu tes pemahaman matematis serta lembar observasi kinerja guru dan lembar aktivitas peserta didik. Pada penelitian ini didapatkan bahwa adanya pengaruh positif dalam penggunaan model RME berbantuan LKPD berbasis budaya yang mendapatkan peningkatan N-Gain sebesar 0,53 pada kategori sedang. Kemudian, berdasarkan uji beda rata-rata yang dilakukan disimpulkan bahwa terdapat perbedaan rata-rata pemahaman matematis peserta didik di kelas model RME berbantuan LKPD berbasis budaya dan kelas model konvensional dengan peningkatan yang lebih baik ada di kelas eksperimen.

Kata kunci: Model RME, Pemahaman Matematis, LKPD berbasis Budaya

Abstract

This study aims to determine the effect of the RME model assisted by culture-based student worksheet on mathematical understanding of multiplication and division material in class II elementary schools. This type of research uses quantitative quasi-experiment with a pretest-posttest design. The research included class II students from select superior schools in the Rancakalong District, with two schools being chosen as samples for the study. In analyzing the data, assumption tests (normality and homogeneity), hypothesis testing and the N-Gain test were used. The instruments used were mathematical understanding tests as well as observation sheets of teacher performance and student activities. In this study, it was found that there was a positive influence of using the RME model assisted by culture-based student worksheet which resulted in an increase in N-Gain of 0.53 in the medium category. Then, based on the mean difference test carried out, it was concluded that there was a difference in the average of students' mathematical understanding in the RME model class assisted by culture-based student worksheet and the conventional model class with a better improvement in the experimental class.

Keywords: *Model RME; mathematical understanding; student worksheets; culture*

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A. Introduction

Learning mathematics is very useful for daily life. But in reality, only a few students like learning mathematics because generally have difficulty solving mathematical problems. Teachers convey knowledge without ensuring students understand basic concepts, causing students to have difficulty understanding what is being taught.

According to previous research, students have difficulty when dealing with addition, subtraction, multiplication, and division operations (Buyung et al., 2022). According to research findings, many students encounter challenges when it comes to interpreting word problems and expressing them as mathematical equations. This difficulty is commonly observed among students attempting to articulate the problems presented in the questions (Wasitoh et al., 2023). These difficulties cause students to be confused in determining the right solution strategy, which ultimately leads to student dependence on the teacher (Paramartha et al., 2020; Yurniwati & Handayani, 2019). Under these circumstances, it is imperative to implement various measures aimed at improving students' mathematical comprehension.

The RME model represents an appropriate learning framework as it underscores the process of constructing students' comprehension through direct activities and the resolution of real-world problems (Maulana et al., 2021). The RME model allows students to reinvent mathematical concepts by leveraging their surroundings and real-world experiences (Tantra et al., 2022). In addition, the implementation of a realistic mathematics learning model will serve to enhance the meaningfulness of the mathematics learning process (Helmaningrum & Arga, 2020; Maulana et al., 2021).

To foster meaningful learning, it is important to consider the social environment in which students learn. The RME model is a learning model that builds interaction between students and teachers through discussions that construct students' knowledge by providing guidance and facilities so that students have the opportunity to construct their thoughts (Armanto, 2002; Nursyahidah & Albab, 2021; Tunimah et al., 2024). In RME students can connect mathematical concepts by constructing their knowledge (Padmakrisya et al., 2024; Ningsih et al., 2024)). Meaningful learning can be created when students learn according to their social environment. One effective approach is to incorporate cultural elements into planning learning at school (Laksana et al., 2020). Culture-based learning can be integrated into the content of teaching materials to the substance of problems related to culture. Culture-based learning can be generated not only through strategies or learning models but also integrated into teaching materials (Ramadhani et al., 2019).

Regarding the enhancement of classroom learning, one of the useful teaching materials to consider is student worksheets, also known as LKPD. As stated by Kadir and Asma (2023) "LKPD can develop process skills, influence increased student activity, and optimize learning outcomes". According to Suyitno (Pane et al., 2022), student worksheet provides several benefits including 1) Making students actively involved during learning, 2) As assistance for students in developing concepts, 3) Training students to develop process skills, 4) As a guide, teachers and students engage in learning activities, 5) Helping students in receiving material and information about the concepts studied systematically. According to research by Adawiyah et al. (Adawiyah et al., 2023), the RME model supported by student worksheet, offers students opportunities to engage in structured thinking, actively participate in the learning process, gain a better understanding of concepts, and develop problem-solving skills. According to Dazrullisa (Dinata et al., 2022) there is an observed increase in learning motivation when utilizing culture-based student worksheet for assignments, in comparison to using textbooks.

