

The Effect of Realistic Mathematics Education Approach on Mathematical Problem Solving Ability

Reri Seprina Anggraini^{1, a)}, Ahmad Fauzan²

¹ Agama Islam Negeri Kerinci

Kapten Muradi Street, Sungai Liuk, Pesisir Bukit, Sungai Penuh, Jambi, Indonesia, 37152

² Universitas Negeri Padang

Prof. Dr. Hamka Street, Air Tawar Barat, Padang Utara, Padang, West Sumatera, 25171

^{a)}rery.anggraini9@gmail.com

Abstract. The improvement of mathematical problem-solving ability was the aim of this study through the application of the Realistic Mathematics Education approach compared to conventional learning according to the students' self-efficacy level. This study used a quasi-experimental study with a static group design conducted in eighth-grade students at SMP Negeri 1 Kerinci and SMP Negeri 5 Kerinci. Data collected through the questionnaire to determine students' self-efficacy level and the test of students' mathematical problem-solving abilities. The hypothesis was tested using a t-test. The results showed that students' mathematical problem-solving abilities who learned using the RME approach were higher than students' abilities who learned using conventional learning. In addition, the mathematical problem-solving abilities of students who have low self-efficacy who learned using the RME approach were higher than those who learned using conventional learning.

Keywords: Problem Solving Ability; Realistic Mathematics Education; Self-Efficacy

Abstrak. Peningkatan kemampuan pemecahan masalah matematis menjadi tujuan penelitian ini melalui penerapan pendekatan Realistic Mathematics Education (RME) yang dibandingkan dengan kelas yang menerapkan pembelajaran konvensional menurut tingkat self-efficacy siswa. Penelitian ini menggunakan penelitian kuasi eksperimen dengan desain static group design yang dilaksanakan di kelas VIII pada SMP Negeri 1 Kerinci dan SMP Negeri 5 Kerinci. Data dikumpulkan melalui angket untuk menentukan tingkat self-efficacy dan tes kemampuan pemecahan masalah matematis. Hipotesis diuji dengan menggunakan uji t. Hasil penelitian menunjukkan kemampuan pemecahan masalah matematis siswa yang belajar menggunakan pendekatan RME lebih tinggi daripada siswa yang belajar menggunakan pembelajaran konvensional, dan kemampuan pemecahan masalah matematis siswa yang memiliki self-efficacy rendah yang belajar dengan menggunakan pendekatan RME lebih tinggi daripada yang belajar dengan menggunakan pembelajaran konvensional.

Kata kunci: Kemampuan Pemecahan Masalah; Realistic Mathematics Education; Self-Efficacy



INTRODUCTION

The aim of learning mathematics is students' abilities to solve mathematical problems. This ability is one of the most important and compulsory aspects of mathematics curricula around the world. Through this ability, students have the opportunity to practice understanding of the concepts that have been learned and this requires students' confidence in solving problems and being creative (Tambunan, 2019). Although problem-solving ability is one of the cognitive abilities that must be possessed, this does not guarantee that students can achieve it. It can be seen from the results of a study conducted by TIMSS (Trends in International Mathematics and Science Study) in 2015 showing the ability of Indonesian students to rank 45 of 50 countries (Masri, Suyono, & Deniyanti, 2018). The TIMSS assessment framework focuses on solving problems that involve students' mathematical problem-solving abilities so that if it is seen from the ranking obtained it can be seen that Indonesian students have low mathematical problem-solving abilities.

Students still have difficulty determining the right steps to solve the problems given following the problem-solving stages stated by Polya (1985) which starts from understanding the problem, planning solutions, solving problems, and re-checking the results obtained (Nurkaeti, 2018). The importance of this ability is because it is stated that someone who has good problem-solving abilities will have good analytical skills to be applied in various situations so that they can solve mathematical problems (Dewi & Kusumah, 2014).

