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Effectiveness of Realistic Mathematics Approach To Increasing Mathematical Representation Ability at SMP N 9 Purwokerto

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Abstract: This research was conducted based on the low ability of students' mathematical representation in the eighth-grade students of SMP N 9 Purwokerto. One of the contributing factors was that the use of the learning approach had not facilitated students in developing mathematical representation abilities. The solution that was considered capable of improving the ability of mathematical representation was to apply the learning process with a realistic mathematical approach. The realistic mathematics approach provided opportunities for students to do modeling, depicting, and symbolizing related to concrete problems. This research was quantitative with a quasi-experimental type with Nonequivalent Control Group Design. The population in this study were all students of grade eight of SMP N 9 Purwokerto. The sample in this study was the students of VIII A with a total of 36 students and VIII B with a total of 36 students. The data analysis used was the z-test and the N-Gain test. The results of the z-test showed a significant effect, the mathematical representation abilities of the experimental class students were higher. Then, the results of the N-Gain test showed that the experimental class was in the medium category and the control class was in the low category. Thus, the representation ability of the experimental class students was higher than that of the control class. The results of this study indicate that the realistic mathematical approach is effective in increasing students' mathematical representation abilities.
Keywords: Mathematical Representation; Realistic Mathematics; Research Results.

A. Introduction

Mathematical representation skills are skills that must be developed and mastered in learning mathematics. According to the National Council of Teachers of Mathematics (NCTM) representation is a skill in translating or transferring a mathematical problem to another form or configuration, the other form can be images or modeling in the form of symbols, graphs, diagrams, tables, orals, and sentences. NCTM recommends that learning programs for students in grades pre-kindergarten through 12 require them to be able to: (1) Create and use representations to plan, record, and communicate mathematical ideas; (2) Selecting, applying, and translating mathematical representations to solve problems; and (3) Using representations in modeling based on phenomena that occur in the student's environment (NCTM, 2000).

Then it was emphasized again in Permendikbud number 58 of 2014 which regulates subject matter standards starting from elementary school to high school, explaining that students' mathematical representation ability is an ability that must be mastered in learning mathematics. Representational ability here is an activity of processing, displaying, and reasoning in concrete domains such as using, modifying, translating, transforming, modeling, and creating and reasoning in abstract realms such as writing, speaking, calculating, and

composing in accordance with learning standards in schools and other sources.

The facts from the direct observation that are happening now show that most teachers pay little attention to students' mathematical representation abilities as an important basis in learning mathematics. Students' skills in performing mathematical representations such as making tables, graphs, images and symbols are not given much attention to their development in the classroom environment, many teachers still view these abilities as accessories in learning. Learning activities by focusing on the teacher as a learning resource cause students not to be free to express their own representational abilities. As a result, students are more likely to follow teacher instructions and hinder the development of students' representation abilities.

The ability to create models and develop mathematical models is an important component of mathematical representation abilities, but in Indonesia students' abilities in this field are still lacking. On a global scale, reports on the achievements of Indonesian students, especially the results from the Trends in International Mathematics and Science Study (TIMSS) and the Program for International Student Assessment (PISA), are proof of this. Indonesia is ranked 44 out of 49 countries in the ranking by TIMSS. then, Indonesia ranks 74th out of 79 countries in the 2018 PISA results. This data can be used as evidence that students' ability to create models and develop mathematical modeling is still low and needs special attention (Tohir, 2019).

The use of a Realistic Mathematical Approach is thought to be an alternative that can improve students' mathematical representation abilities. The use of students' mathematical representations can be explored through realistic mathematics approach learning. Model-based learning is a feature of realistic mathematics approach, which means that a mathematical concept or problem can be represented as a model. The model in question can be obtained by a concrete situation or a model that develops to an abstract level (Al jupri, 2012). In the learning process using realistic mathematics approach will pay attention to and explore the potential of students who must be discovered and developed. The teacher's belief in the existence of potential in students will create how teachers plan the process of learning mathematics which aims to discover and develop students' abilities. This condition will affect both the teacher's teaching habits and student learning habits. In this lesson students are expected to be able to communicate their point of view and respect the viewpoints of others. A teacher needs to reduce his tendency to teach and switch functions to become a facilitator in learning activities (Soedjadi, 2007)

