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## The Effectiveness of Realistic Mathematics Education Learning Approach on Critical Thinking Skills of Elementary School Students

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### Info Artikel

*Sejarah Artikel:*

Diterima 10 Juli 2022

Direvisi 7 Maret 2023

Disetujui 16 Maret 2023

*Keywords:* Realistic  
Mathematical Education,  
critical thinking skills

*Paper type:*  
Research paper

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### Abstract

*Critical thinking is an ability that students must have to make a reasonable decision based on facts in solving a problem correctly. But in reality not all students have this ability. This study aims to determine the effectiveness of applying the Realistic Mathematics Education approach compared to the direct learning model on the critical thinking skills of elementary school students. This study uses a quasi-experimental method. The research design was a non-equivalent control group design. The sample of this research is the fourth grade students of SDN 2 Mangunrejo as the experimental class and the fourth grade students of SDN 3 Mangunrejo as the control class. The instrument used to measure critical thinking skills is a written test. The average value of student learning outcomes for the experimental class is 82.30, while the control class is 62.33. Thus it can be concluded that there is a difference in the average student learning outcomes between the RME class and the control class. The results of the Independent Sample t-test showed a sig (2-tailed) value of 0.00 < 0.05 so it can be concluded that there is a significant difference between the average student learning outcomes in the RME class and the control class. From the results of data analysis, it can be concluded that the Realistic Mathematics Education approach is more effective in improving critical thinking skills when compared to the direct learning model.*

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### Abstrak

Berpikir kritis adalah kemampuan yang harus dilakukan siswa untuk membuat keputusan yang masuk akal berdasarkan fakta dalam memecahkan masalah dengan benar. Tetapi pada kenyataannya tidak semua siswa memiliki kemampuan ini. Penelitian ini bertujuan untuk menentukan efektivitas penerapan pendekatan pendidikan matematika yang realistik dibandingkan dengan model pembelajaran langsung tentang keterampilan berpikir kritis siswa sekolah dasar. Studi ini menggunakan metode eksperimental semu. Desain penelitian adalah desain kelompok kontrol yang tidak setara. Sampel penelitian ini adalah siswa kelas empat dari SDN 2 Mangunrejo sebagai kelas eksperimental dan siswa kelas empat SDN 3 Mangunrejo sebagai kelas kontrol. Instrumen yang digunakan untuk mengukur keterampilan berpikir kritis adalah tes tertulis. Nilai rata-rata hasil pembelajaran siswa untuk kelas eksperimental adalah 82,30, sedangkan kelas kontrol adalah 62,33. Dengan demikian dapat disimpulkan bahwa ada perbedaan dalam rata-rata hasil pembelajaran siswa antara kelas RME dan kelas kontrol. Hasil uji-t sampel independen menunjukkan nilai SIG (2-tailed) 0,00 < 0,05 sehingga dapat disimpulkan bahwa ada perbedaan yang signifikan antara rata-rata hasil pembelajaran siswa di kelas RME dan kelas kontrol. Dari hasil analisis data, dapat disimpulkan bahwa pendekatan pendidikan matematika yang realistik lebih efektif dalam meningkatkan keterampilan berpikir kritis jika dibandingkan dengan model pembelajaran langsung.

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p-ISSN 2615-4196

e-ISSN 2615-4072

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## INTRODUCTION

The quality of a nation is very influential on the development of the nation. Indonesia is one of the developing countries that always strives to improve the quality of its human resources in order to be able to compete in this current era. One of the efforts made to improve the quality of human resources is through education. Education can be taken through three channels, namely formal, non-formal, and informal. Formal education is taken by students through learning at school. Learning is an activity created in a learning environment by teachers, students, and learning resources (Ardina et al., 2019). One of the lessons at school is learning mathematics.