Meanwhile, research conducted by Setiadi (2014) at the VIII grade junior high school level in Kerinci Regency shows that students' mathematical problem-solving abilities are one of the low mathematical abilities. After further investigation, this also happened to other schools in Kerinci district, namely SMP Negeri 1 Kerinci and SMP Negeri 5 Kerinci, which are two schools that have implemented Curriculum 2013 in grade VIII. Students can solve routine problems commonly given time to learn, but if given in the form of non-routine matter that is shaped about contextual and requires students to be able to develop the ability to solve problems, students tend to be difficult and not able to give a complete answer to that question.

The low ability of students' mathematical problem solving is caused by the learning approach used in the classroom which is more teacher-centered so that it still does not facilitate students to develop mathematical problem-solving abilities. Learning activities focus more on "chalk and talk" (Fauzan, Musdi, & Yani, 2017). As a result, students find it difficult to hone their mathematical problem-solving skills. Students tend to receive learning material without being able to solve problems if they are given different questions from the examples during learning. If this is allowed to continue, it can have an impact on mathematics learning goals that will not be achieved, the knowledge gained by students is meaningless. In the future, there will be fewer nation successors who can think critically, have new ideas, and are ready to face the challenges of the times.

The problem of low ability to solve mathematical problems is thought to be overcome by applying the Realistic Mathematics Education (RME) approach. This approach uses realistic problems in learning, students have the opportunity to understand the problem before solving, planning, choosing the right problem strategy, so that the contextual problem can be solved. A realistic problem does not always have to be a problem that exists in the real world, but it is said to be realistic if it can be imagined or real in students' minds (Mulyati, 2017). This approach is also said to be a form of contextual learning since the learning materials used refer to materials that are close, known, and attract students' attention (Lubis, Ariswoyo, & Syahputra., 2020).

Students find the concept of the material being studied. Through the RME approach students have the opportunity to rediscover and reconstruct mathematical concepts, so they have a good understanding of mathematical concepts and help students solve problems (Susanti, 2017). The application of this approach consists of 4 aspects, namely understanding contextual problems, solving problems, comparing and discussing answers, and finally concluding (Lady, Utomo, & Lovi, 2018). The main principle of this approach is that students must be allowed to rediscover mathematical concepts through a process of discovery, horizontal mathematization, vertical mathematics, and formal mathematics, as well as a highly interactive teaching and learning process (Fauzan, Slettenhaar, & Plomp, 2002). The process of mathematics in learning with the RME approach is the key to learning mathematics which is closely related to the procedure for solving problems (Laurens, Batlolona, Batlolona, & Leasa, 2018).

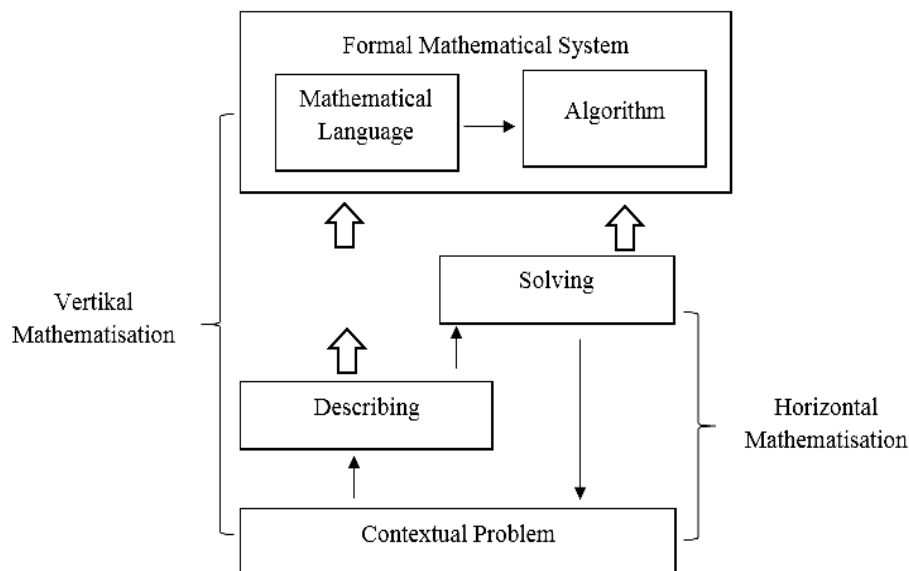


Figure 1. Horizontal and Vertical Mathematical Processes

Mathematization in learning activities is part of the application of the RME approach, both horizontal and vertical mathematics. The stages that students go through in this approach are horizontal mathematization and then enter the vertical mathematical stage which can be seen in