Culture-based RME and student worksheet models have been proven effective in several of the contexts mentioned previously, but further validation of this research is still needed. Especially in mathematics learning in elementary schools to measure the effect of implementing the culture-based RME and student worksheet models. This study will focus on measuring the effect of implementing the RME model supported by culture-based worksheets on mathematical understanding of the concepts of multiplication and division in second-grade students. This study holds importance due to the scarcity of research documenting the influence of utilizing RME in conjunction with culture-based teaching materials like student worksheet on second-grade students' grasp of multiplication and division. The understanding of these concepts is pivotal for students, hence the need for an investigation into their efficacy. It is hoped that this research will have a positive impact on students' mathematical understanding of multiplication and division material.

B. Research Method

This is a quantitative quasi-experimental research with a Nonequivalent Control Group Design, where group selection is non-random (Sugiyono, 2016). The researcher used purposive sampling as the sampling technique, where the researcher first determines the number of research subjects.

Before implementation in the experimental and control classes, the assessment instruments utilized in this research were subject to testing to ensure normality, validity, reliability, appropriateness, and level of difficulty. The question instrument comprises 14 questions, including 7 multiplication and 7 division questions, with fill-in-the-blank and essay-type questions to assess student's ability to complete and elaborate on the answers. The purpose of these inquiries was to assess three fundamental indicators of mathematical comprehension: articulating concepts, providing examples and non-examples, and employing mathematical principles to resolve problems. The test instrument is used to see the increase in students' mathematical understanding of multiplication and division material. Moreover, researchers employed observation sheets to evaluate teacher performance and student engagement while implementing treatment in the two classes. The researchers conducted data analysis by initially evaluating the assumptions of normality and homogeneity for the two classes. Subsequently, they examined the pretest and posttest results to ascertain if there were discernible differences in impact.

C. Result and Discussion

In this research, experimental and control classes were initially given pretest to measure initial abilities. After three meetings, both classes underwent a post-test to evaluate the outcomes of the treated and untreated classes. According to the data obtained by researchers, there is an average difference between the pretest and posttest values in the two treated classes. In the experimental class, the average pretest score was 49.62, and the posttest score was 76.89. This differs from the control class, which had an average pretest score of 41.29 and a posttest score of 56.97.

To interpret the mean differences more effectively, a mean difference test is performed to assess the following hypothesis:

H_0: There is no significant difference in the average scores between pretest and posttest.

H_a: There is a significant difference in the average scores between pretest and posttest.

Table 1: Results of pretest-posttest normality tests for the experimental and control classes

The value of	P-value	Category
Pre-test experiment	0,571	Normally distributed
Post-test experiment	0,265	Normally distributed
Pre-test control	0,70	Normally distributed
Post-test control	0,018	Not Normally distributed

The researchers tested the normality of the pretest and posttest data for both classes. A significant value of 0.571 > 0.05 in the pretest and 0.265 > 0.05 in the posttest were obtained with the results obtained in the experimental class. In the control class, the pretest value was 0.70 and the posttest value was 0.018 <0.05. The pretest and posttest values obtained from the experimental class were found to be normally distributed. Consequently, a follow-up test was conducted, preceded by a homogeneity test.

To determine whether the data is homogeneous or not, we conducted calculations using the Levene test (F test) in SPSS. The hypothesis testing criterion used a significance level ($\alpha = 0.05$) in this study. If the P-value is less than α, then H_0 is rejected; if the P-value is greater than or equal to α, then H_0 is accepted. The summary of the homogeneity test is presented in Table 2.

Table 2. Results of the pretest and posttest homogeneity test for the experimental class

The value of	P-value	Significance (α)
Pre-test & post-test experiment	0,824	0,05

The Levene test results show a significance value for understanding mathematics based on the experimental and control pretest results of 0,824. This shows that 0.824 is greater than the significance level, so H_0 is accepted, so it can be concluded that the pretest data in both classes are homogeneous. Therefore, the *Paired Sample t-test* with a Sig (2-tailed) value of 0.000 while for the control class, there is data that is not normally distributed and the *Wilcoxon* test is carried out which shows that there is an average difference with the Asymp.Sig (2-tailed) value of 0.000. It can be concluded that both the experimental and control classes have significant average differences in the pretest and posttest results.

