Implementation of realistic mathematic education (RME) learning model in improving critical thinking skills

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Abstract

Learning mathematics that can improve elementary school students' critical thinking skills is rarely done. Therefore, students' mathematical necessary thinking skills still need to improve. The realistic Mathematics Education (RME) learning model is expected to enhance mathematical critical thinking skills because of providing contextual problems to students. This study aims to determine the effect of the Realistic Mathematics Education (RME) learning model on students' critical thinking skills in mathematics. This research uses quasi-experimental research. The population in this study were students of class VI SDN 1 Kalikoa, Cirebon Regency. The sample selection in this study was carried out using a cluster random sampling technique to determine the experimental and control classes. In this case, two classes were selected: class VI A as the practical class and class VI B as the control class. The instrument for collecting data tests mathematical critical thinking skills on integer material. The results showed that the RME learning model is more effective than the direct learning model on students' critical thinking skills in mathematics. This is because the value of $t_h\ was$ 2.30, and $t_t\ was$ 1.68 at a significance level of 5% and DK of 40, which means $that\ th\ was\ higher\ than\ t_t$, so H_0 was rejected, and H_1 was accepted. The results of this study can be used as input for teachers and prospective teachers to improve themselves concerning the teaching that has been done and the student's critical thinking skills that have been achieved by paying attention to the right learning model to improve students' critical thinking skills in mathematics.

INTRODUCTION

Mathematics learning in schools has a very important position which aims to make students have problem-solving skills, can use mathematics as a tool for life, communicate ideas through mathematical symbols, have critical thinking skills, logical thinking skills, and creative abilities towards a problem (Ardiyani, 2018; Ekowati & Nenohai, 2017). Mathematics can also be used to prepare students for real-life situations so that students can study well (Švecová et al., 2014). But in reality, students do not have good abilities in mathematics because many students feel afraid and have difficulty learning mathematics (Laurens et al., 2018; Yerizon et al., 2018). One of the abilities in mathematics that is of concern in the 21st century is critical thinking skills (Abed et al., 2015; As'ari, 2014; Lamb et al., 2017; Sanabria & Arámburo-Lizárraga, 2017; Susandi, et al., 2019). Through this ability, students are expected to analyze, evaluate, and conclude from the problems they face (Gholami et al., 2016; Şendağ & Ferhan Odabaşi, 2009; Vong & Kaewurai, 2017). However,

students do not have good mathematical critical thinking skills (Susandi et al., 2018; Susandi, et al., 2020). Therefore, mathematical critical thinking skills need to be developed in classroom learning.

Some of the benefits of developing mathematical critical thinking skills include critical thinking skills needed to be applied in the learning process as one of the education system's goals (Massa, 2014; Yeh, 2009). In addition, critical thinking skills in mathematics can help someone make valid decisions to acquire new knowledge quickly through complex challenges (Ahuna et al., 2014; Ananiadou & Claro, 2009). Furthermore, mathematical critical thinking skills can also help someone in comparing and analyzing various perspectives; evaluate, understanding events, solving problems, and make decisions based on strong reasoning and logical evidence, and drawing conclusions (Haataja et al., 2019; Kopzhassarova et al., 2016; Živkovic, 2016).

Based on the results of observations at SD N 1 Kalikoa, the following information was obtained: the average student's mathematical critical thinking skills are still relatively low; the teacher still dominates the learning carried out in class; students are only given ordinary questions do not provide questions that can develop students' critical thinking skills in mathematics; students are less active in the learning carried out in class, and students are not accustomed to expressing their ideas in class learning so that mathematical critical thinking skills do not develop properly. In addition, when students are given questions related to the indicators of mathematical critical thinking skills, which consist of the ability to analyze, evaluate, and conclude skills, they are classified in the low category. On the indicator of ability to analyze, only about 25% of students answered correctly. Then the indicator of ability evaluates students who answer correctly, only around 15%. As for the indicator of the ability to conclude, students who answered correctly only about 5%. This happened because students were not used to working on questions in such a form, so students felt surprised and wrong in answering the questions given. Therefore, a learning model is needed in mathematics that can improve students' mathematical critical thinking skills.