Mathematics subjects are subjects that are obtained by students at the elementary level as a beginning to continue mathematics subjects at the next level. An expression expressed by Freudheta (Widyastuti, N. S., 2014) mathematics for life and mathematics as a human activities means that mathematics is an activity that is applicable and useful in everyday life. Every activity carried out by humans cannot be separated from the role of mathematics itself. This is in accordance with the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 64 of 2013 concerning the content standards of primary and secondary education explaining that learning mathematics aims to demonstrate a logical, critical attitude (Ermawati, D., & Zuliana, 2020). Through learning Mathematics, it is expected that students can improve their mathematical thinking skills and be able to apply mathematics itself in solving various problems in real life (Ardina et al., 2019f)

Widana et al (2018) states that the rapidly growing field of information and communication technology is currently based on the development of mathematics in several theories, algebra, analysis, probability theory, and discrete mathematics. Given the importance of mathematics in everyday life and the development of science and technology today, schools as formal educational institutions need to create interesting and meaningful learning, so that abstract mathematical concepts become easy for students to understand. To achieve these goals, students must have the ability to think critically in solving mathematical problems. This opinion is in accordance with the opinion (Widiyatmoko et al., 2021), Critical thinking skills are one of the skills that must be possessed in the current era. This is

because they are able to think well and solve problems systematically in their lives

Thinking is an activity carried out by humans to make discoveries with a specific purpose (Taubah, R., Isnarto., 2018). Meanwhile, according to Syaiful and Sumaji (Asrobuanam et al., 2021) revealed that thinking is a process of transforming information to get the results of thinking carried out through complex interactions of mental attributes which include abstraction, consideration, reasoning, depiction, logical problem solving, concept formation, creativity, and intelligence. To face the current era of globalization, high-level thinking is needed because competition is very tight in various fields, including education. One of the higher order thinking skills needed is critical thinking. Glaser (Sumarmo et al., 2012) states that critical thinking in mathematics is an ability and disposition that is combined with prior knowledge, mathematical reasoning abilities, and cognitive strategies, to generalize, prove, evaluate mathematical situations reflectively. Meanwhile, according to Fahim and Pezeshki (Fahim, M., & Pezeshki, 2012), critical thinking includes reasoning. depth and awareness of what we receive rather than direct acceptance of the differences in an idea. That is, ideas and suggestions from someone about a phenomenon cannot be directly accepted completely if the idea does not run systematically and a logical truth-seeking process.

The purpose of learning mathematics in the 2013 Curriculum emphasizes the application of learning with a scientific model that is designed in such a way that learning is more meaningful. Students are required to demonstrate the ability to think and act creatively, critically, productively, independently, collaboratively, and communicatively (Ayudya, M. S., & Rahayu, 2020). In its implementation, students are learning subjects, competency-oriented learning, emphasizing knowledge and skills in a balanced way (Afriansyah et al., 2021). And the teacher acts as a facilitator who needs to facilitate the development of students' critical thinking skills by providing relevant activities, which can be embedded in any subject, with some creativity from the teacher (Rihayati, Utaminingsih. S., 2020).

Laurens (Laurens. T., Batlolona, F. A., Batlolona, J. R., Leasa, 2018) revealed that many students feel afraid and find it difficult to learn mathematics. Laurens also adds that math problems are created more complicated so that students find it difficult to solve it which has an

impact on student learning outcomes. In line with that, research by Zubainur & Veloo (Zubainur et al., 2015) states that students in Indonesia who are enrolled in mathematics classes have higher levels of anxiety. Taubah (Taubah, R., Isnarto., 2018) revealed that mathematics learning activities in schools often provide one correct answer, so students cannot develop their ability to issue new ideas. The impact of this is that students cannot express their thoughts and cannot develop their critical thinking skills.

