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ACHIEVEMENT AND IMPROVEMENT OF JUNIOR HIGH SCHOOL STUDENTS' NUMERACY SKILLS THROUGH A REALISTIC MATHEMATICS EDUCATION APPROACH

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Abstract

The results of a survey conducted by PISA show that the achievement of students' numeracy skills in Indonesia is relatively low, with many students having difficulty applying basic mathematical concepts in everyday life. This condition requires 21st-century learning to not only focus on mastering content, but also on developing numeracy skills that are integrated into various subjects. Therefore, this study was conducted to determine the achievement and improvement of numeracy skills of grade VIII junior high school (JHS) students through the realistic mathematics education (RME) approach. The research method used is a quantitative method with a quasi-experimental research type, which was conducted at a junior high school in North Central Timor Regency. The instrument used was a numeracy ability test sheet. The data obtained were analyzed using the t-test. The results of the study showed that the achievement and improvement of numeracy skills of grade VIII junior high school students who studied through RME approach were higher than students who studied without the RME approach. Specifically, students taught with the RME approach showed better understanding in solving contextual problems and applying mathematical concepts, and experienced a more significant increase in scores between the pretest and posttest. It is recommended for junior high school mathematics teachers to implement RME to facilitate students' numeracy skills. It is recommended for junior high school mathematics teachers to implement RME to facilitate students' numeracy skills.

Keywords: Achievement, Improvement, Numeracy skill, Realistic mathematics education.

Abstrak

Hasil survey yang dilakukan oleh PISA menunjukkan bahwa pencapaian kemampuan numerasi siswa di Indonesia tergolong rendah, dengan banyak siswa yang kesulitan dalam menerapkan konsep matematika dasar dalam kehidupan sehari-hari. Kondisi ini menuntut pembelajaran abad ke-21 untuk tidak hanya berfokus pada penguasaan konten, tetapi juga pada pengembangan kemampuan numerasi yang terintegrasi dalam berbagai mata pelajaran. Oleh karena itu, penelitian ini dilakukan untuk mengetahui pencapaian dan peningkatan kemampuan numerasi siswa kelas VIII Sekolah Menengah Pertama (SMP) melalui pendekatan pendidikan matematika realistik. Metode penelitian yang digunakan adalah metode kuantitatif dengan jenis penelitian eksperimen semu, yang dilakukan di salah satu SMP di Kabupaten Timor Tengah Utara. Instrumen yang digunakan adalah lembar soal tes kemampuan numerasi. Data yang diperoleh dianalisis menggunakan uji-t. Hasil penelitian menunjukkan bahwa pencapaian dan peningkatan kemampuan numerasi siswa kelas VIII SMP yang belajar melalui pendekatan Pendidikan Matematika Realistik lebih tinggi dibandingkan dengan siswa yang belajar tanpa pendekatan Pendidikan Matematika Realistik. Secara khusus, siswa yang dibelajarkan dengan pendekatan Pendidikan Matematika Realistik menunjukkan pemahaman yang lebih baik dalam menyelesaikan soal kontekstual dan menerapkan konsep matematika, serta mengalami peningkatan skor yang lebih signifikan antara pretest dan posttest. Direkomendasikan bagi guru matematika SMP agar dapat menerapkan Pendidikan Matematika Realistik untuk memfasilitasi kemampuan numerasi siswa. Direkomendasikan bagi guru matematika SMP agar dapat menerapkan Pendidikan Matematika Realistik untuk memfasilitasi kemampuan numerasi siswa.

Kata kunci: *Kemampuan numerasi, Pencapaian, Peningkatan, Pendidikan matematika realistik.*

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INTRODUCTION

In the current era of globalization, numeracy skills are one of the important skills that every individual must have to adapt to the development of the times. Numeracy skills are skills in processing quantitative information around us. Numeracy is also the ability to operate numbers (addition, subtraction, multiplication, division) in everyday life (Machromah et al., 2021).

Numeracy skills are very important for students, especially high school students, because these skills can enable students to solve mathematical problems in everyday life. As Masruroh (2023) in his research emphasized that numeracy is very important in junior high school learning because it can train students to understand problems in everyday life and be able to implement mathematics in solving contextual problems, for example when making purchases, measuring distances, and calculating the time needed to get to a certain place. Numeracy is also one of the student learning outcome competencies measured in the national assessment starting in 2021, which is called the minimum competency assessment (KEMENDIKBUD, 2019). There are three components measured in numeracy, namely content (numbers, measurement & geometry, data & uncertainty, and algebra), cognitive processes (understanding, application, and reasoning) and context (personal, socio-cultural, and scientific) (Susanto et al., 2021).