One alternative mathematics learning model that is expected to improve student's critical thinking skills is Realistic Mathematics Education (RME). This is because RME is based on the claim that students work from a context that makes sense to improve mathematical understanding so that students can express opinions and reasons freely (Dickinson & Hough, 2012). In addition, the RME learning model is better than the learning model that is usually applied in schools because of the context of the problem given in the form of a problem that students can clearly understand, and the teacher acts as a facilitator (Arsaythamby & Zubainur, 2014; Putri et al., 2019a). RME is a mathematics learning program that offers learning strategies by building concepts through rediscovery based on students' real experiences and knowledge, so RME has proven to be an effective method in helping students better understand abstract mathematical concepts (Makonye, 2014).

Several studies have been conducted related to the RME learning model. Research result Kusumaningsih et al. (2018) concluded that the RME learning model can improve students' algebraic abilities because students are given real problems in learning in class. Furthermore, Güler (2018) research concluded that the teacher's theoretical knowledge of the RME learning model was insufficient, so it affected its implementation in the classroom. Research conducted by Yetim Karaca & Özkaya (2017) concluded that learning using the

RME learning model is better than learning using the classical learning model when viewed from student achievement. Research conducted by Putri et al. (2019b) concluded that the learning tools based on the realistic mathematics education approach developed have met the criteria for effectiveness and can improve mathematical spatial abilities and student motivation. Research conducted by Ulandari et al. (2019) concluded that RME-based teaching materials are effective and can improve students' mathematical problem-solving abilities and self-efficacy. Research conducted by Nguyen et al. (2020) concluded that using the RME learning model has successfully improved students' learning achievement. From this research, no one has discussed how to implement the RME learning model in improving mathematical critical thinking skills. Therefore, it is necessary to do follow-up research because students' critical thinking skills in mathematics are needed in modern times.

Based on the description, which is accompanied by some evidence of previous research, further researchers want to conduct research on implementing the RME learning model in improving students' critical thinking skills in mathematics. This is because the RME learning model requires students to solve problems using contextual problems to make students more active in the learning process, and collaboration occurs in their groups.

METHODS

The method used in this research is quasi-experimental research. This research was conducted at SDN 1 Kalikoa in Cirebon Regency, West Java Province. The population in this study were sixth-grade students at SDN 1 Kaliko. The sample selection in this study was selected using a cluster random sampling technique to determine the experimental and control classes. In this case, two classes were selected: class VI A as the experimental class and class VI B as the control class. The dependent variable of this study is the ability to think critically in mathematics, and the independent variable is the learning model. To collect data, user documentation, and test methods. The documentation method was used to collect data on students' initial abilities taken from the test scores for critical thinking skills in mathematics before the RME learning model was applied.