The application of realistic mathematics approach is carried out by integrating it with practical context and experience. Therefore, the application of realistic mathematics approach facilitates students' mathematics learning and improves the ability of mathematical representation according to students' abilities. This method can encourage students to discuss, work together, exchange ideas with other students and be able to find their own concepts. The realistic mathematics approach learning concept used is real-world situations and student experiences so that it becomes a good initial foundation for developing students' mathematical representation abilities (holisin, 2007). Like the research conducted by Misel and Erna Suwangsih, students' mathematical representation skills can be improved by applying a realistic mathematical approach. This type of research is class action research (classroom action research). In this study, the change in mathematical representation ability from cycle 1

to cycle 2 after being given a realistic mathematical approach treatment has a very high category (Misel and erna, 2018).

The pioneer of realistic mathematics education, Hans Freudenthal, argues that students cannot be viewed as passive consumers of ready-made mathematics, on the contrary, mathematics education must encourage students to use various contexts and opportunities to retrieve mathematics in creative ways themselves (Hadi, 2018). The realistic mathematics approach learning concept used is real-world situations and student experiences so that it becomes a good initial foundation in starting to learn mathematics.

In interviews with mathematics teachers at SMP N 9 Purwokerto the ability of students' mathematical representations is not maximized and has not been fully implemented in the learning process, this condition can be proven from the ability of students to solve real or contextual problems, where there are still many students who are less skilled in constructing their logic into the form mathematical representation, this is influenced by several factors, the first is due to a lack of understanding of mathematical concepts, students have a less in-depth understanding of basic mathematical concepts, such as numbers, mathematical operations, geometry, and algebra. This can affect their ability to represent mathematical problems visually or symbolically. Second, Lack of mathematical modeling skills, mathematical representation involves the ability to transform real-world problems into a mathematical form that can be understood and solved. Students may have difficulty identifying variables, constructing equations or functions, or using mathematical notation correctly to model mathematical situations. Third, students' limitations in visualizing mathematical problems in the form of pictures or diagrams become mathematical understanding, this can affect the ability of graphical representations or diagrams in solving mathematical problems.

This problem is caused by students not accustomed to dealing with contextual problems that are contained in other representations in mathematical models. Mathematical representational ability is one of the competencies that must be achieved in learning mathematics, but students at SMP N 9 Purwokerto have not got this to the fullest, one way that is thought to be able to improve students' mathematical representation abilities is to use a realistic mathematics approach. Based on this problem the aim of the research this is to determine the effectiveness of a realistic mathematical approach to improving students' mathematical representation abilities at SMP N 9 Purwokerto.

B. Methods

The type of research used is a type of experimental research using a quantitative approach. Experimental research is a research technique used in order to find out how far the influence of a certain treatment on something else in a controlled situation. The quantitative approach is research conducted based on data analysis using statistical procedures (Sugiyono, 2016). This study used a quasi-experimental type of research with the Nonequivalent Control Group Design category, because the researcher wanted to know the effectiveness of the realistic mathematical approach on students' representation abilities before being given treatment and after being given treatment. In this study, the independent variable is "Realistic Mathematical Approach" and the dependent variable is "Students' Mathematical Representational Ability".

This research was conducted at SMP N 9 Purwokerto in January 2023, the object of the research was class VIII students at SMP N 9 Purwokerto who were going through semester II. The population used was students from class VIII A to class VIII H, totaling 288 students. Then the samples used as the research were class VIII G and class VIII H, who were randomly selected. Class VIII G has 36 students as the control class and class VIII H has 36 students as the experimental class.

The research procedure begins with giving a pretest to the experimental class and the control class. The researcher wanted to know the extent to which students' mathematical representation abilities were given before being given treatment using a realistic mathematical approach. After that, by providing treatment for several learning sessions or meetings, where the experimental class learning uses a realistic mathematical approach and the control class uses a conventional approach. then the posttest was given in the last meeting in the experimental class and control class to ensure changes in students' mathematical representation abilities after being given treatment. The research was carried out in a planned manner according to the running schedule at SMP N 9 Purwokerto.