Figure 1. Horizontal mathematics occurs when students use informal strategies to describe and solve contextual problems, this process is continued with vertical mathematics, which occurs when the strategy informal knowledge owned by students is used as a guide for them to solve problems using mathematical language or to find suitable algorithms (Barnes, 2005). Then students are also allowed to go through the intertwining stage, which is learning to relate mathematical concepts/ideas that are being studied with other ideas/concepts (Bunga, Isrok'atun, & Julia, 2016). If this activity occurs continuously, it is assumed that the students' mathematical problem-solving ability will increase.

Students' mathematical problem-solving abilities are not obtained only from knowledge. The ability of students to solve problems is supported by several factors, including those related to students' belief in solving problems (Ulya & Hidayah, 2016). This belief is called self-efficacy. Self-confidence provides an overview of how an individual completes a task through the understanding he has to solve problems (Masitoh & Fitriyani, 2018). Self-efficacy that a person has can generate determination or desire in himself to fulfill demands and complete or not a task (Adinugraha, 2017). This affects students' cognitive behavior, namely how they interpret the persuasive message given which then encourages changes in behavior (Wilde & Hsu, 2019). Through someone's self-efficacy, it can be seen how they can effectively complete their tasks (Yusuf, 2011).

Each student has different levels of self-efficacy so that their effort habits and success in learning are also different. Students who have high self-efficacy are considered capable of solving problems that require problem-solving abilities, while students who have low self-efficacy are considered to be more likely to give up and stay away from difficult tasks (Alifia & Rakhmawati, 2018). However, most teachers in Indonesia rarely consider self-efficacy to determine the right approach in learning mathematics. The RME approach provides comfort for students who have low self-efficacy in learning because learning is oriented towards contextual problems and does not feel pressured in learning to spur students to solve contextual problems given. Whereas for students who have high self-efficacy, learning using contextual problems makes students feel challenged and willing to solve them. This is the background for investigating the RME approach that will suit students who have different levels of self-efficacy.

The purpose of this study was to test the hypothesis that are the mathematical problem-solving abilities of students who learn using the RME approach are higher than students who learn using conventional learning; are mathematical problem-solving abilities of students who have high self-efficacy who learn using the RME approach are better than those who learn using conventional learning; and are the mathematical problem-solving ability of students who have low self-efficacy who learn using the RME approach is higher than those who learn using conventional learning.

METHOD

This research is a quasi-experimental study to compare the effect of the RME approach with conventional learning on students' mathematical problem-solving abilities. The variables used in this study were the ability to solve mathematical problems as the dependent variable, the RME approach as the independent variable, and self-efficacy as the moderate variable.

This research was conducted at SMP Negeri 1 Kerinci and SMP Negeri 5 Kerinci. This school was chosen deliberately because it is a school that has implemented the 2013 curriculum in grade VIII. To determine the sample class, two classes from class VIII were selected randomly by using probability sampling which would provide equal opportunities for each school, one class as the experimental class, and the other as the control class. The research design used is a static group design, in which the experimental class students learn using the RME approach while the control class students learn using conventional learning. Then both classes were given a final test of their mathematical problem-solving abilities.

The data used in this study are data obtained through questionnaires and tests. Questionnaires are used to identify the level of self-efficacy that students have, while tests are used to measure students' mathematical problem-solving abilities. The questionnaire has been developed by previous researchers who also examined self-efficacy by Dony Darma Sagita (2017) in his research with the validity and reliability of self-efficacy instruments, respectively 0.554 and 0.930. The test used was validated by three mathematical experts, then the test was tried out on other VIII classes who had the same characteristics as the sample class to determine the validity and reliability of the test. The results of the validation by the experts stated that the test questions were valid and the results of the test trials obtained a reliability value of 0.46. After the trial, the test was carried out on the sample class students then the test results were tested for normality and homogeneity using the Kolmogorov Smirnov Z test and Levene's test. Based on the results of the normality and homogeneity tests, it is known that the hypothesis testing was carried out using the t-test with the help of SPSS software.