Numeracy ability is one of the assessment indicators carried out by the Programme for International Student Assessment (PISA) for 15-year-old students. This assessment focuses on proficiency in reading, mathematics, science and innovative domains (Heuston, 2022; OECD, 2019, 2023). Indonesia has participated in the PISA assessment program since 2000. Based on the results of PISA in the last 3 periods, the numeracy achievements of Indonesian students can be seen in Figure 1.

The results of the PISA report are in line with the findings of research conducted by Son et al. (2023) describing that the numeracy skills of junior high school students in Kefamenanu City District are classified as moderate. However, based on the results of interviews conducted by researchers with one of the mathematics subject teachers of class VIII junior high schools in Kefamenanu, North Central Timor Regency, explained that students have not been able to solve mathematical problems in everyday life. The

difficulty faced by many students in solving descriptive problem-solving tasks is largely attributed to their low levels of understanding, application, and reasoning skills.

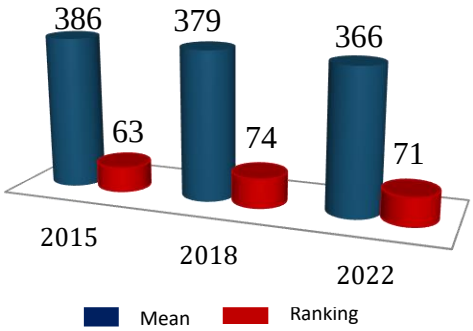

Figure 1. Indonesian students' numeracy achievement in PISA

Efforts that can be made by teachers to overcome students' numeracy abilities are by using the right mathematics learning approach. The use of the right approach will encourage students to develop their abilities. Mathematics learning must be based on students' contextual and empirical and be able to develop students' critical, independent, responsible, cooperative and empathetic characters (Fauzan, et al. 2024). One approach that emphasizes context and content is the Realistic Mathematics Education approach (Hadi & Zaidah, 2023).

Realistic Mathematics Education (RME) is a learning approach that requires students to be able to solve problems with various types of contexts that are relevant to everyday life so that students can actively participate during the learning process (Putri, 2023). The word realistic in the RME concept states that the problems given to students must be imaginable by students, not just limited to the problem being real (Payadnya et al., 2021). This approach focuses on the context of everyday life so that students can more easily imagine during the learning process (Diva, et al. 2023). There are five characteristics of RME, namely (1) using context, (2) using models, (3) there is student contribution, (4) there is interaction between teachers and students, and (5) there is a relationship between parts of the subject matter (Suryati & Krisna, 2021).

Many previous studies have examined students' numeracy skills through the RME approach, such as Mostoli et al. (2021) on improving junior high school students' mathematical literacy skills through the Indonesian Realistic Mathematics Education (IRME) approach. Another study is Maslihah (2021) on the effect of IRME on junior high school students' numeracy literacy skills. In this study, the researcher tried to compare the

average posttest in the experimental and control classes. In addition, the researcher also compared N-gain. The comparison of the average posttest is stated with the keyword achievement and the comparison of N-gain is stated with the keyword increase so that the research objective is formulated, namely to determine the achievement and improvement of the numeracy skills of junior high school students in grade VIII who study through RME and without RME.

RESEARCH METHODS

The approach used in this study is a quantitative approach with a quasi-experimental research design. A quasi-experiment is a research design where participants are assigned to experimental or control groups without randomization (Hastjarjo, 2019).

This research was conducted in the odd semester of the 2024/2025 academic year. The population in this study were grade VIII students at a junior high school in North Central Timor Regency consisting of 8 parallel classes. Based on Cluster Random Sampling, two classes were obtained, namely class VIID consisting of 20 students as the experimental class and class VIIIF consisting of 19 students as the control class. The research process began by giving pretest questions on numeracy skills to the experimental class and the control class to determine the students' initial abilities. Furthermore, students were given learning treatment through RME and without RME.

The research instrument used was a pretest and posttest question sheet to measure students' numeracy skills. The questions were arranged based on indicators such as the ability to read and interpret points on Cartesian coordinates, solve problems related to distance, and apply logical reasoning in mathematical situations. The pretest and posttest questions each had 3 numbers and each question measured one indicator of numeracy skills, namely understanding, application and reasoning (Machromah et al., 2021).

Data analysis was conducted to analyze the achievement and improvement of students' numeracy skills in the experimental and control classes. Data analysis was conducted by considering normality and homogeneity as prerequisites. Prerequisite tests and hypothesis tests were conducted with the help of the IBM Statistics version 25 application, with a significance level of 5%. The hypothesis in this study uses the keywords achievement and improvement. achievement tests involve posttest data while improvement tests involve N-gain data.

