THE INFLUENCE OF INDONESIA'S REALISTIC MATHEMATICS EDUCATION APPROACH ON STUDENTS' CREATIVE THINKING ABILITY

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Abstract :
This research aims to explore how PMRI, a student-centered and contextualized mathematics learning approach, can foster students' creative thinking abilities in the morning, when students may have different levels of alertness, motivation, and mood, which are the result of applied science, in the field of mathematics education. The research method used is a quantitative method with Posttest-Only Control Design. The population of this study was class VIII students. The sample used was 2 classes with a quota sampling technique where classes determined from the school were used as samples. The data collection techniques used are tests and observations. Based on the student test results, a significance value of 0.00 was obtained, which means a value of $0.00 < 0.05$. Observations are carried out to see the implementation of learning. Based on the results of observations, the learning carried out was following PMRI characteristics, which means the learning was carried out well. From the research results, it was concluded that using the Indonesian realistic mathematics education approach in the morning influenced the creative thinking abilities of class VIII students at Lais State Middle School. The novelty of this research is that it introduces a new experiment of PMRI learning in the morning on students' creative thinking abilities. The research contributes to the literature on mathematics education and creative thinking by highlighting the role of PMRI in improving students' creative thinking abilities in the morning.

Keywords: Creative Thinking Ability, Indonesian Realistic Mathematics Education Approach (PMRI), Number Patterns

INTRODUCTION

Creative thinking is one of the most important things for 21st century students (Zubaidah, 2016; Wang & Li, 2022; Wang & Burdina, 2023). Learners must have the ability to create, expand and implement their ideas both independently and as part of group work (Ministry of Education and Culture, 2018). Learners you must have the ability to think creatively to be able to do it increase broad understanding in solving a problem with a variety of ideas or ideas (Supardi, 2015; Amalina, & Vidákovich, 2023; Silva et al., 2023). Develop think student creativity is one of the goals an educator's learning (Sofia, 2018; Chen, 2021; Han & Suh, 2023). Through creativity the learning process can become more meaningful because students can develop the ideas or thoughts they have to solve problems (Saidah et al., 2022; Yang, Chen, & Hung, 2022; Zhan & Louie, 2024). Creativity is the process of understanding a problem, exploring possible solutions to the problem, generating assumptions, checking and evaluating them, and clarifying the findings so that students can understand

them (Susanto, 2013; Sitorus, 2016; Yenmez, 2022; Lee et al., 2023). The ability to think creatively is very important in learning, because students gain experience using the knowledge and skill they have to apply them to everyday mathematics questions and problems.

Based on initial observations carried out, the learning process at SMP N 3 Lais is centered on educators. Students are still not active in learning activities where students' activities are only listening, taking notes, and students rarely ask questions or express ideas that require creative thinking skills in mathematics. During the learning process, students only get information from educators. But students are not given the opportunity to develop the ideas they have or different methods from what they have learned (Afiani & Putra, 2017; Matić, 2022; Suherman & Vidákovich, 2022; Kirişçi, 2023). If the learning process is implemented only procedurally then students cannot expand their creative thinking abilities during teaching and learning activities.

Judging from the problems that occur, it is very necessary to have a learning system that is able to enable students to think creatively. An approach that can enable students to think creatively is the Indonesian Realistic Mathematics Education (PMRI) approach. PMRI is an approach that aims to reveal conditions and events in students' environments as a way to understand mathematical problems (Sadiq & Mustajab, 2010; Aljarrah, 2020; Khairunnisak et al., 2022; Suwarto et al., 2023). The PMRI approach is able to improve the results of students' mathematical creative thinking abilities, this can be seen from several previous studies. The PMRI approach shows a positive response compared to using conventional approaches in improving students' mathematical creative thinking abilities (Iskandar & Riyanti, 2015; Chua, 2021; Çakıroğlu et al., 2023). Next is research Sari, (2015) shows the feasibility of using the PMRI approach, learning increases each cycle based on the results of testing students' mathematical creative thinking abilities. So it can be concluded from several previous studies that teaching and learning using the PMRI approach can improve the results of creative thinking abilities.

The gap research of this study is that there is a lack of literature on the effect of the Indonesian realistic mathematics education (PMRI) learning approach in the morning on students' creative thinking abilities. Most previous studies have focused on the effect of PMRI on students' mathematical understanding, reasoning, and problem-solving skills, but not on their creative thinking abilities. Creative thinking is an important skill for students to develop, as it enables them to generate new and original ideas, solutions, and products. However, there is a need to explore how PMRI, which is a student-centered and contextualized approach to mathematics learning, can foster students' creative thinking abilities, especially in the morning, when students may have different levels of alertness, motivation, and mood.