RESULTS AND DISCUSSION

The application of the RME approach during learning is conducted following the level of self-efficacy possessed by students. Learning continues without separating students who have high and low self-efficacy. Based on the results of the questionnaire data, it is known that the number of students who have high self-efficacy in the experimental and control classes from the two schools is 16 students, while the number of students who have low self-efficacy in the experimental and control classes from the two schools respectively is as much as 15 and 21 students. After applying

this approach, data were obtained about students' mathematical problem-solving abilities, the results of which can be seen in Table 1 and Table 2.

Table 1. Comparison of the Average Value of Students' Mathematical Problem Solving Ability

Sample Class	\bar{x}	S
Experiment	78,60	14,06
Control	65,86	17,43

Table 1 shows that the mathematical problem-solving abilities of students who learn by applying the RME approach have a higher average score than the mathematical problem-solving abilities of students who learn using conventional learning. Likewise, in terms of the standard deviation value, the value of the experimental class is lower than the control class, this shows that the experimental class scores are more similar since they have almost the same abilities.

Table 2. Average Value of Students' Mathematical Problem Solving Ability Based on the Level of Self-Efficacy

Self-Efficacy Level	Sample Class	\bar{x}	S
High	Experiment	79,86	17,79
	Control	52,08	23,21
Low	Experiment	73,33	19,15
	Control	44,97	24,71

Table 2 shows that the average score of students whom both have high and low self-efficacy who learn using the RME approach has a higher average score than those who learn using conventional learning. To find out which test is used in hypothesis testing, first, the normality and homogeneity tests are conducted. Tests are assisted by SPSS software, the test results can be seen in Table 3 and Table 4.

Table 3. Normality Test Results

Sample class	Sig.	Information
Experiment	0,056	Normal
Control	0,153	Normal

Table 4. Normality Test Results Based on Self-Efficacy Level

Self-Efficacy Level	Sample Class	Sig.	Information
High	Experiment	0,200	Normal
	Control	0,200	Normal
Low	Experiment	0,200	Normal
	Control	0,082	Normal

Table 3 and Table 4 show that the two sample classes have Sig values. > 0.05 . This also applies to the sample class with students who have high and low self-efficacy. So, it can be concluded that the sample class values are normally distributed. Furthermore, the homogeneity test was carried out on the two-sample classes that were learning with different approaches and in the sample class where students had high and low self-efficacy with the help of SPSS software, which can be seen in Table 5.

Table 5. Homogeneity Test Results

Homogeneity Test	Sig.	Information
Sample Class	0,158	Homogenous
High Self-Efficacy Sample Class	0,150	Homogenous
Low Self-Efficacy Sample Class	0,907	Homogenous

Based on the results of the homogeneity test in Table 5, it shows the Sig value. > 0.05 , it can be stated that the sample class is homogeneously distributed. The results of the normality and homogeneity test showed that the data were normally distributed and homogeneous, so to test the hypothesis used in the sample class and sample class with students who had high and low self-efficacy using the t-test. The results of hypothesis testing were carried out with the help of SPSS software. The results of hypothesis testing on the value of students' mathematical problem-solving abilities obtained Sig. 0.002, namely Sig. < 0.05 , so it can be stated that the mathematical problem-solving abilities of students who learn using the RME approach are better than the abilities of students who learn using conventional learning. While the results of hypothesis testing based on the level of self-efficacy can be seen in Table 6.

Table 6. Hypothesis Test Results in Value of Problem Solving Ability Based on Level of Self-Efficacy

Self-Efficacy Level	Sig.
High	0,065
Low	0,016

The results of hypothesis testing in Table 6 show the Sig. > 0.05 for the classification of students who have high self-efficacy, so it can be stated that the mathematical problem-solving abilities of students who have high self-efficacy are no better than the mathematical problem-solving abilities of students who learn using conventional learning. Meanwhile, the classification of students who have low self-efficacy shows the value of Sig. < 0.05 , so it can be stated that the mathematical problem-solving abilities of students who have low self-efficacy who learn using the RME approach are higher than those who learn using conventional learning.