The data collection technique used is as follows interview, this interview method takes information from a grade VIII mathematics teacher at SMP N 9 Purwokerto as the most relevant source. Then The observation technique applied in this study was to determine the condition of the object directly such as the geographical location of the school, the completeness of school facilities and infrastructure and the teaching and learning process at SMP N 9 Purwokerto. Documentation, documentation is a technique of collecting data from various sources that are relevant to the object of research, the data collected can be in the form of pictures, notes, documents, transcripts, books and other sources (Hamzah and susanti, 2016). Test, the test is an instrument or tool consisting of several questions or questionnaires that are used to measure the knowledge, skills and talents of the subject under study. The instrument sheet is a type of test in the form of questions or questions. The object under study will be measured using questions that have been set according to the variables determined by the level (Amir and Lidia, 2020). In this study, tests in the form of pretest and posttest were carried out in the control group (Class VIII G) and the experimental group (Class VIII H). The test used to obtain an overview of students' representational abilities is in the form of realistic math problem solving test scores.

Before the research was carried out, the test instrument was tested for data quality first, namely through a validity test. Validity test is used to measure the extent to which the function of a test instrument is said to be valid or not to be tested. (Amir and Lidia, 2016). In this study, the validity test used the expert validity test and the validity test used the product moment correlation coefficient.

Table 1. Test the validity of the instrument test

	Q1	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**
r_hitung	0.710	0.782	0.806	0.518	0.615	0.635	0.709	0.766	0.542	0.624
r_tabel	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329	0.329
V/IV	V	V	V	V	V	V	V	V	V	V

V : Valid
IV : Invalid

From the table above using r_table at a significance of 5% (0.05) with a total of 36 respondent data so that r_table shows a value of 0.329. A test instrument is said to be valid if the value of r_count ≥ r_table, using the excel application of the 10 questions all test instruments show valid results because r_count ≥ r_table.

After the test instrument is valid then it is continued with the reliability test. The reliability level is said to be sufficient when the Cronbach Alpha value is ≥ 0.7, if the Cronbach Alpha value is ≥ 0.8 then all test instrument items are said to have strong reliability (Amir and Lidia, 2016). In this test the Cronbach Alpha value of 0.796990 is included in the sufficient reliability category because ≥ 0.7 Cronbach Alpha value. Of the 10 questions that were valid and reliable, the researcher took 5 questions that were used as test instruments. After the test instrument is valid and reliable then proceed with the normality test, homogeneity test, z-test and N-Gain score test.

C. Results and Discussion

This research was conducted with the aim of knowing the effectiveness of a realistic mathematical approach to the mathematical representation abilities of students at SMP N 9 Purwokerto. This representation ability was measured by the types of questions on the Pythagorean theorem material. This research was conducted in class VIII, two classes that became the object of research, namely class VIII G as the control class and class VIII H as the experimental class.

In practice, the experimental class and the control class were given different treatments, the experimental class was given treatment in the form of learning using a realistic mathematical approach and the control class was given learning in a conventional way. The purpose of having different treatments is to determine the effect of a realistic mathematical approach on students' representation abilities. The following are the results of the pretest and posttest data analysis from the experimental class and the control class.

1. The Results Of Data Analysis Pretest Experiment Class And Control Class

The pretest was carried out before the experimental class and control class were given treatment, namely the experimental class used a realistic mathematical approach and the control class used a conventional approach. The purpose of the pretest was to determine the initial condition of students' representation abilities.

Then the results of the pretest are tested whether the data is normally distributed. In this study, the normality test used the Shapiro Wilk method, when the p-value ≥ 0.05, the data is normally distributed, and if the p-value < 0.05, the data is not normally distributed (Rozali, 2011). The following are the results of the pretest Normality Test for the experimental class and the control class using the python application.