The low critical thinking ability of students has an impact on students' low mathematics learning outcomes. Based on the results of observations and interviews conducted by researchers in fourth grade students of SD Negeri 2 Mangunrejo on students' daily tests in mathematics, it shows that students' critical thinking skills in mathematics are low. The low critical thinking ability of students is known from the average value of students' mathematics learning outcomes that are still below the Minimum Completeness Criteria (KKM). The low critical thinking ability of students is influenced by several factors, including students find it difficult to understand and solve story problems, the teacher's role is still very dominant during learning, in this case students are always waiting for an explanation from the teacher to understand a mathematical material, students are only able to solve problems which is directly applied to the formula, so that if there are questions that require more reasoning students find it difficult to solve them. This is in line with the research by Ermawati & Zuliana (Ermawati, D., & Zuliana, 2020) which states that the factor in the low mathematical problem solving ability of students in elementary schools is that students have difficulty understanding story problems, students often work on questions that only have one closed answer, students tend to memorize practical formulas without understanding concepts, and teacher-centered learning.

Based on the problems above, a learning model is needed that not only emphasizes aspects of remembering, knowledge, and understanding, but also applies, analyzes, evaluates, and creativity. This is important because it can train critical thinking and problemsolving skills as well as the application of concepts in students' daily lives. one of them is Realistic Mathematics Education. According to Gravemeijer (Ardina et al., 2019) Realistic Mathematics Education has characteristics, among others, in the learning process through teacher guidance, students must be given the opportunity to reinvent mathematics,

and according to de Lange (Ardina et al., 2019) that the reinvention of mathematical ideas and concepts must start from exploring various situations and problems in the "real world". Real problems from everyday life are used as a starting point for learning mathematics to show that mathematics is actually close to everyday life. Realistic Mathematics Education is a theory of learning and teaching in mathematics education which was first introduced by the Freudenthal Institute in 1970 in the Netherlands (Aristiyo, D. N., Rochmad., 2014). Gravemijer (Julie, 2016) reveals that Realistic Mathematics Education has the following characteristics: 1) Phenomenological exploration, 2) Bridging by vertical instruments, 3) Student contributions, 4) Interactivity, 5) Intertwining. Meanwhile, according to Palinussa (Palinussa, 2013) Realistic Mathematics Education has characteristics including (1) students are more active in thinking, (2) the context and teaching materials used are directly related to the school environment and students, (3) teachers play an active role in designing teaching materials and class activities.

With Realistic Mathematics Education, it is expected that learning will be more meaningful and can improve students' critical thinking skills which have an impact on increasing students' mathematics learning outcomes. In accordance with research conducted by Devrim & Uyangor (Sugesti et al., 2014) revealed that real problems are used as a source of mathematical concepts so that they can affect the improvement of student learning outcomes. A similar study was conducted by Ismunandar et al (Ismunandar et al., 2020)) which showed that based on the results of the N-Gain test, a realistic mathematics education approach was quite practical to improve students' creative thinking skills.

Based on the description above, it strengthens the assumptions of researchers to conduct research. So the purpose of this study was to determine the effectiveness of the application of the Realistic Mathematics Education learning model on students' critical thinking skills in the fourth grade Elementary School.

## CONCEPTUAL FRAMEWORK

The rapidly growing field of information and communication technology currently relies on the development of mathematics in several theories, algebra, analysis, probability theory, and discrete mathematics (Widana et al., 2018). Given the importance of mathematics in everyday life and the development of science and technology

today, schools as formal educational institutions need to create interesting and meaningful learning, so that abstract mathematical concepts can be easily understood by students. However, the reality on the ground that occurs in Indonesia, mathematics is a subject that is considered difficult and feared by students in general. This has an impact on mathematics learning outcomes which are always lower than other subjects such as science, social studies, etc. Mathematics is always identified with numbers, formulas, and includes other arithmetic operations. The results of a survey on the education system and the ability of school students conducted by the Program for International Student Assessment (PISA), an organization under the auspices of the Organization for Economic Cooperation and Development (OECD) which is held every 3 years since 2000, it turns out that Indonesia is in the lowest rank to -2 in the field of mathematics (Egok, 2016). In Egok's research it can be seen from the survey results of the International Statistical Center for Education (National Center for Education in Statistics, 2003) which shows the low mathematics achievement of Indonesian students, where Indonesia is ranked 39th out of 41 countries in mathematics learning below Thailand and Uruguay.

