

THE EFFECT OF REALISTIC MATHEMATICS EDUCATION (RME) ON THE UNDERSTAND MATHEMATICAL CONCEPTS SKILLS OF ELEMENTARY STUDENTS USING HYPOTHETICAL LEARNING TRAJECTORY (HLT)

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Abstract

The background of this research is the difficulty in teaching mathematics concepts to fourth graders in elementary school. So we need activities that can bridge the initial abilities of students with abilities that must be mastered by students. One of the alternatives to learn mathematical concepts is by implementing Realistic Mathematics Education (RME) learning using Hypothetical Learning Trajectory (HLT). The research is aimed to describe and analyze the existence of significant differences in improvement of students' understanding mathematical concepts skills who learned and not learned used RME with HLT. This research method is quasi-experimental with the pretest-postest nonequivalent design. The data collection instrument used was a understanding mathematical concepts skills test. The population of this research is all fourth grade students in one elementary school, district of Tawang, Tasikmalaya. The results showed that based on the data analysis N-gain scores understanding mathematical concepts skills using the Mann-Whitney U test, the increased understanding the mathematical concepts skills of the experimental class is higher than the control class. It can be concluded that there is a significant difference in improvement students' understanding mathematical concepts skills who learned and not learned used RME with HLT.

Keywords: Mathematics; Realistics Mathematics Education, Understanding mathematical concepts skills; Elementary education.

Abstrak

Latar belakang penelitian ini adalah masih sulitnya mengajarkan konsep matematika kepada siswa kelas IV sekolah dasar. Maka dibutuhkan aktivitas yang dapat menjembatani kemampuan awal siswa dengan kemampuan yang harus dikuasai oleh siswa, salah satu alternatif untuk mempelajari konsep matematika adalah dengan menerapkan pembelajaran Realistic Mathematics Education (RME) yang menggunakan Hypothetical Learning Trajectory (HLT). Tujuan penelitian ini adalah untuk mengetahui gambaran dan menganalisis tentang adanya perbedaan peningkatan yang signifikan kemampuan pemahaman konsep matematis siswa SD menggunakan HLT dengan yang tidak menggunakan HLT dalam pembelajaran RME. Penelitian ini menggunakan pendekatan kuantitatif dengan menggunakan metode eksperimen kuasi. Desain penelitian yang digunakan adalah *the pretest-postest non-equivalent design*. Instrumen pengumpul data yang digunakan adalah tes kemampuan pemahaman konsep matematis. Populasi penelitian ini adalah seluruh siswa kelas IV di SDN Dadaha, Kecamatan Tawang, Kota Tasikmalaya. Hasil penelitian menunjukkan bahwa berdasarkan pada analisis uji data skor N-gain kemampuan pemahaman konsep matematis menggunakan uji Mann-Whitney U, peningkatan kemampuan pemahaman konsep matematis kelas eksperimen lebih tinggi dibandingkan kelas kontrol. Disimpulkan bahwa terdapat perbedaan peningkatan kemampuan pemahaman konsep matematis antara siswa yang mengikuti dengan yang tidak mengikuti Pembelajaran RME menggunakan HLT.

Keywords: Matematika; Realistic mathematic education; Pemahaman konsep matematis; pendidikan dasar.

INTRODUCTION

The ability to understand mathematical concepts is one of the most important abilities to master by students in 21st century education. Thus, learning is required to teach the concept of mathematics to be a concrete for students. In addition, elementary school students must be able to understand the mathematical concepts for learning mathematics in the next level. This is in accordance with the regulation of the Minister of National Education (Permendiknas) No. 20 year 2006 on the standard of contents regarding mathematics learning objectives and *National Council of Teachers of Mathematics* (NCTM, 1989) about the process standards in mathematics learning, including:

1. Understand the mathematical concept, explain the interconcept linkage and apply the concept or algoritma, efficiently, and precisely, in problem solving.
2. Communicating ideas with symbols, tables, or other media to clarify circumstances or problems.

Based on the Permendiknas and the NCTM above, the elementary school students must be able to develop The ability to understand concepts and can communicate mathematical concepts both orally and in writing.