	Class	Statistic	p-value
0	Eksperiment_Pretest	0.948880	0.096422
1	Control_Pretest	0.952957	0.129572

Figure 1. Pretest Normality Test for Experimental Class and Control Class

From the results of Figure 1, the pretest value for the experimental class has a p-value = 0.096 and the pretest value for the control class has a p-value = 0.129. All of these tests show a p-value ≥ 0.05 so that the data is normally distributed.

After all the data is normal, the data is continued with a homogeneity test, the aim is to find out whether the samples are in the same population. The homogeneity test used is the Levene test, if the p-value is ≥ 0.05 then the data is said to be homogeneous and if the p-value < 0.05 then the data is not homogeneous (Yulingga and Wasis, 2017). The following are the results of the homogeneity test of the posttest experimental and control class data using the Python application.

```
stats.levene(Pretest_Eksperiment,Pretest_Control)

LeveneResult(statistic=0.0, pvalue=1.0)
```

Figure 2. Homogeneity Test Pretest Experiment Class and Control Class

Based on the iteration results in Figure 2, we can conclude that the pretest values for the experimental and control classes have a p-value of 1,000 > 0.05, so the data can be said to be homogeneous. To find out the initial conditions whether there is a significant difference between the experimental class and the control class before being given treatment, the data is carried out a hypothesis test. In this study using the z-test because the data is more than 30 samples. The criterion in the z-test is when the z-score value ≥ z-table then Ho is rejected and Ha is accepted, then if the z-score < z-table then Ho is accepted and Ha is rejected (Takiar, 2021). The following are the results of the pretest z-test of the experimental class and the control class using the Python application.

```
Z Score Pretest_Eksperiment_Control: 0.5995770664853974
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score  < Z-table.
the data does not show a significant difference.
```

Figure 3. Z-Test Pretest Experiment Class and Control Class

The results of the iteration in Figure 3 show that the z-score = 0.599 and the z-table value = 1.644, so that the z-score <z-table, so that Ho is accepted and Ha is rejected, in other words the pretest value of the experimental class and control class (no treatment has been done) did not show a significant difference.

2. The Results of Data Analysis Posttest Experimental Class and Control Class

The posttest was carried out after the experimental class and control class were given treatment, namely the experimental class used a realistic mathematical approach and the control class used a conventional approach. The purpose of the posttest was to find out the development or changes in students' representation abilities after being given treatment.

Then the results of the posttest are tested whether the data is normally distributed. In this study, the normality test used the Shapiro Wilk method, when the p-value ≥ 0.05, the data is normally distributed and if the p-value < 0.05, the data is not normally distributed (Rozali, 2011). The following are the results of the Posttest Normality Test for the experimental class and the control class using the python application.

	Class	Statistic	p-value
0	Eksperiment_Posttest	0.941359	0.056002
1	Control_Posttest	0.953946	0.139179

Figure 4. Posttest normality test for experimental class and control class

From the results of Figure 4, the pretest value for the experimental class has a p-value = 0.056 and the pretest value for the control class has a p-value = 0.139. All of these tests show a p-value ≥ 0.05 so that the data is normally distributed.

After all the data is normal, the data is continued with a homogeneity test, the aim is to find out whether the samples are in the same population. The homogeneity test used is the Levene test, if the p-value is ≥ 0.05 then the data is said to be homogeneous and if the p-value < 0.05 then the data is not homogeneous (Yulingga and Wasis, 2017). The following are the results of the homogeneity test of the posttest experimental and control class data using the Python application.

```
stats.levene(Posttest_Eksperiment,Posttest_Control)
LeveneResult(statistic=0.4525182172017207, pvalue=0.5033561662553766)
```

Figure 5. Posttest Homogeneity Test of Experimental Class and Control Class

Based on the iteration results of Figure 5, the posttest values for the experimental and control classes have a p-value of 0.503 ≥ 0.05. Because the data is ≥ 0.05, the data is homogeneous. To find out the final condition whether there is a significant difference between the experimental class and the control class after being given treatment, the data is tested by a hypothesis. In this study using the z-test because the data is more than 30 samples. The criterion in the z-test is when the z-score value ≥ z-table then Ho is rejected and Ha is accepted, then if the z-score < z-table then Ho is accepted and Ha is rejected (Takiar, 2021). The following are the results of the posttest z-test of the experimental class and the control class using the Python application.

```
Z Score Posttest_Eksperiment_Control: 7.991543048365845
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score >= Z-Table.
the data shows a significant difference.
```