The results of the data analysis show that the RME approach provides equal opportunities for students to solve contextual problems for both students who have high self-efficacy and students who have low self-efficacy. This is in line with the opinion of Zulkardi (Nursiddik, Noto, & Hartono, 2017) which states that the RME approach is a teaching approach that starts from real things for students, emphasizes the skills of the process of doing mathematics, discussing and collaborating, arguing with classmates so that they can find own strategies or ways of solving problems and in the end using mathematics to solve problems, either individually or in groups.

The test results also show that not always students who have high self-efficacy can get high scores and vice versa, but students who have low self-efficacy get low scores. Students who have

high self-efficacy always want to show their ability to solve problems and when given difficult questions that have never been encountered before, they are instead used as challenges and are motivated to find solutions as a challenge. This is in line with Alifia's opinion, which states that students with high self-efficacy have motivation, courage, and persistence in carrying out the assigned tasks (Alifia & Rakhmawati, 2018). This happens regardless of what learning is used either using the RME approach or using conventional learning. This results in the problem-solving ability data obtained by students who have high self-efficacy who learn with the RME approach and the abilities of students who learn with conventional learning have almost the same high value so that the hypothesis test results show that the mathematical problem-solving abilities of students who have self- high efficacy who learn by applying the RME approach are no better than the mathematical problem-solving ability of students who learn with conventional learning.

CONCLUSIONS

Based on the research results, it can be concluded that the mathematical problem-solving abilities of students who learn using the RME approach are better than those who learn using conventional learning. The same thing also happens for students who have low self-efficacy. Whereas for students who have high self-efficacy, the RME approach provides an opportunity for them to improve their mathematical problem-solving abilities, even though the learning approach used does not significantly affect their ability to solve problems. So it can be concluded that the RME approach contributes to the improvement of students' mathematical problem-solving abilities.

REFERENCES

- Adinugraha, F. (2017). Pengaruh Model Pembelajaran dan Efikasi Diri Terhadap Sikap Ilmiah Siswa SMA Peminatan MIPA. *Pro-Life*, 4(3), 441-455.
- Alifia, N. N., & Rakhmawati, I. A. (2018). Kajian Kemampuan Self-Efficacy Matematis Siswa dalam Pemecahan Masalah Matematika. *Elektronik Pembelajaran Matematika*, 5(1), 44–54. <http://jurnal.uns.ac.id/jpm>
- Barnes, H. (2005). The theory of Realistic Mathematics Education as a theoretical framework for teaching low attainers in mathematics. *Pythagoras*, 2005(61), 42–57. <https://doi.org/10.4102/pythagoras.v0i61.120>
- Bunga, N., Isrok'atun, & Julia. (2016). Pendekatan Realistic Mathematics Education Untuk Meningkatkan Kemampuan Koneksi dan Komunikasi Matematis Siswa. *Jurnal Pena Ilmiah*, 1(2), 441–450. <https://doi.org/10.30870/jppm.v10i2.2043>
- Dewi, N. R., & Kusumah, Y. S. (2014). Developing Test of High Order Mathematical Thinking Ability in Integral Calculus Subject. *International Journal of Education and Research*, 2(12), 101–108.
- Fauzan, A., Musdi, E., & Yani, R. (2017). The Influence of Realistic Mathematics Education (RME) Approach on Students' Mathematical Representation Ability. *Advance in Social Science, Education and Humanities Research*, 173, 9–12.
- Fauzan, A., Slettenhaar, D., & Plomp, T. (2002, April). Traditional mathematics education vs. realistic mathematics education: Hoping for changes. In *Proceedings of the 3rd International Mathematics Education and Society Conference* (pp. 1-4). Copenhagen: Centre for Research in Learning Mathematics.