The understanding of the concept according to Killpatrick, Swafford, & Findell (2001) is the ability to understand concepts, operations and relationships in mathematics. Based on exploration study by conducting observations to class IV in one of elementary school in Tasikmalaya City, the ability to understand the students' mathematical concept of fractional numbers is not maximized. This is due to the ability of diverse students, there are students who can quickly and there are students who are slow in receiving information and understand a concept and communicate it. However, the study plan provided is still lacking in facilitating students who are slow in understanding a concept.

Understand mathematical concepts is the primary basic in mathematics learning. According to Sadirman (2010, pp. 43) understanding can be interpreted to master something with the mind. Meanwhile, according to Donovan, Bransford, & Pellegrion (Jbeili, 2012) stated that conceptual understanding refers to the ability of students to connect new ideas in mathematics with ideas they know, to describe mathematical situations in different ways and to determine differences between representations this. The concept of mathematics is all things in the form of new notions that can arise as a result of thought, including definitions, meanings, special characteristics, the nature, and content of mathematical material. Based on some of these meanings, the understand mathematical concepts is to master something with a mind that

contains classes or categories of stimuli that have general characteristics. In studying mathematics, understand mathematical concepts is very important for students. Because mathematical concepts are related to one another so to learn it must be coherent and continuous. If students have understood mathematical concepts, it will be easier for students to learn mathematical concepts that are more complex next.

According to Gulo (2008) abilities that are classified in the understanding of a concept from the lowest to the highest are translation, interpretation, and extrapolation. The ability to be examined in this study is interpretation, namely the ability to explain the meaning contained in symbols (verbal and non-verbal). In this ability, a person can compare, differentiate, or contrast with something else and extrapolate, that is the ability to see the tendency or direction or continuation of a finding. For example: in a series of rectangular drawings, students are able to express the meaning of fractions and can show names of fractions and worth fractions, and so on.

Indicators that show understand mathematical concepts include: Restatement of a concept; Classifying objects according to certain properties; Give examples and non-examples of concepts; Presenting concepts in various forms of mathematical representation; and, apply the concept or problem-solving algorithm.

Understand mathematical concepts that need to be maximized in mathematics learning is in the subject of fraction numbers. The prerequisite material students have about integers and count numbers, fractions are prerequisites for further mathematical concepts. In connection with the above, we need an effective learning design that can be applied by the teacher to maximize the ability to understand students' mathematical concepts. One learning design that is thought to be able to improve students' understanding of mathematical concepts is the Realistic Mathematics Education (RME) learning using Hypothetical Learning Trajectory (HLT).

RME is learning that connects student experience with the subject matter that is obtained. According to Hadi in (Budiyono, Kusumaningsih, & Albah, 2019) the real world can be used as a starting point for the development of mathematical ideas and concepts in the RME approach. RME learning uses Hypothetical Learning Trajectory (HLT). Intended to bridge students' initial knowledge with knowledge that students must master in the learning process. Sarama & Clements (2009) states that the goals or learning objectives to be achieved; levels of teaching or levels of thinking from easy to complex; and Instructional Task or set of instructional tasks that can help students understand a concept from one level to the next.

Therefore, the purpose of this study is to find out the picture and analyze the differences in the significant improvement in the ability to understand mathematical concepts in elementary students using Hypothetical Learning Trajectory (HLT) with those who learn and not learn used Realistic Mathematics Education (RME) with Hypothetical Learning Trajectory (HLT). The research question of this study is “Is there an increase in understand mathematical concepts skills between students who learn and those not learn used Realistic Mathematics Education (RME) with Hypothetical Learning Trajectory (HLT)?”. The research hypothesis is "There is an increase in the understand mathematical concepts skills between students who learn and those not learn used Realistic Mathematics Education (RME) with Hypothetical Learning Trajectory (HLT)."

