



The Influence of Indonesian Realistic Mathematics Approach to Improve Concept Understanding and Critical Thinking Skills of Fourth Grade Elementary School Students

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ABSTRAK

Penggunaan konteks dunia nyata dalam pembelajaran matematika sangat diperlukan untuk mengasah pikiran siswa. Penelitian ini bertujuan untuk menganalisis penggunaan pendekatan PMRI terhadap pemahaman konsep dan keterampilan berpikir kritis siswa, dan menganalisis perbedaan antara pemahaman konsep dan keterampilan berpikir kritis siswa yang menggunakan pendekatan PMRI dengan siswa yang menggunakan pendekatan konvensional. Jenis penelitian yang digunakan adalah quasi eksperimen, dengan desain penelitian pretest posttest control group design. Populasi yang digunakan adalah siswa kelas IV Sekolah dasar. Teknik pengambilan sampel dengan menggunakan purposive cluster random sampling dengan sampel 59 siswa kelas IV sebagai kelas eksperimen dan 54 siswa kelas sebagai kelas kontrol. Data dikumpulkan dengan menggunakan instrumen tes pilihan ganda dan uraian. Teknik analisis data dengan menggunakan uji analisis deskriptif, uji normalitas, uji homogenitas, uji paired sampel t-test dan uji independent sampel t-test. Hasil penelitian menunjukkan bahwa pertama, terdapat pengaruh penggunaan pendekatan PMRI terhadap pemahaman konsep dan keterampilan berpikir kritis siswa. Disimpulkan bahwa penggunaan pendekatan PMR dapat meningkatkan pemahaman konsep dan keterampilan berpikir kritis siswa.

ABSTRACT

Using real-world contexts in learning mathematics is necessary to hone students' minds. This study aims to analyze the use of the PMRI approach on students' conceptual understanding and critical thinking skills and the differences between students' conceptual understanding and critical thinking skills using the PMRI approach and students using conventional approaches. The type of research used is quasi-experimental, with a pretest-posttest control group design. The population used is fourth-grade elementary school students. The sampling technique used purposive cluster random sampling with a sample of 59 class IV students as the experimental class and 54 class students as the control class. Data were collected using multiple-choice test instruments and descriptions. Data analysis techniques used descriptive analysis test, normality test, homogeneity test, paired sample t-test and independent sample t-test. The results showed that first, using the PMRI approach affected students' conceptual understanding and critical thinking skills. The PMR approach could improve students' conceptual understanding and critical thinking skills.

1. INTRODUCTION

Mathematics has an important role in life and to solve everyday problems. Without the help of concepts in learning and mastering basic mathematics, humans will have many difficulties in applying mathematics in everyday life (Hillmayr et al., 2020; Nenotaek et al., 2019; D. P. Sari et al., 2020). This is what makes learning mathematics mandatory to be taught starting from elementary school. A universal science that has an important role in life which is needed in studying other sciences (Septihani et al., 2020; Toma & Greca, 2018). Mathematics is used as a basic science in studying arithmetic and as a provision for students in learning and understanding education at a further level of education (Kim & Kim, 2021; Mutmainah et al., 2019). Learning mathematics has standard abilities such as 1) students are able to understand mathematical concepts, 2) are able to use reasoning and proof, 3) are able to solve problems, 4) students are able to communicate ideas, 5) are able to connect and represent mathematics, 6) have an attitude of appreciating the use mathematics in everyday life, 7) can think critically, logically (Ahmad et al., 2018; Ardiyani & Gunarhadi, 2018; Yulianty, 2019).

It is hoped that all of these mathematical ability standards can be possessed by students, but the standard abilities above have not been achieved optimally. Students' ability in mathematics that is still felt

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to be low is conceptual understanding and skills in critical thinking. The study by stating that students' understanding of concepts in learning mathematics was still low (Mangelep, 2017; Mukrimatin et al., 2018; Nofrialdi et al., 2018). The results also supported by the results of a study conducted by which stated that students' ability to think critically in learning mathematics for fourth grade students was still low (Setyowati & Masrukan, 2016). There were students who were unable to critical thinking in learning mathematics, as well as in understanding concepts where many students still have not mastered understanding mathematical concepts (Khasanah & Supriyono, 2016).