The low mathematics learning outcomes of students are influenced by several factors, including low critical thinking skills. In the current era of globalization, critical thinking skills are needed, skilled in gathering information and then concluding something based on valid facts to make decisions (Bete, 2020). Critical thinking can change thinking patterns, see the problem as a whole, be able to solve problems as a whole, able to concretize abstract knowledge (Fayakun, M., & Joko, 2015). Critical thinking in principle is higher order thinking. Students' critical thinking ability can be a provision for students in dealing with real-life problems because it becomes the basis for someone to take further decisions (Lambertus et al., 2016). Jean Piaget in developmental theory reveals that school education must empower students to do new things based on creativity, discoveries, and be critical of all the problems they face (Lillard et al., 2013). Then Piaget added that the purpose of education is not just to repeat what was done by previous generations, but to learn from them to improve efforts to be better in the present and in the future.

Realistic Mathematics Education is an approach to learning mathematics that is oriented to everyday experience and applies it in everyday

life (Taubah, R., Isnarto., 2018). Realistic Mathematics Education learning model is basically the use of reality and the environment understood by students to instill the concept of flat shapes that are associated with real problems with the help of the media to concrete the abstract flat shapes concepts. According to Arsaythamby, et al (Permatasari et al., 2019) the hallmark of Realistic Mathematics Education is that it requires students to be active in learning and the teacher only directs the activities of these students. The learning steps with the Realistic Mathematical Education approach in this study are: 1. Understanding contextual problems. 2. Explain contextual issues. 3. Solve contextual problems. Compare and discuss answers. 5. Summing up. With this learning model, it is expected to develop critical thinking skills by directly involving students in the learning process. Learning mathematics with Realistic Mathematics Education requires students to actively build their own knowledge by using the real world for the development of mathematical ideas and concepts (Astuty et al., 2019). Then Astuty added that the model was used to solve mathematical problems and then applied it in everyday life, so that students not only memorized and applied formulas but were also able to create and remember the process itself.

His study aims to determine the effectiveness of the application of the Realistic Mathematics Education learning model compared to the direct learning model on the critical thinking skills of fourth grade students in flat-building materials in the Yos Sudarso Gugus, Pulokulon District, Grobogan Regency, Central Java, Indonesia. The research results obtained will be used as a basis for proposing the use of Realistic Mathematical Education learning models in improving students' critical thinking skills in mathematics subjects.

## METHODOLOGY

This research is a quantitative study using a quasi-experimental method to determine the effectiveness of the Realistic Mathematical Education learning model on students' critical thinking skills by comparing the treatment of the teaching and learning process in the experimental class and the control class. The research design used in this study was a non-equivalent control group design (pretest-posttest control group design without random).

The study population was all fourth grade elementary school students in the Yos Sudarso Group, Pulokulon District, Grobogan Regency as

many as 11 public schools with 258 students. The sample in this study were two elementary schools, namely fourth grade students at SDN 2 Mangunrejo as an experimental class and fourth grade students at SDN 3 Mangunrejo as control class. In this study, the research sample was taken using a purposive sampling technique because not all samples had criteria that matched the phenomenon under study. Therefore, the authors chose the Purposive Sampling technique which stipulates certain considerations or criteria that must be met by the samples used in this study.

In this study, the researcher used an instrument to reveal the necessary data in the form of a test to measure students' critical thinking skills. The test method aims to determine the successful achievement of critical thinking skills in learning mathematics with flat shapes through the application of Realistic Mathematics Education. The test in this study is the main data collection technique. The test carried out in this study was in the form of a description test of 10 questions which contained aspects of critical thinking skills. The choice of the test in the form of a description is intended to show the ability to analyze, synthesize, evaluate, conclude, and solve problems in the process of answering and is intended to minimize the guesswork element.