The test method was used to collect data on mathematical critical thinking skills. Before the experiment, a balance test and initial prerequisite tests were carried out, including a normality test using the chi-square method and a population variance homogeneity test using the Bartlett method. The balance test uses the analysis of the two-party mean test. The results obtained, the sample comes from a population that is normally distributed, homogeneous, and has the same initial ability. Before using the mathematical critical thinking ability test instrument, content validity, difficulty level test, discriminatory power test, and reliability test were conducted first. Questions are said to be good if they meet the criteria, namely valid, level of difficulty ($0.3 \leq TK \geq 0.7$), distinguishing power ($r_{xy} \geq 0.3$), and reliability ($r_{11} = 0.7$). To test the hypothesis is done by testing the average of one side with the t-test. The research flow can be seen in Figure 1.
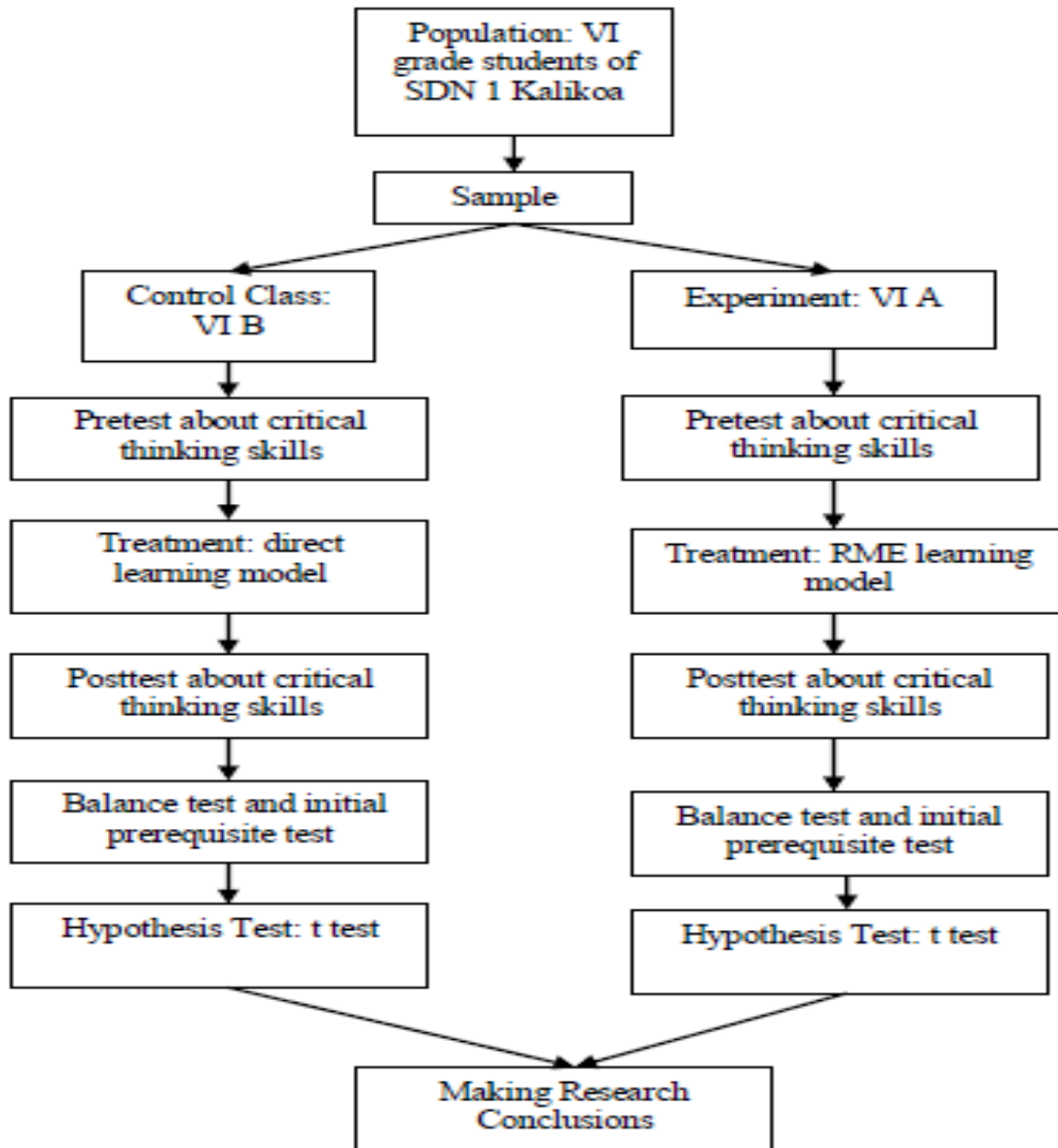
Figure 1. Research Method Flow

RESULTS AND DISCUSSION

Hypothesis testing in this study uses a one-party hypothesis test. The results of the calculation of the one-party hypothesis test can be seen in Table 1.

Table 1. Summary of One-Party Hypothesis Test Results

t_{count}	t_{table}	Significance Level	df
2.30	1.68	5%	40

Based on Table 1. It is known that the value of $t_{observed}$ was 2.30 and $t_{critical}$ was 1.68, at a significance level of 5% with a dk of 40. Therefore, $t_{observed}$ was higher than $t_{critical}$. Thus, H0 was rejected, and H_1 was accepted. In other words, the RME learning model is more effective

than the direct learning model on students' mathematical critical thinking skills on the whole number material for sixth-grade students of SD N 1 Kalikoa.

The learning of integer material with the RME learning model begins with understanding contextual problems by providing contextual problems, and the teacher involves students in identifying contextual problems. The application of learning follows the characteristics of RME; namely, learning begins with contextual problems that encourage students to make connections between knowledge and application in everyday life, which involves the role of the teacher guiding students in solving these problems (Bevins & Price, 2016; Das, 2020). In addition, students are active in learning and care about the environment by being given contextual problems (Ekowati & Nenohai, 2017). Students will also learn to relate knowledge based on what they already know, relate knowledge to everyday experiences, ask questions, collaborate with other students to share ideas, and be able to transfer knowledge based on interrelated problems. The teacher's role is also to teach students through the provision of contextual problems in RME learning, which greatly impacts the student learning process (Lestari et al., 2021; Putri et al., 2019a). This is done because children aged 12-15 years have not been able to think abstractly, so in the learning process, concrete objects are needed so that children can construct the knowledge they have acquired (George, 2017). In addition, teachers must also develop learning materials by taking into account the abilities of each student through problems in the context of the student's environment so that it can be useful for students so that students' mathematical critical thinking skills can increase (Ozdemir, 2017).