In learning understanding of concepts is very important, this is because when learning students will not experience difficulties in solving math problems even though the teacher changes the difficulty level of the questions, with learning that has good conceptualization, it can be ensured that students will be able to understand, record, apply, and be able to modify a concept in solving various problems both in real life and in mathematical problems (Alexander et al., 2021; Turmuzi & Wahidaturrahmi, 2021). Likewise with students' skills in critical thinking. Critical thinking skills are one of the objectives of learning mathematics. Mastery in critical thinking skills is very important to master in solving problems that are relevant to learning mathematics in students' daily lives problems that students can imagine (Jeheman et al., 2019; Trisnowali MS., 2017).

Based on the results of interviews with school teachers implementing the Independent Curriculum Implementation (IKM) in cluster 10 of the Pujut sub-district, which was carried out in August 2020, which shows that the most common problems in learning mathematics are understanding concepts and critical thinking skills, this can be seen from the indicators of conceptual understanding and indicators of critical thinking skills have not yet been achieved. The indicators of understanding the concept are: 1) being able to re-express concepts that have been learned using their own language either spoken or written, 2) being able to explain mathematics into various models, diagrams, and mathematical symbols, 3) being able to classify objects according to certain characteristics in accordance with the applicable concepts, 4) capable of applying relationships between concepts. with procedures, (5) capable of determining examples or non-examples of concepts. 6) able to make logical conclusions from the information received (Karaca & Ozkaya, 2017; Septihani et al., 2020; Yudha et al., 2019).

However, in reality the indicators of understanding the concepts described above have not been optimally achieved. The facts in the field show that around 60% of students have not mastered the indicators of understanding the concepts. This is evidenced by the results of observations and interviews conducted with grade IV teachers in August. which shows that: 1) students have not been able to re-express concepts that have been learned in their own language both in writing and spoken, this is proven when students are asked about concepts in multiples material and student factors answer based on what is memorized, not yet at the stage of being able to explain what that they know or master after learning, 2) students are not fully able to explain concepts in various models, diagrams, or symbols. For example, when students are given illustrative questions, students have not been able to describe the meaning of the questions by using models or diagrams that can simplify or simplify the intent of the questions or questions. 3) students have not been able to classify learning objects based on the properties that are in accordance with the concept. This can be seen when students are given problems regarding multiples or factors, students have difficulty distinguishing between solving multiples or solving factors. 4) students have not been able to apply the relationship between concepts and procedures from learning, this can be seen when students are given questions with the hots level, students are confused because they have not mastered the concept with the completion procedure. 5) students have not been able to determine which examples of multiple statements and which are not examples of multiples. 6) students are mistaken when concluding learning or information received during the teaching and learning process.

Students in learning must first understand the concept of material before being introduced to the broader or development of the material (Hidayat et al., 2020; Pramuditya et al., 2018). The ability to understand concepts is a very important foundation for being able to achieve other cognitive abilities (Cahani et al., 2021; Dwipayana et al., 2018). After students understand the material by mastering the basic concepts of the material, students do not need to memorize formulas or steps in solving problems, but students can find their own concepts regarding the material and steps to solving problems with their own steps or models. Understanding of concepts is closely related to students' interest in learning and even students will make problem solving with their own understanding. But this must be under the supervision and guidance of the teacher. In the learning process, the teacher must be able to build students' conceptual understanding in the learning process, with students' conceptual understanding that has been built students can directly organize or reflect, articulate their knowledge, so that students have a sense of ownership of knowledge (Radiusman, 2020; Wulandari et al., 2020).