From the iteration results in Figure 6, it shows that the z-score = 7,991 and the z-table value = 1,644, so that the z-score ≥ z-table, so that Ho is rejected and Ha is accepted, in other words, the posttest value of the experimental class and control class (after being given treatment) showed a significant difference. Then the following diagram illustrates the comparison of the values of the experimental and control classes after being given treatment

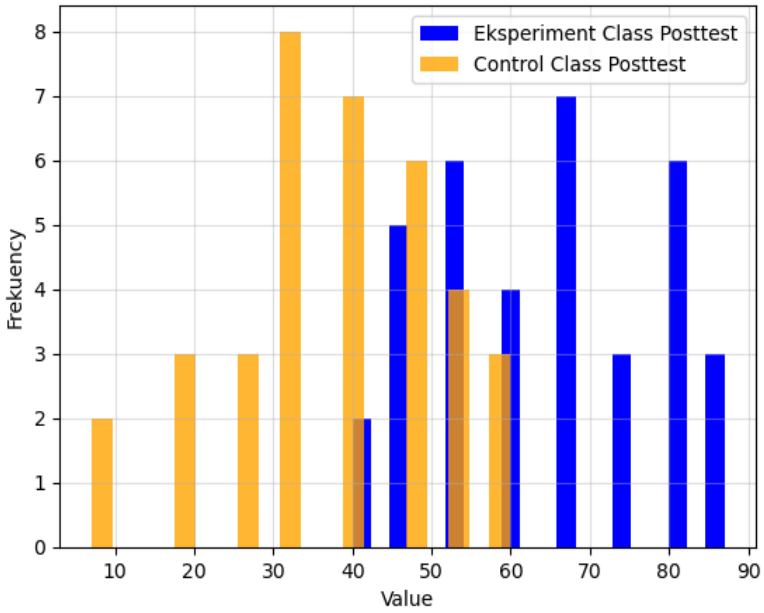

Figure 7. Posttest Histogram of Experimental Class and Control Class

The histogram data in the Figure 7 the posttest value of the experimental class shows a significant change in value from the posttest value of the control class. This can be seen in the histogram above which shows that the distribution of data in the experimental class posttest has a higher value. So we can say that the treatment using a realistic mathematical approach to the experimental class has a significant effect.

3. Uji N-Gain Score

Gain is the difference between the pretest and posttest scores. The increase in students' mathematical representation abilities in the two groups can be calculated using the normalized average gain formula. N-gain (normalized gain) is used to measure students' mathematical representation abilities before and after treatment (Sesmyanti, 2020). The following is the result of calculating the N-Gain score using the excel application.

Table 2. N-Gain Score Results

No.	Class	N-Gain Score	Interpretation
1	Eksperiment	0.5276	Effective
2	Control	0.1816	ineffective

Based on the table above, the results of the N-Gain test in the experimental class are 0.5276, this value is included in the medium criteria. While the control class has an N-Gain value of 0.1816 which is included in the low criteria. The results of the N-Gain show a positive difference, meaning that the experimental class after being treated in the form of a realistic mathematical approach has an increase in better representation results.

Then to find out whether the N-Gain results have an influence, the N-Gain results of the control class and the experiment are carried out by Z-Test. The following are the Z-Test results of the N-Gain values of the control class and the experimental class.

```
Z Score Pretest_Eksperiment_Control: 9.03186939909925
Z value table on alpha = 0.05 : 1.6448536269514722
Z-score >= Z-table.
the data shows a significant difference.
```

Figure 8. Z-test N-Gain Scores for Experimental and Control Classes

The results of the iteration Figure 8 show that the z-score = 9,031 and the z-table value = 1,644, so that the z-score ≥ z-table, so that Ho is rejected, in other words the posttest value of the experimental class and the control class (after being given treatment) shows a difference significant.