At the stage of solving problems, the teacher facilitates students to solve the problems they are facing, and students are expected to be able to share ideas with their friends to solve contextual problems related to critical mathematical thinking. Therefore, the use of contextual problems needs to be given to students so that students in RME learning have good achievements better (Ardiyani, 2018). Students are also involved in constructing their knowledge through mathematical critical thinking skills questions given in groups. In addition, the teacher gives students the flexibility to explore their ability to solve problems related to critical mathematical thinking in the discussions carried out. This will make students successful in the RME learning model that is applied in the classroom so that students critical thinking skills in mathematics will increase (Anggraini & Fauzan, 2018). The teacher's role in guiding students to solve problems is very helpful for students in finding strategies and sharing ideas (reinvention). Through such activities, students have the opportunity to try to solve problems on their own. Students can find and solve problems, understand strategies, give reasons for their methods, and evaluate techniques. This is done so that students' critical thinking skills in mathematics can develop in learning activities in class (Susandi et al., 2020).

In the next stage, students compare and discuss the answers guided by the teacher. Students are actively involved in interacting with group mates to be able to share opinions and provide reasons for the results of the group's presentation answers. This activity will improve students' mathematical critical thinking skills in the RME learning model carried out in the classroom (Wulandari et al., 2020). The teacher's role is to organize student answers and direct students' opinions. When the process occurs, the teacher mediates with students to ask questions and develop mathematical critical thinking skills. Therefore, teachers must create an

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interactive atmosphere that encourages students to ask questions, answer, criticize, and give ideas because it aims to see students' critical thinking processes in mathematics (Bjørndal, 2020). So, in comparing and discussing answers, students will exchange ideas to increase their mathematical critical thinking skills (Florea & Hurjui, 2015).

In the last stage, students make conclusions from the answers made during presentations. At this stage, students are allowed to express conclusions with valid reasons. The purpose of this activity is so that all students in learning are more active in expressing conclusions accompanied by true reasons from what each student understands (Marni, 2019). In addition, in the critical thinking skills in mathematics, students must be able to compare various information, and then the correct conclusion will be obtained (Husnaeni, 2016). This is done so that students can make the right decisions they have good critical thinking skills (Ulger, 2018; Yaldiz & Bailey, 2019).

The various activities carried out by students with the help of teachers positively impact students' ideas, stating that learning becomes fun and meaningful because knowledge is actually built into learning. Through the application of RME, students' ability to analyze, evaluate, and conclude is critical in solving contextual problems. Student's ability to analyze is marked by being able to describe answers correctly and use strategies to solve problems. Students' ability to evaluate is marked by students being able to correct wrong answers and then correct them based on the right reasons. Furthermore, the ability to conclude is characterized by the involvement of students to be better at comparing concepts and concluding the answers to the questions given. From the discussion, it can be concluded that critical thinking skills can be improved by using contextual problems that make students active in expressing ideas and reasons in learning (Saleh et al., 2018; Toheri et al., 2020).

CONCLUSIONS

Based on the analysis and discussion results, it can be concluded that the RME learning model is more effective than the direct learning model on mathematical critical thinking skills on the whole number material for class VI SDN 1 Kalikoa. Therefore, applying the RME learning model on integer material in grade VI SD can improve students' critical thinking skills. This can be seen from the student indicators in analyzing, evaluating, and concluding that the average has reached the critical category. Students can mention the information that is known and the questions asked in the problem correctly, choose the appropriate information, find outlines of questions to support problem-solving, describe answers, use strategies and relevant information before solving problems with logical reasons, find steps to solve problems, conclude from various strategies that have been found correctly, and compare the results of answers with other students before concluding answers. After knowing the increased mathematical critical thinking skills through the RME learning model, for further research, it is expected to be able to conduct research related to how students' mathematical critical thinking processes in solving problems on integer material

AUTHOR CONTRIBUTIONS STATEMENT

The author's contribution to this research is ADS as correspondent and translator and SW as data collection and processing.

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