Likewise the results of interviews with IKM implementing school teachers in cluster 10 related to skills in critical thinking that have not been optimally achieved in learning mathematics, this can be seen

based on the results of observations and interviews with grade 4 teachers in schools in cluster 10, Pujut sub-district, Central Lombok district that there are around 70% of students who have not mastered the indicators of skills in critical thinking. The indicators of these critical thinking skills must be present in students and must be completed which is useful for building critical thinking skills, but based on the results of observations and interviews the researcher found that there were 70% of students still having difficulties in mastering students' critical thinking skills in learning mathematics, while Critical thinking skills are needed in learning, especially in learning mathematics. From the results of observations and interviews with class IV class 10 teachers in Pujut sub-district, Central Lombok district, researchers found that students' difficulties in critical thinking skills were 1) students were not able to explain in simple terms the concepts being studied, students still memorized concepts not yet at the stage of being able to provide explanations which is simpler. 2) the inability of students to build basic skills such as analyzing, describing, and understanding the intent of the questions or problems given. 3) the inability of students to give proper reasons for the answers submitted. 4) students are less responsive when given a stimulus regarding math problems.

Critical thinking skills are a form of thinking that must be developed in each individual student, this is because critical thinking is the basis for analyzing arguments to develop a logical mindset. With critical thinking skills students are able to improve understanding and concept development, solve more complex problems easily, draw logical and valid conclusions (Nashrullah et al., 2021; Ucicaputri et al., 2020). Solving mathematical problems requires good and correct mathematical critical thinking skills (Dolapcioglu & Doğanay, 2022; Maulidah et al., 2020). Critical thinking skills are the main foundation for becoming intelligent human beings. Someone who has skills in critical thinking has a high curiosity so that the person continues to find out about the answers to the problems faced and prevents himself and others from acting or taking and making bad or inappropriate decisions (Balqis, 2019; Samo et al., 2017). So that skills in critical thinking in elementary school learning are needed in increasing intelligence, curiosity, and being able to pet what is right or wrong.

So the problems that have been described above must be addressed immediately to achieve the goals of learning mathematics. So that teachers must immediately improve their learning systems, especially in selecting and determining learning models or approaches that can support students to be able to understand concepts and think critically (Azizah et al., 2018; Fauzi et al., 2020). In this case teachers really need to use an approach that can relate learning material to students' daily life activities that can build passion in learning, provide freedom in expressing student understanding in accordance with experiences in students' daily lives, provide active student involvement in learning and discussing, being able to link or connecting conceptual understanding and critical thinking with daily activities and being able to make elementary school students obtain a variety of new information that allows students to see patterns, relationships between various knowledge.

The Indonesian realistic mathematics learning approach can be an alternative to strengthen students' conceptual understanding and critical thinking skills in mathematics lessons. PMRI is an approach to learning mathematics that brings students into real life. With the PMRI approach students are required to link learning in the real world which provides opportunities for students to learn according to student observations, so that the impressions received by students in learning can be more meaningful by involving generalization and formalization of learning to facilitate students in learning (Ahmad et al., 2018; Herawaty, 2018).

PMRI in its learning involves students to construct knowledge with their own abilities through the activities they do in learning activities. This is in line with the opinion of Hidayat et al., (2020) who revealed that the PMRI approach can improve students' understanding of concepts, as well as the opinion of Wijaya & Irianti, (2021) who say that the RME approach can improve students' critical thinking skills. In line with the aim of assisting students in improving critical thinking skills and conceptual understanding abilities, students are expected to be able to seek and find solutions to problems or problems given by the teacher when studying, so that it is expected to stimulate the students' mathematics learning process. The purpose of this study was to analyze the effect of the PMRI approach on students' critical thinking skills in mathematics, determine the effect of the PMRI approach on students' understanding of mathematical concepts, and determine differences in students' conceptual understanding using the PMRI approach.

2. METHOD

The type of research used is a quasi-experimental, with a pretest-posttest control group design. The population is class IV who are in SD cluster 10 Pujut District. The sampling technique used purposive cluster random sampling, namely the selection of samples carried out randomly from predetermined classes with certain characteristics and criteria to obtain the results and objectives of this study. So from

the population and sample that has been described above, it can be obtained that the experimental group is SDN 1 with a total of 59 students and the control class is SDN 2 with a total of 54 students.