RESULT AND DISCUSSION

Based on the analysis of pretest data, information was obtained that the research sample came from a population that was normally distributed and had homogeneous variance. Furthermore, the researcher analyzed the pretest data to see the similarities in students' initial abilities. The results of the pretest data analysis can be seen in Table 1.

Table.1 Initial ability equivalency test results

	Levene's test		*t*-test		
	F	*Sig.*	*t*	*df*	*Sig.*
Pretest, numeracy skills	0.035	0.852	8.942	37	0.141

In Table 1, the significant value of the similarity of students' numeracy abilities in the experimental class and the control class is 0.141 > 0.05. This means that there is no significant difference between the initial abilities of students in the experimental class and the control class, so that research can be conducted. Students in the experimental class will learn through RME while students in the control class learn without going through RME. The results of the numeracy ability test are presented in Table 2.

Table 2. Student numeracy ability score

Statistics	Experimental group			Control group		
	pretest	Posttest	N-gain	Pretest	posttest	N-gain
N	20	20	20	19	19	19
Mean	31.33	79.67	0.69	24.21	33.69	0.12
Varians	219.04	257.28		229.52	225.90	

Based on Table 2, it is obtained information that descriptively the achievement and improvement of numeracy skills in the experimental class is greater than the improvement in the control class, when compared to the average score before and after treatment in both the experimental and control classes. This shows that the learning method applied has a positive effect on students' numeracy skills. The increase in post-test scores shows an increase in understanding, application, and reasoning in solving mathematical problems. The data obtained was then analyzed inferentially for the achievement and improvement of students' numeracy skills which can be described in the following section.

Student numeracy ability achievement test

This analysis of students' numeracy achievement involves posttest data on students in

both experimental and control classes. This data analysis considers normality and homogeneity tests. The results of the normality test obtained the significance value of the numeracy achievement data for students in the experimental and control classes in the Shapiro-Wilk columns of 0.97 and 0.075, respectively. This value is more than α=0.05, so it can be concluded that the posttest data for both experimental and control classes are normally distributed. Similarly, the data homogeneity test obtained the significance value in the based on mean row of 0.852>0.05. This means that the data variance is homogeneous. Furthermore, an independent sample t-test was conducted. The results can be seen in Table 3.

Table 3. Results of students' numeracy ability achievement test

	Levene's test		*t*-test		
	F	*Sig.*	*t*	*df*	*Sig.*
Numeracy ability test results	0.035	0.852	8.942	37	0.000

In Table 3, the significant value of students' numeracy achievement in the experimental class and the control class is 0.000 < 0.05. This means that there is a significant difference between the achievement of students' numeracy in the experimental class and the control class. Descriptively, the average achievement of students' numeracy in the experimental class is 79.67, which is greater than the average achievement of students' numeracy in the control class, which is 33.69. Thus, it can be concluded that the achievement of students' numeracy in learning through RME is better than students who learn without RME.

This is in line with the findings of Maslihah et al. (2021) that the achievement of mathematical literacy skills of students who learn through RME is better than students who learn conventionally. Also in line with research conducted by Laurens et al. (2017) that the average posttest in the experimental class is greater than the average posttest in the control class.

Based on the research results, information was obtained that students were enthusiastic in participating in learning with the RME approach because the context provided could be imagined by students and came from the real world or student experience as a perception material to start learning activities. Real-world problems are used to emphasize mathematical concepts and help students understand abstract mathematical content more easily and increase their motivation in solving various basic

mathematical problems (Febriana, 2021).

Context-based learning is able to actively involve students in exploring a problem. The results of this exploration are not only aimed at finding the final answer to the problem given, but students are able to find solutions and develop various problem-solving strategies that can be used to solve problems (Rangkuti, 2019).

There are four principles of RME, namely; (1) The material begins by providing concrete examples to the abstract based on students' knowledge and empirics related to the reality of life, (2) learning is more interesting, fun and effective, (3) students participate actively, think critically and creatively, and (4) learning is more meaningful to life and positive behavioral changes occur (Natalia, 2017).

Student numeracy ability improvement test

This analysis of students' numeracy ability improvement involves N-gain data in both the experimental and control classes. This data analysis considers normality and homogeneity tests. The results of the normality test obtained the significance value of the data on the increase in students' numeracy ability in the experimental and control classes in the Shapiro-Wilk columns of 0.58 and 0.382, respectively. This value is more than $\alpha = 0.05$, so it can be concluded that the N-gain data in the experimental and control classes are normally distributed. Similarly, the data homogeneity test obtained a significance value in the based on mean row of 0.165> 0.05. This means that the data variance is homogeneous. Furthermore, an independent sample t-test was conducted. The results can be seen in Table 4.