In previous research conducted by Suciati et al., (2021),shows that the ability to think creatively mathematically using the PMRI Approach has experienced a low increase due to the lack of time for maximum effective learning activities. So previous researchers suggested carrying out the learning process by choosing the right and effective time so that the learning process can be carried out optimally. this situation corresponds to Rahmahdhani, (2022) Implementing the PMRI approach in an effective time can improve student learning outcomes.

RESEARCH METHOD

This research uses quantitative experimental research to see the influence of Indonesia's realistic mathematics education approach on students' creative thinking abilities (Sugiono, 2018). This research uses a Posttest-Only Control Design (Syahrum & Salim, 2013). This design has 2 class groups for the research sample, namely the first class group as the experimental class or treatment class and the second class group as the control class or untreated class. The experimental class was given treatment using the PMRI approach to creative thinking.

The population in this study were all students in class VIII SMP N Lais. The sampling technique used by researchers is the Quota Sampling technique. Sampling quotasis a sampling technique carried out based on a predetermined quantity or quota (Priadana & Sunarsi, 2021).Because this study used 2 classes, the sample used consisted of two classes with the sample determined by the school. One class was chosen as the control class and another class as the experimental class.

There are three procedures for carrying out this research (Lestari & Yudhanegara, 2015)namely: preparation stage, implementation stage, and final stage (reporting). The instruments used in this research were test questions, RPP (learning implementation plan), LKPD (student worksheet), and

learning implementation observation sheet. The data collection techniques used in this research are test techniques used to measure students' creative thinking abilities and observation techniques used to see the implementation of learning using the PMRI approach (Djaali, 2020).

For analysis test questions based on scoring guidelines for students' creative thinking abilities. Before being given to the research sample, the test questions were tested for validity and reliability to measure the validity and reliability of the data. After the questions were given to the research sample, the students' test results data were analyzed for normality using the Kolmogorov Smirnov test, to analyze the homogeneity of the data using the f test, and to draw hypotheses using the two-tailed t test. The tool used to analyze this data is the SPSS application.

RESULTS AND DISCUSSION

This research was conducted in two classes, where class 8.4 was the experimental class and class 8.5 was the control class.Posttest data was collected to determine students' overall scores with the ultimate aim of seeing the impact of the PMRI approach on students' creative thinking abilities. The questions are created according to indicators of creative thinking ability and each question raises a number of indicators of creative thinking ability. Questions were asked to 31 students in the experimental class and the control class, totaling 29 students. Based on the recapitulation of students' posttest scores, the calculation of the final post-test scores showed that the highest score in the experimental class was higher than the highest score in the control class and the lowest score in the control class was lower than the experimental class. This situation shows that the creative thinking abilities of students in the experimental class are higher than those in the control class. Judging from the summary of students' post-test data, the average value obtained for each indicator is as follows.
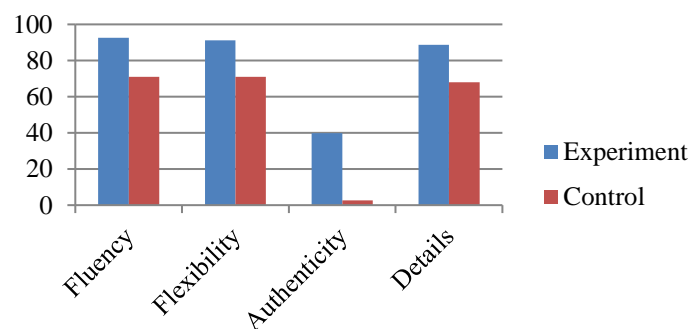

Figure 1. Graph of Average Value of each Indicator

Based on calculations, it can be seen that the highest average score of students in each indicator is dominated by the experimental class. The experimental class can be seen as more creative than the control class. This is seen based on the final calculation results, the posttest scores obtained for the experimental class and control class are.

Table 1. Final Test Score

Class	The highest score	Lowest Value	Mean
Experiment	90	63	82
Control	69	50	58

Calculation of the final post-test score shows that the highest score is in the experimental class, which is higher than the highest score in the control class and the control class also has the lowest score than the experimental class. This shows that the creative thinking abilities of students in the experimental class are higher than those in the control class.

After getting the test result data, the researcher carried out a hypothesis test. However, the researchers carried out a normality test for each group first. The Kolmogorov Smirnov normality test using the SPSS application shows that the experimental class data is not normally distributed because

the significance value is smaller than 0.05. Meanwhile, for the control class, the data is normally distributed because the significance value is greater than 0.05.