The data collection technique used the test method, with pretest and posttest instruments in the form of multiple choices and descriptions of the previous test questions, which were tested for instrument validation and reliability. Testing the validity of the instrument was carried out by expert assessment which was declared valid and revised, then the instrument was tested on 38 grade IV SD students who had the same criteria as the school where the research was conducted, after conducting a validity test using product moment correlation with the results of all items with the results 20 multiple choice questions and 5 descriptions were declared valid and reliable.

The research steps were: students in the experimental class and control class were given a pretest first, after that the experimental class was given the learning treatment using PMRI and the control class with a conventional approach, after being given learning, each experimental class and control class were given a posttest. After that, the pretest and posttest data were analyzed using descriptive analysis techniques and inferential statistical analysis techniques using multivariate tests using the Paired sample t-test, and univariate tests using independent sample t-tests with the condition that before testing the hypothesis the data must be normally distributed and the data homogeneous. Kolmogorov-Smirnov statistical test at a significance of 0.05. While testing the homogeneity of variance in this study was carried out using the Levene's Test of Equality of Error through the Box's M test. The hypothesis testing used SPSS version 23 for windows.

3. RESULT AND DISCUSSION

Result

The following is the result of the thesis statistical calculation of the effect of using the PMRI approach on the understanding of the concepts of fourth grade elementary school students. The results of the research data analysis showed that the average pretest score of the experimental class was 59.39 and after being given treatment using the PMRI approach the average score of students increased to 79.69. while for the control class the pretest results were 62.39 and the posttest results were 69.56 In the prerequisite test, namely the normality test and homogeneity test with the results listed in [Table 1](#).

Table 1. Table Results of the Normality Test Of Concept Understanding

	Kelas	Kolmogorov-Smirnov		
		Statistic	df	Sig.
Concept Understanding	pre-test eksperimen PMRI	0.097	59	0.200
	post-test eksperimen PMRI	0.105	59	0.163
	pre-test kontrol konvensional	0.097	54	0.200
	post-test kontrol konvensional	0.112	54	0.091

From [Table 1](#) above it can be seen that the data is normally distributed both experimental pretest, experimental posttest, as well as control pretest and control posttest data because the data significance is greater than 0.05. As for the next prerequisite test, namely the homogeneity test for understanding the concept, it can be seen in the [Table 2](#).

Table 2. Table Results of the Homogeneity Test of Critical Thinking Skills

		Levene Statistic	df1	df2	Sig.
Pre-test understanding of the concept	Based on Mean	1.229	1	111	0.270
	Based on Median	1.180	1	111	0.280
	Based on Median and with adjusted df	1.180	1	103.077	0.280
	Based on trimmed mean	1.193	1	111	0.277
Posttest understanding of the concept	Based on Mean	0.135	1	111	0.714
	Based on Median	0.118	1	111	0.732
	Based on Median and with adjusted df	0.118	1	109.889	0.732
	Based on trimmed mean	0.124	1	111	0.726

Based on the results of calculations using SPSS version 23 in [table 3](#) above, it can be seen that the data from students' conceptual understanding research results are homogeneous with the provisions of each significance value greater than 0.05. The next test is a descriptive test for critical thinking skills, the following is the result of a statistical descriptive test for normality and homogeneity of critical thinking skills. The average pretest score of the experimental class on critical thinking skills was 55.68 and the posttest result was 78.71. And the average score for the control class at the pretest was 49.98 and the posttest was 56.02. Then a normality test is carried out using the Kolmogorov-Smirnov of critical thinking skills, while the results of the normality test for critical thinking skills showed in [Table 3](#).