METHOD

The research approach used is a quantitative research approach using a quasi-experimental method. The research design used was *the pretest-posttest non-equivalent design* (Cohen, 2007, p. 283), with the following pattern:

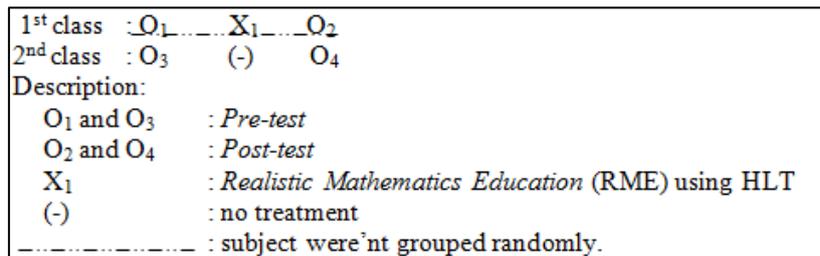


Figure 1. research design

The subjects in this study were IVA and IVB grade students at SDN Dadaha located on Dadaha street, Tasikmalaya City. The IVA class at SDN Dadaha as an experimental class and treated with *Realistic Mathematics Education (RME) learning* uses the *Hypothetical Learning Trajectory (HLT)*, while all IVB class students are the control class with direct learning. Learning Instruments in the form of RME-based Learning Implementation Plans (RPP); set of instructional assignments or *Hypothetical Learning Trajectory (HLT)*. Instruments that used is instrument test the ability of understanding mathematical concepts ability tests; observation instrument; and, documentation.

Data collection techniques used were test techniques of pretest and posttest tests for the ability to understand mathematical concepts; non-test techniques in the form of observation to determine the process during the treatment carried out; and, documentation in the form of supporting documents for evidence of research implementation.

Data processing was carried out with the help of SPSS 21 and *Microsoft Excel 2007*. Software processing and analysis of the results of this research data are as follows:

Calculate student pretest and posttest scores according to the scoring rubric used; minimum score; maximum score; average, and, standard deviation. Calculate the magnitude of the score increase understand mathematical concepts with the formula Meltzer (2002), namely:

$$N\text{-gain } (g) = \frac{(\text{posttest score}) - (\text{pretest score})}{(\text{max.score}) - (\text{pretest score})}$$

Conduct normality tests and homogeneity tests on research data in the form of scores increasing understand mathematical concepts. Conduct a difference test of two averages using the *Independent t-Test* to prove the hypothesis of this study. Make conclusions and generalizations from the results of the hypothesis test of this research.

RESULTS AND DISCUSSION

Results

The results of data acquisition pretest understand mathematical concepts skills of students in the experimental class (RME) and the control class. Pretest data analysis was conducted to determine differences in the acquisition of understand mathematical concepts skills among students in two classes before receiving treatment (*treatment*). The following are the results of the normality test scores of students' understand mathematical concepts skills tests between the experimental class and the control class can be seen in Table 1 below.

Table 1. Pretest score

Class	Student	Score Min.	Score Max.	Average	Std. Dev.
Experiment	28	17	58	35,417	10,786
Control	30	8	58	34,722	14,614

Based on table 1, it can be seen that the difference in the average score of the pretest understand mathematical concepts skills between the experimental class and the control class respectively 35,417 and 34,722. From these data, a prerequisite test is used to test the normality before testing the research hypothesis. The hypotheses tested in the normality test are:

H₀: the pretest score of students' understand mathematical concepts skills is normally distributed.

H_a: the pretest score of students' understand mathematical concepts skills is not normally distributed.

The test criteria using the Kolmogorov-Smirnov test are if the sig value. > the level of sig. (α = 0.05) then H₀ is accepted, if the value of sig. <the level of sig. (α = 0.05) then H₀ is

rejected. The following are the results of the normality test of the pretest score of students' understanding of mathematical concepts between the experimental class and the control class can be seen in Table 2 below.