Table 4. Results of the student numeracy ability improvement

	Levene's test		*t*-test		
	F	*Sig.*	*t*	*df*	*Sig.*
Numeracy ability results	2.011	.165	7.781	37	.000

In Table 4, the significant value obtained for the increase in students' numeracy skills in the experimental class and the control class is 0.000 <0.05. This means that there is a significant difference between the increase in numeracy skills of students in the experimental class and the control class. The average increase in numeracy skills of students in the experimental class is 0.69, which is greater than the average achievement of numeracy skills in the control class, which is 0.12. Thus, it can be concluded that the

increase in numeracy skills of students who learn through RME is better than students who learn without RME.

The results of the second hypothesis test obtained information that the increase in numeracy skills of students who learned through RME was better than students who learned without RME. This is in line with the results of research conducted by Marpaung (2024) explaining that the numeracy skills of students who took part in learning with the PMR approach were better than students who learned conventionally. Also in line with research Mutmainah and Suhendar (2023), the RME approach is better at improving students' mathematical literacy skills.

The increase in numeracy ability is also based on the increasing number of students answering questions with indicators of numeracy ability. There are three indicators of numeracy ability used in this research, namely; indicators of understanding, application and reasoning. The pretest and posttest each have one question that contains an indicator of numeracy ability.

In the understanding indicator, students are required to formulate a mathematical model of mathematics itself. Based on the initial pretest results, students were not able to formulate a mathematical model correctly, but after learning was given RME treatment, there were 17 students who were able and 3 students wrote the final answer incorrectly. This shows that there is an increase in students in the understanding indicator in accordance with research conducted by Uyen et al. (2021) which concluded that numeracy skills in formulating real problems into mathematical models increased after the RME approach was applied to the learning process. Also in accordance with research conducted by Yuanita et al. (2018) which concluded that after learning with RME there was an increase in students' numeracy skills in formulating real problems into mathematical models.

In the application indicator, students are required to be able to solve contextual problems by applying mathematical concepts to solve the problems given. Based on the pretest results, all students were not able to apply mathematical concepts, but after learning through RME, there were 7 students who had answered the questions correctly and 13 students were able to apply mathematical concepts but wrote the final answer incorrectly. Numeracy skills in the application indicator in the experimental class increased, also in accordance with research conducted by Simbolon (2023) that after

learning by applying RME, students were able to use mathematical concepts correctly in solving the problems given.

In the reasoning indicator, students are required to be able to analyze contextual problems and write down the right solution by providing a clear interpretation from the beginning of the problem solving steps to the end systematically. Based on the pretest results, all students were not able to interpret and analyze the problem. However, after the learning process with RME, there were 3 students who answered correctly and correctly, in line with research conducted by Simbolon (2023) that after learning by implementing RME, students were able to interpret the results of mathematical problem analysis to draw a conclusion. In this study, there were 17 students who were not able to draw a conclusion because students were unable to evaluate information. This is in line with research conducted by Ekowati et al. (2021) explaining that in the reasoning indicator, students were not able to interpret and draw conclusions correctly.

The improvement of students' numeracy skills is also caused by the learning approach designed so that students can actively participate during the teaching and learning process so that it can make it easier for them to understand a given problem. RME is one of the approaches to learning mathematics where the problems given are not only contextual problems, but also problems that can be imagined by students and start from where the students understand. This word emphasizes the process of making something real in the minds of students. Thus the results obtained will last a long time in memory. The basis of this form is that students can draw conclusions from their own knowledge.

This learning is more focused on the condition of the students or based on the students' empiricism, so that students actively participate during the learning process. This is also in accordance with Nurjamaludin et al. (2021) and Ekowati et al. (2021) opinions that the RME approach can encourage students to be actively involved during the learning process.

CONCLUSION

Based on the research results and discussions, it can be concluded that: 1) The achievement of numeracy skills of students who learn through RME is better than students who learn without RME, and 2) The increase in numeracy skills of students who learn

through RME is better than students who learn without RME.

Researchers recommend that junior high school mathematics teachers apply the Realistic Mathematics Education (RME) approach as an alternative to facilitate students' numeracy skills. Specifically, schools are encouraged to integrate real-life contexts into math instruction, design problem-based learning activities aligned with students' experiences, and provide regular training or workshops to support teachers in implementing RME effectively in the classroom.

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