Table 3. Table Results of the Normality Test of Critical Thinking Skills

class		Kolmogorov-Smirnov ^a		
		Statistic	df	Sig.
Critical Thinking Skills	pre-test eksperimen PMRI	0.101	59	0.200*
	post-test eksperimen PMRI	0.113	59	0.060
	pre-test kontrol konvensional	0.095	54	0.200*
	post-test kontrol konvensional	0.073	54	0.200*

From the table above it can be seen that the results of the normality test for critical thinking skills are normal with a significance level using the Cologogorov Smirnov greater than 0.05. Then a homogeneity test was carried out on critical thinking skills showed in [Table 4](#).

Table 4. Table Results of the Homogeneity Test of Critical Thinking Skills

		Levene Statistic	df1	df2	Sig.
Critical Thinking Pretest	Based on Mean	1.209	1	111	0.274
	Based on Median	0.970	1	111	0.327
	Based on Median and with adjusted df	0.970	1	106.446	0.327
	Based on trimmed mean	1.153	1	111	0.285
Critical Thinking Posttest	Based on Mean	0.558	1	111	0.456
	Based on Median	0.448	1	111	0.505
	Based on Median and with adjusted df	0.448	1	109.857	0.505
	Based on trimmed mean	0.568	1	111	0.452

The homogeneity results in [Table 4](#) show that the data is homogeneous because each criterion shows a significance value greater than 0.05. Results of paired sample analysis t-test concepts understanding and critical thinking showed in [Table 5](#).

Table 5. Results of Paired Sample Analysis T-Test Concepts Understanding and Critical Thinking

		Paired Differences					T	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Concept understanding	PreTest-PostTest	-20.305	17.943	2.336	-24.981	-15.629	-8.692	58	.000
Critical Thinking Skills	PreTest-PostTest	-23.034	15.380	2.002	-27.042	-19.026	-11.504	58	.000

From [Table 5](#) above it shows that the significance value <0.05 that the decision making from the results of the Paired Sample t-test on H_{a1} is the PMRI approach has a significant positive effect on the understanding of mathematical concepts in class IV students in cluster 10 of Pujut District. And H_{a2} is a significance value <0.05 , it can be said that H_{01} is rejected, and H_{a1} is accepted that the PMRI Approach has a significant positive effect on the critical thinking skills of class IV students in cluster 10 in Pujut District. The next test is a univariate test carried out with an independent sample t-test test. This test is carried out

to find out the differences from students who use the PMRI approach to conceptual understanding and students' critical thinking skills showed in [Table 6](#).

Table 6. Analysis of Results of Independent Sample T-Test Concepts Understanding and Critical Thinking

Class	Variable	T _{count}	Df	Sig	explanation
Experiment and control	Concept	3.680	111	0.000	There is a difference
	Critical thinking	9.349	111	0.000	There is a difference

[Table 6](#) above shows that the significance value is <0.05 . With Df 111 with a ttable calculation of 0.184 based on the decision criteria that have been determined with the results of the table above, it can be concluded that: H_{a1} The value of $t_{count} > t_{table}$ is $3.680 > 0.184$ it can be said that there are differences in understanding the concepts of students who use the PMRI model and students who use the conventional class IV elementary school in a cluster of 10 Pujut District. And the results of the calculation from H_{a2} $t_{count} > t_{table}$, namely $9.349 > 0.184$, it can be said that H_{02} is rejected, therefore it can be concluded that there are differences in the critical thinking of students who use the PMRI model and students who use the conventional model of class IV SD in cluster 10 Pujut District.

Discussion

From the results of the analysis of the results of the research above, it can be concluded that the use of the PMRI approach has a significant positive effect on students' understanding of the concepts of fourth grade elementary school students in a group of 10, Pujut District, Central Lombok Regency. The results of this study were strengthened by the results who said that the PMRI approach had a significant positive effect on students' understanding of concepts ([Hanifah et al., 2019](#); [Jeheman et al., 2019](#); [Lestariningsih & Trismawati, 2020](#)). Likewise with the results of research said that there were differences in the ability to understand mathematical concepts between students who were taught using the PMRI approach and students who were taught with a conventional approach ([Maulidya & Nugraheni, 2021](#); [Yuliyanti & Sunarsih, 2019](#)). So that even in learning they can easily and actively complete learning because the basic concepts of learning are in accordance with their knowledge ([Sari & Yuniati, 2018](#)).