Table 2. Normality test result

Class	Kolmogorov - Smirnov		
	Statistic	df	Sig.
Experiment	.165	28	.066
Control	.156	30	.059

Based on table 2, it can be seen that the normality test with the *Kolmogorov-Smirnov test* at the significance level ($\alpha = 0.05$), the experimental class (RME) obtained the significance value of the calculation results of 0,066 and the control class obtained a significance value of 0,059. It can be concluded that the data is normally distributed. Then the test continued with the independent test sample t-test to see the difference in understand mathematical concepts skills between the experimental class (RME) with the control class before receiving treatment. The results of the t-test are as follows.

Table 3. Independent t-test result

	Levene's test of equality of variances		t-test Equality of means				
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Equal variances assumed	4.408	.040	.421	58	.676	1.464	3.479
Equal variances not assumed			.430	52.743	.669	1.464	3.479

Based on table 3, the value of *Sig. (2-tailed) Equal Variances Assumed* at 0.676 and 0.669 higher than the significance level ($\alpha = 0.05$) then H_0 accepted. So it can be concluded that there is no difference in understand mathematical concepts skills between students who take and who do not take learning *Realistic Mathematics Education* (RME) using HLT before receiving treatment (*treatment*).

Analysis of the effect of RME on increasing understand mathematical concepts skills using *N-gain* scores of understand mathematical concepts skills in the experimental class (RME) and in the control class. The mean *N-gain* score illustrates the improvement in mathematical communication skills after learning. This analysis is to test the second research

hypothesis. Before testing the hypothesis, the prerequisite test is performed first, the normality test. The normality test results are as follows.

H_0 : the N-gain score of students' understand mathematical concepts skills is normally distributed.

H_a : the N-gain score of students' understand mathematical concepts skills is not normally distributed.

The test criteria using the Kolmogorov-Smirnov test are if the sig value. $>$ the level of sig. ($\alpha = 0.05$) then H_0 is accepted, if the value of sig. $<$ the level of sig. ($\alpha = 0.05$) then H_0 is rejected. The normality test results are as follows.

Table 4. Normality test result

Class	Kolmogorov - Smirnov		
	Statistic	df	Sig.
Experiment	.266	28	.000
Control	.176	30	.019

Based on table 4, the value of sig. experimental class 0,000 and control class 0.019 smaller than the significance level ($\alpha = 0.05$), then H_0 is rejected. Therefore, the N-gain score of students' mathematical concept understanding ability is not normally distributed. The next step, to test the research hypothesis using a nonparametric test, namely the Mann-Whitney U test. Hypothesis research work 1, "there is a difference in the increase in the understand mathematical concepts skills between students who learn and not learn in Realistic Mathematics Education (RME) using Hypothetical Learning Trajectory (HLT)". Formally H_0 and H_a , as follows.

$$H_0 : \mu_1 = \mu_2$$

$$H_1 : \mu_1 \neq \mu_2$$

The hypothesis testing criteria is if the value of sig. $>$ significance level ($\alpha = 0.05$) then H_0 is accepted. If the value of sig. $<$ significance level ($\alpha = 0.05$) then H_0 is rejected. The results of the Mann-Whitney U test output are:

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of N-gain Kemampuan Pemahaman Konsep Matematis is the same across categories of Kelas.	Independent-Samples Mann-Whitney U Test	.033	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 2. Mann-whitney U test result

Based on figure 2, the value of sig. 0.033 is less than the significance level ($\alpha = 0.05$) then H_0 is rejected and H_a is accepted. So, it can be said that the increased understand mathematical concepts skills of the experimental class is higher than the control class. It can be concluded that there is a difference in the increase in the understand mathematical concepts skills difference between students who learn and not learn *Realistic Mathematics Education* (RME) using *Hypothetical Learning Trajectory* (HLT).

Discussion

Discussion of research results is based on data that has been analyzed. The first discussion, seen from the improvement of students' understand mathematical concepts skills, is shown in the average N-gain score data obtained in the experimental and control classes, as follows.