Furthermore, the difference in the influence of the RME model assisted by culture-based student worksheet and the conventional model on mathematical understanding can be determined by analyzing the posttest scores in the experimental class and the control class, with the following hypothesis:

H_0: The average of the experimental posttest and control posttest does not show a significant difference.

H_a: The average of the experimental posttest and control posttest shows a significant difference.

Following the posttest, it was found that the distribution of data in the experimental class was normal, whereas it was not normal in the control class so subsequently a *Mann-Whitney* test was conducted experimental and control class got Asymp.Sig values. (2-tailed) is 0.000 < 0.05, It can be concluded that there is a difference in the average mathematical understanding of students between the experimental and control classes. From the results of the average difference test, it is known that there is a significant difference so that it can be concluded that there is an influence of the RME model assisted by culture-based student worksheets on the mathematical understanding of class II students in multiplication and division material, so further testing is needed by calculating the N-Gain.

The amount of improvement before and after learning is calculated using the N-gain Formula as follows.

$$\text{N-Gain} = \frac{\text{Posttest score} - \text{Pretest score}}{\text{Maximum Score} - \text{Pretest score}}$$

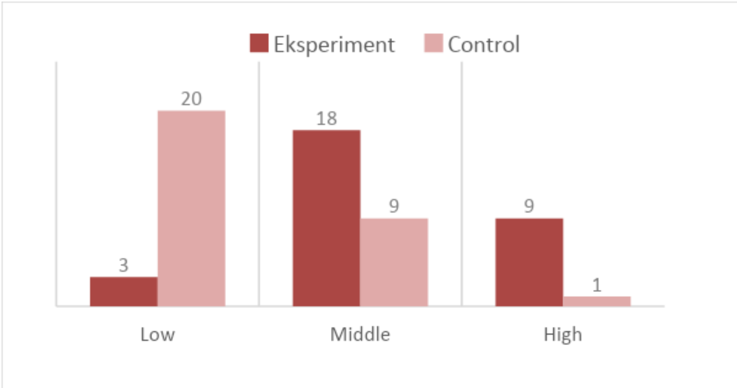
The categories below are used to interpret the decision-making basis from the N-Gain test results.

Table 3. N-Gain Category

N-Gain Value	Category
N-Gain ≥ 0,70	High
0,30 ≤ N-Gain < 0,70	Middle
N-Gain < 0,30	Low

(Lestari & Yudhanegara, 2018)

The N-Gain calculation results are summed up in the graph below based on the number of students in each category.



Grafik 1. N-Gain graph based on gain category

In the experimental class, there was an increase in the moderate category, while the control class experienced a rise in the low category. In the experimental class, there was an observed rise in the medium category, while the control class experienced an increase in the low category. The experimental class showed a greater increase on the N-gain test, with an average N-gain of 0.53, compared to the control class and-gain of 0.27.

The experimental class showed a greater improvement between the pre-test and post-tests. This is supported by the application of the RME model which is very helpful in forming student understanding. The use of culture-based student worksheets aims to support in constructing student understanding of multiplication and division material with student worksheets provided in accordance with the steps of the RME model. The learning steps used are adapted to the 5 stages of the RME model according to Hobri (in Isrok'atun & Rosmala, 2018; Ningsih, 2014). As according to (Pulungan et al., 2020), one of the benefits of student worksheet is to activate students in developing concepts. The utilization of cultural context through traditional games also enhances learning's meaning and connects it to their lives. Using congklak as a concrete medium supports students to understand the abstract concepts of multiplication and division which students use to manipulate during the learning process. In this study, congklak is used as a problem context in student worksheets and as a teaching aid to help students understand multiplication and division operations. By linking mathematical material with *congklak*, students can learn more relevantly and meaningfully, because students can link learning with cultural experiences that they know. Students build a process of understanding through solving problems presented in student worksheets and playing *congklak* in groups. Students are allowed to work on the questions in the student worksheet by manipulating *congklak* according to the instructions in the student worksheet. Students are asked to understand the contextual problems of multiplication and division related to the *congklak* game. The contents of the questions on the culture-based student worksheet used in this study are counting the number of *congklak* seeds in the *congklak* holes, and finding the results of dividing *congklak* seeds which are presented in the form of picture illustrations and story problems. In the first meeting, questions were presented that aimed to determine the total number of *congklak* seeds put into the *congklak* board. In the second meeting, questions were presented that aimed to determine the number of *congklak* seeds distributed. In the third meeting, two questions were presented, namely one multiplication question and one division question, students were asked to think about how to solve the question whether using multiplication or division. This follows what was stated by Yorulmaz & Doğan (2022) that the use of concrete objects can minimize errors in multiplication and division operations. The study conducted by Maria (2020) revealed a notable improvement in students' learning outcomes attributed to the incorporation of *congklak* in the teaching of multiplication and division concepts. In addition, culture-based learning really accommodates students' freedom of expression, increasing the ability of teachers and students to appreciate art and culture in their cultural community (Prihartini & Buska, 2019).