Based on the results of hypothesis testing, it was concluded that the PMRI approach had a significant positive effect on the critical thinking skills of fourth grade students of SD in a cluster of 10 Pujut District, Central Lombok Regency. The PMRI learning approach is a learning approach that provides opportunities for students to learn independently and use experiences or events experienced by students in the school environment and the community where they live. By using real-world contexts or student experiences in learning, students can relate experience to the lessons being taught and can criticize and even provide opportunities for students to think at a higher level or think critically about the learning material presented. The results of research said that the PMRI approach could improve students' critical thinking skills ([Rosalia et al., 2022](#); [Utami & Indarini, 2021](#)). Other results shows that using the RME approach can improve critical thinking skills, the process of student answers to problem solving critical thinking skills can be better and varied ([Aminah, 2017](#)). Likewise with the results of research stated that the application of a realistic mathematics education approach assisted by origami manipulative media was able to improve students' critical thinking skills ([Amalia & Untari, 2019](#)).

After the implementation of research using the PMRI approach, namely the experimental class using the PMRI approach and the control class using a conventional approach in learning, it was found that there were differences in the effect of students' conceptual understanding in the experimental class and students in the control class. This is based on descriptive analysis of data and univariate test results using an independent sample t-test which shows that the average score of posttest students' conceptual understanding using the PMRI approach is 79,69 and the average score of control class students who use a conventional approach gets an average -the average score is 69,56 and based on the results of the analysis with the Independent sample t-test showing that the significance value is less than 0,05 which means that there is a difference between students in the experimental class using the PMRI approach and students in the control class with the conventional approach . PMRI learning is not only cases related to children that occur in everyday life, but the PMRI approach is more than that, namely referring to real cases or cases that can be imagined in the minds or minds of students, in learning it also involves interactions between students and students. students, students with teachers. Learning with PMRI also has the principle that students are freed to express opinions or hold discussions about the models they use in solving problems or questions given by the teacher, so that they can hone and improve students' abilities in various aspects such as conceptual understanding, and mathematical critical thinking ([Alexander et al., 2021](#); [Karaca & Ozkaya,](#)

2017). The PMRI approach involves interactivity between teachers and students, between students and students, which can motivate students and stimulate curiosity, a sense of being valued for expressing opinions, students can find their own problem solving models so that students can solve math problems without memorizing formulas (Ahmad et al., 2018; Dewi & Agustika, 2020).

The use of the PMRI approach in teaching learning activities can provide motivation to students in learning. A significant influence of the Indonesian realistic mathematics learning approach on students' critical thinking skills with good criteria meaning that most students can achieve good learning outcomes with critical thinking skills (Rosalia et al., 2022). The RME approach can improve students' critical thinking skills (Wijaya & Irianti, 2021). This study has the implication that the use of the PMRI approach has a significant positive effect on conceptual understanding and critical thinking skills in mathematics of fourth grade elementary school students in Cluster 10, Pujut District, Central Lombok Regency. PMRI can be an alternative approach model used by teachers. Students in using the PMRI approach are faced with everyday life problems that they encounter in life both in the school environment and in community life. The application of the PMRI approach can help students in depth with a learning material so that it can optimize students' mathematical conceptual understanding and critical thinking skills.

4. CONCLUSION

Based on the results of the data analysis and discussion that has been described in this study, it can be concluded that the PMRI approach has a positive and significant effect on conceptual understanding and critical thinking skills of class IV SD students in a cluster of 10 Pujut sub-district, Central Lombok Regency, and after an independent test of sample t -test found that there are differences in conceptual understanding and critical thinking skills of groups of students who use the PMRI approach with groups of students who use conventional approaches.

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