Table 5. N-Gain Interpretation

Score (g)	Interpretation
0.71 – 1.00	High
0.31 – 0.70	Medium
0.00 – 0.30	Low

Increasing the N-gain score in understand mathematical concepts skills in the experimental class is included in the high category, which is 0,753. From the calculation of N-gain data understand mathematical concepts skills, that of 28 students in the experimental class, 16 students included in the high category normalized gain and 12 students included in the medium category normalized gain. That is, 16 students experienced an increase in understand mathematical concepts skills are high. Increasing the N-gain score in understand mathematical concepts skills in the control class included in the medium category, namely 0,667. From the calculation of N-gain data understand mathematical concepts skills, that of 30 control class students, 8 students included in the high category normalized gain, 16 students included in the medium category normalized gain, and, 6 students included in the low category normalized gain. That is, 8 students experienced an increase in the comprehend high mathematical concepts skills.

Therefore, based on an analysis of the results of the N-gain score and hypothesis testing, it can be concluded that there is a difference in the increase in the understand mathematical concepts skills difference between students who learn and not learn *Realistic Mathematics Education* (RME) using *Hypothetical Learning Trajectory* (HLT).

This research was also analyzed based on the implementation of the learning process. The results of the data analysis showed that there were differences in increase understand mathematical concepts between students learn and not learn RME using HLT. The implementation of learning at the time of the study was 4 times each in the experimental class and the control class, and twice for the implementation of the pretest and posttest. Class IVA as an experimental class and class IVB as a control class. The learning process uses RME with the help of HLT, the focus of its activities is on the activities carried out by students in solving the problems raised and on the problems faced by students in accordance with the material being studied.

The implementation of learning using RME in the experimental class, begins with apperception to find out the student's initial knowledge before learning fractions of class 4 semester 1 material. Then, communicate the learning objectives and inform the material to be learned. At the core activities, the RME learning steps are carried out. The first step, namely filing a group problem regarding the material fractions. Submitting this group problem, the teacher presents a contextual problem, such as "Miss has a rectangular paper. Try who can divide the paper into two equal parts in different ways? ". The use of this contextual problem refers to the characteristics of RME according to Treffers. The task of the teacher here is as a guide and director. That is, when students have difficulty in solving problems, the teacher provides feedback questions that lead students to find further clues in solving individual problems.

Then, the third step, Interactivity: Submitting group problems. In this third step students are grouped 3-5 people in each group to work on the problem problems proposed by the teacher listed in the Student Activity Sheet (LKS). The LKS is made in the form of a Hypothetical Learning Trajectory or a planned learning path regarding fractional material. By grouping, this aspect of interactivity in RME learning helps students to be able to interact, exchange ideas, and discuss with group friends, so they can find ways to solve these problems. Next, in the fourth step, which is concluded. After discussing the group, the student representatives present or communicate the results of the answer questions to the worksheet and each student pays attention and is involved in class discussion. The fifth step, namely the confirmation and assignment of tasks. After students discuss and communicate the results of the answers to problems, then the next step is to equalize the perceptions of each student, so students know the essence of the fractional material being studied. And to develop students' thinking skills,

given the problem of other problems and students work individually, to find out whether each student has understood or has understood the fraction material being studied.

The implementation of learning in the control class is not treated. That is, learning done is learning that uses conventional learning models. The learning steps are as follows. The first step is to convey the learning objectives and the material to be learned. Then, the teacher makes apperception to find out the students' abilities and initial information related to the material to be studied. The second step, demonstrating. The teacher gives the material and demonstrates the concept of fraction kepada students. In the implementation there is a question and answer process between the teacher and students in this second step. Then, the third step is guiding the practice. Students are given a worksheet containing fractional problems. Next, the fourth step is understanding and feedback, students progress one by one to answer the questions in the worksheet and discuss it together with other friends and teachers. The fifth step, which is to provide opportunities for further training and implementation. At this stage, individual students are given evaluation questions from the teacher.

CONCLUSION

The learning process using the RME with the help of HLT is already very good. Learning focus is on activities undertaken by the students in solving the problems posed and the problems faced by students individually appropriate material fractions. The conclusion from the study is that there is a difference in the increase in the understand mathematical concepts skills between students who learn and not learn *Realistic Mathematics Education* (RME) using *Hypothetical Learning Trajectory* (HLT) .

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