- Lady, A., Utomo, B. T., & Lovi, C. (2018). Improving mathematical ability and student learning outcomes through realistic mathematic education (RME) approach. *International Journal of Engineering and Technology*, 7(2), 55–57. <https://doi.org/10.14419/ijet.v7i2.10.10954>
- Laurens, T., Batlolona, F. A., Batlolona, J. R., & Leasa, M. (2018). How does realistic mathematics education (RME) improve students' mathematics cognitive achievement?. *Eurasia Journal of Mathematics, Science and Technology Education*, 14(2), 569–578. <https://doi.org/10.12973/ejmste/76959>
- Lubis, W. A., Ariswoyo, S., & Syahputra, E. (2020). Kemampuan Pemecahan Masalah Matematika Melalui Pendekatan Pendidikan Matematika Realistik dan Pendekatan Penemuan Terbimbing Berbantuan Autograph. *Edumatika: Jurnal Riset Pendidikan Matematika*, 3(1), 1. <https://doi.org/10.32939/ejrpm.v3i1.483>
- Masitoh, L. F., & Fitriyani, H. (2018). Improving students' mathematics self-efficacy through problem based learning. *Malikussaleh Journal of Mathematics Learning (MJML)*, 1(1), 26. <https://doi.org/10.29103/mjml.v1i1.679>
- Masri, M. F., Suyono, S., & Deniyanti, P. (2018). Pengaruh Metode Pembelajaran Berbasis Masalah Terhadap Self-Efficacy Dan Kemampuan Pemecahan Masalah Matematis Ditinjau dari Kemampuan Awal Matematika Siswa SMA. *Jurnal Penelitian Dan Pembelajaran Matematika*, 11(1). <https://doi.org/10.30870/jppm.v11i1.2990>
- Mulyati, A. (2017). Pengaruh Pendekatan RME terhadap Kemampuan Pemecahan Masalah Siswa pada Materi Operasi Hitung Campuran di Kelas IV SD IT Adzkie I Padang. *Jurnal Didaktik Matematika*, 4(1), 90–97. <https://doi.org/10.24815/jdm.v4i1.8484>
- Nurkaeti, N. (2018). Polya'S Strategy: an Analysis of Mathematical Problem Solving Difficulty in 5Th Grade Elementary School. *EduHumaniora | Jurnal Pendidikan Dasar Kampus Cibiru*, 10(2), 140. <https://doi.org/10.17509/eh.v10i2.10868>
- Nursiddik, I., Noto, M. S., & Hartono, W. (2017). Pengaruh Pembelajaran Matematika Realistik Terhadap Kemampuan Pemahaman Matematis dan Keyakinan Diri Siswa SMP. *UNION: Jurnal Ilmiah Pendidikan Matematika*, 5(2), 151–160. <https://doi.org/10.30738/v5i2.1085>
- Susanti, S. (2017). Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Self-Efficacy Siswa MTs Melalui Pendekatan Pendidikan Matematika Realistik. *Suska Journal of Mathematics Education*, 3(2), 92. <https://doi.org/10.24014/sjme.v3i2.4148>
- Tambunan, H. (2019). The Effectiveness of the Problem Solving Strategy and the Scientific Approach to Students' Mathematical Capabilities in High Order Thinking Skills. *International Electronic Journal of Mathematics Education*, 14(2), 293–302. <https://doi.org/10.29333/iejme/5715>
- Ulya, R., & Hidayah, I. (2016). Kemampuan Pemecahan Masalah Ditinjau dari Self-Efficacy Siswa dalam Model Pembelajaran Missouri Mathematics Project. *UJMER Unnes Journal of Mathematics Education Research*, 5(2), 178–183. <http://journal.unnes.ac.id/sju/index.php/ujmer>
- Wilde, N., & Hsu, A. (2019). The influence of general self-efficacy on the interpretation of vicarious experience information within online learning. *International Journal of Educational Technology in Higher Education*, 16(1). <https://doi.org/10.1186/s41239-019-0158-x>
- Yusuf, M. (2011). The impact of self-efficacy, achievement motivation, and self-regulated learning strategies on students' academic achievement. *Procedia - Social and Behavioral Sciences*, 15, 2623–2626. <https://doi.org/10.1016/j.sbspro.2011.04.158>