D. Conclusion

Based on the results of the research and discussion described in the previous chapter, it can be concluded that the use of a realistic mathematical approach is effective in improving students' mathematical representation skills in class VIII SMP N 9 Purwokerto. This can be seen in the results of data analysis carried out through the calculation of the Hypothesis Test (z-Test) and the N-Gain Test, Score. In the z-test, the posttest scores for the experimental and control classes have a z-score value = 7,991, and a z-table value = 1,644, which means that the z-score ≥ z-table, so that the Ho hypothesis is rejected and the Ha hypothesis is accepted, therefore the class posttest value the experimental and control class after being treated showed a significant difference, in other words that the experimental class which had been treated with a realistic mathematical approach could improve students' representation abilities. Then through the N-Gain Score Test the experimental class obtained an average N-Gain of 0.5276 included in the effective criteria. While the control class obtained an average N-Gain of 0.1816 included in the ineffective criteria. So it can be seen that the results of the N-Gain scores in the experimental class are higher than the N-Gain scores in the control class, therefore a realistic mathematical approach is effective in improving students' mathematical representation abilities.

References

Al Jupri. 2012 “Pendidikan Matematika Realistik: Sejarah, Teori, Dan Implementasinya”. Jurnal : Universitas Pendidikan Indonesia.

Hadi. S. 2018. *Pendidikan Matematika* Realistik.Depok : Rajawali Pers.

Hamzah, A., & Susanti, L. 2020. *Metode Penelitian Kuantitatif*. Malang: Literasi Nusantara Abadi.

Hanief, Y. N., & Himawanto, W. 2017. *Statistika Pendidikan*. Yogyakarta: CV Budi Utama.

Holisin, I. 2007. “Pendidikan Matematika Realistik”. Didaktis, Vol. 5, No. 3, Hal 1 -68, Ok, ISSN 1412-5889.

Misel & Erna. 2016. “Penerapan Pendekatan Matematika Realistik Untuk Meningkatkan Kemampuan Representasi Matematis Siswa. Metodi DIdaktik Vol. 10, No. 2.

NCTM. 2000. *Principles and Standards for School Mathematics*. Inc. 1906 Association Drive, Reston, VA 20191-9988.

Peraturan MentEri Pendidikan dan Kebudayaan (Permendikbud) RI Nomor 58 Tahun 2014 tenatang kurikulum 2013 Menengah Pertama/Madrasah Tsanawiyah.

Rangkuti, A. N. 2013. ” Representasi Matematis”. Logaritma Vol. I, No. 02.

Razali, N.M & Wah, Y.B. 2011. "*Power Comparisons Saphiro Wilk, Kolmogorov – Smirnov, Lilliefors and Anderson Darling Test*". *Jurnal of Statistical modeling and analytics* Vol.2.No.1, 21 -33.

Safitri. F. E. "Penerapan Pendekatan Matematika Realistik". Hasil Wawancara Pribadi : 16 September 2022.

Sesmiyanti dkk. 2020. "*N-Gain Algorithm for Analysis of Basic Reading*", ICLLE 2019, July 19-20, Padang, Indonesia

Soedjadi, R. "Inti Dasar– Dasar Pendidikan Matematika Realistik Indonesia".Jurnal Pendidikan Matematika, Volume 1, No.2, Juli 2007.

Sugiyono. 2016. Model Penelitian Kuantitatif, Kualitatif, dan R&D. Bandung: Alfabeta Bandung.

Suyono .2014. Analisis Regresi Untuk Penelitian. Yogyakarta CV Budi Utama.

Takiar, R. 2021. "*Validity of the t-test and Z-test for the Small One sample and Two Small Sample tests", Indian Council of Medical Research* (1978-2013) Bangalore – 562110, Karnataka, India.

Tohir, M. 2019. Hasil PISA Indonesia Tahun 2018 turun dibanding tahun 2015. Universitas Ibrahimy, Situbondo, Indonesia.