In this study, researchers determined critical thinking indicators using the Facione version of indicators (Munira, 2020), namely: Interpretation, Analysis, Evaluation, and Inference.

**Table 1.** Critical thinking indicator Facione version

| Aspect                     | Indicator  |
|----------------------------|--|
| Interpretation<br>Analysis | Understand the problem indicated by writing known or asked questions correctly   |
| Evaluation                 | Identify the relationships between the statements, questions, and concepts given in the problems   |
| Inference                  | shown by making an appropriate mathematical model and providing an appropriate explanation.<br>Using the right strategy in solving problems, complete and correct in doing calculations<br>Draw conclusions correctly. |

Before the test questions were given to students in the experimental class and control class, the questions were tested in classes other than the class to be studied to see the validity of the items and the reliability of the test. From the test of this instrument, it will be known which items are valid and which are failed. Items that

fail are not included in the research to be carried out. Calculation of validity is calculated using the product moment formula for a significant level of 5% through the SPSS version 23 application.

Based on the results of the validity test of critical thinking, it shows that of the 10 description questions, validity tests were carried out with  $n = 30$  and a significance value of 0.05, then the results obtained after testing of 10 essay questions there were 7 valid questions and 3 invalid questions. The question is declared valid because the sig count < significance (0.05), and the question is said to be invalid because the sig count > significance (0.05). Furthermore, valid questions will be used as instruments to measure the success of students' critical thinking skills and invalid questions will be discarded or not used.

If the measuring instrument has been declared valid, then the reliability of the measuring instrument is tested using the Cronbach Alpha technique with a Cronbach alpha value of 0.6.

**Table 2.** Item reliability category

| Limitation    | Category    |
|---------------|-------------|
| 0.800 – 1.000 | Very high   |
| 0.600 – 0.799 | High        |
| 0.400 – 0.599 | High enough |
| 0.200 – 0.399 | Low         |
| 0.000 – 0.199 | Very low    |

Based on the reliability test, information was obtained that the results of the critical thinking ability test had a reliability coefficient of 0.803,  $r$  arithmetic ( $rh$ ) > 0.600. So it can be concluded that the critical thinking test instrument is reliable.

Methods in analyzing this research include data description, analysis prerequisite test, and final analysis (hypothesis test). SPSS version 23 and microsoft excel 2013 was used for statistical data analysis in this study. The results of the data obtained will be used to test the research hypotheses that have been formulated previously

## CONCLUSIONS

Based on the results of this study, it can be concluded that the Realistic Mathematics Education learning model is more effective in improving students' critical thinking skills compared to the direct learning model in the fourth grade of SD Gugus Yos Sudarso, Pulokulon District. This is because Realistic Mathematics Education provides a stimulus to real problems and provides opportunities for students to think of effective strategies. Students are encouraged to be able to collect information that is appropriate and in accordance with the

problem so that it can grow students' ability to think critically.

Teachers need to apply Realistic Mathematics Education in the classroom to make abstract mathematical concepts more real and easy for students to understand. Therefore, teachers must be more creative and innovative in designing learning with this learning model. Teachers should also improve their ability to use other learning models to instill mathematical concepts and critical thinking skills related to students' daily lives. Then students also need to be accustomed to being given contextual-based problem-solving questions so that they can connect mathematical concepts through experience and knowledge that are close to their environment so that mathematics becomes easier and more enjoyable. Further research needs to be done to further explore how much influence Realistic Mathematics Education contributes to students' cognitive achievement in the subject of mathematics in different classes. The research can also determine the effect of Realistic Mathematics Education on students' attitudes, problem solving abilities, interest in learning, or other variables related to learning mathematics.

#### ACKNOWLEDGEMENT

The author would like to thank the participation of the elementary school where the researcher carried out the research. The authors also thank the Postgraduate Masters Program in Basic Education, Muria Kudus University, Central Java, Indonesia, which has guided the preparation of research reports and analyzing research results.

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