In this research, the learning process begins with understanding contextual problems. Wijdeveld (in Laurens et al., 2018) states that realistic means that the questions asked are questions that students can think about. Mills (2019) explains that better understanding is seen when students see relevance by making connections between what they learn in class and the things they care about in the world around them. In this study, the contextual concerns addressed pertain to aspects relevant to children's lives through the traditional game "*congklak*". In the second stage of the instructional process, contextual problems are re-explained under the guidance of the teacher, aligning with the principles of the RME model This stage reflects the concept of guided reinvention, which defines mathematics learning as a process in which students carry out mathematics tasks with the guidance of teachers or peers (Sembiring et al., 2008). In the third stage, students work together to solve problems. During this stage, students use *congklak* to solve the problems presented on their worksheets. This stage demonstrates the application of didactic phenomenology principles and mediating models principles, which are designed to connect informal knowledge with formal mathematics. Gravimeijer, Treffers & Goffree (in Yilmaz, 2020) state that "Didactical phenomenology requires working with phenomenon that are meaningful to students in the process of learning mathematics, can be organized by students, are stimulating for the learning process and meet four functions including concept formation, model formation, applicability, and practice". The application of this principle is exemplified in the third stage, as students endeavor to solve problems by applying the concepts of multiplication and division, which are linked to *congklak*. This approach aligns with the four functions outlined by Gravimeijer, Treffer & Goffree, serving to encourage students to autonomously engage in the learning process. After students solve the problem, the fourth stage continues with discussing and comparing the answers of each group. Encouraging interaction between groups, this stage culminates in a final concluding stage.

The RME model makes students understand multiplication and division material with culture-based student worksheets (*congklak*) which help facilitate students in building their understanding in solving problems regarding multiplication and division. As stated by (Maulana et al., 2021) who stated that in learning, contextual problems can be used to allow students to bridge the gap between concrete operational thinking and the abstract nature of mathematical concepts. The students in the experimental class showed high enthusiasm for using the *congklak* as a tool to understand multiplication and division concepts. This increase is influenced by the characteristics of elementary school students who find it easier to understand when learning through concrete objects and student worksheets which serve as guidelines during learning in the experimental class. This study provides further support for previous research demonstrating the positive impact of the RME model learning (Adawiyah et al., 2023; Apriyanti et al., 2023; Özkaya & Yetim Karaca, 2017). Therefore, it can be concluded that learning using the RME model assisted by culture-based worksheets has a greater impact compared to learning in the control class which uses the conventional model.

D. Conclusion

Learning by being given the treatment of the RME model (Realistic Mathematics Education) has a positive influence, as can be seen from the increase obtained by the N-Gain test, namely 0.53. If we look at the average N-Gain value obtained by the experimental class, it is better because in the control class, the N-Gain value was 0.27. It can be concluded that mathematical understanding of multiplication and division material can be improved through the RME model assisted by culture-based student worksheet. The problem of students' lack of interest in learning mathematics can be resolved by using the findings of this research as an alternative solution. By students constructing their knowledge, learning will be easy to understand and not easily forgotten. This research's results can provide an alternative solution to the problem of students' lack of interest in learning mathematics. Hence, it is advisable to utilize the RME learning model, particularly in the context of mathematics learning.

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