Apart from the data being normal, the data must also be homogeneous. for this reason the research carried out a homogeneity test for the 2 groups. The homogeneity test was carried out using the SPSS application, showing that the data had a homogeneous distribution because the significance value obtained was 0.408, which means significance > 0.05.*f*

After completing the normal and homogeneous posttest, the researcher then carried out a hypothesis test to find out the differences in the posttest during the research. Test the hypothesis using the following test, namely the results of the calculation of the hypothesis test.*t.*

Table 2. Hypothesis Testing

T-Test

	Class	N	Mean	Std. Deviation	Std. Error Mean
Creative	Class 8.4	31	82	4.731	0.849
Thinking	Class 8.5	29	58	4.569	0.849

Independent Sample Test

	Levene's Test		t-test For Equality of Means					95% Confidence Interval of the Difference	
	F	Sig	t	df	Sig(2-tailed)	Mean Difference	Std. Error Difference	Lover	Upper
Assumed	0.693	0.408	19.565	58	0.00	23.522	1.202	25.929	
Not assumed			19.588	57.937	0.00	23.522	1.200	25.926	

It can be seen that the sig (sig 2-tailed) obtained is 0.00, which means a value of $0.00 < 0.05$, so there is an influence of using the Indonesian realistic mathematics education approach on students' creative thinking abilities. This means that there is an influence of the PMRI approach used in the morning on the creative thinking abilities of class VIII students at Lais State Middle School.

Observation results of the researcher's implementation of teaching and learning using the Indonesian realistic mathematics education (PMRI) approach. Data from the results of the observation of learning implementation values shows that the overall value of the implementation of teaching and learning which took place over four meetings was included in the predicate of very good. So, this shows that every teaching and learning process in accordance with PMRI characteristics has been carried out very well.

The research was carried out to see whether or not there was an influence of the learning approach on students' creative thinking abilities when learning mathematics after being given treatment using the PMRI approach in the morning in the experimental class, and using a scientific approach in the control class because it was in accordance with the 2013 curriculum used at school. The research was conducted over four meetings. Three meetings, one meeting for the post-test.

At the first meeting, the difference between the creative thinking abilities of the experimental class and the control class at the first meeting was not visible. This situation is caused by teaching and learning using the PMRI approach which has just been implemented. However, several groups in the experimental class have issued indicators of creative thinking abilities. In the control class, only a few students produced indicators of creative thinking ability. At the second meeting, the students had improved. Students in the experimental class and in the control class can produce indicators of flexibility. At the third meeting in the experimental class and control class, students were able to produce indicators of authenticity. Indicators of students' creative thinking abilities achieved in the experimental class and the control class show that there is a difference. The achievement of indicators

of students' creative thinking abilities leads to differences in the level of students' creative thinking abilities in the post-test results, very few students reach very good and very creative levels. Explanatory table of indicators of students' creative thinking abilities in the experimental class and control class.

Fluency

Table 3. Fluency Indicators

Experiment Class	Control Class
92.58	71

From table 3 it can be seen that the fluency indicator in the experimental class has a higher percentage than the control class. The experimental class was 92.58% and the control class was 71%. This means that in the experimental class the fluency ability is in the very good category and in the control class the students' fluency ability is in the good category. The following are students' answers to the fluency indicator.
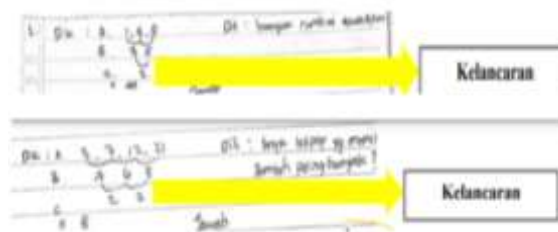

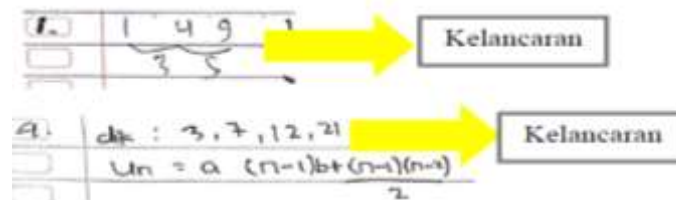Figure 2. Experimental Class Answers

Figure 3. Control Class Answers

The differences in the answers of experimental class and control class students can be seen. In the experimental class answers to questions 1 and 4, students can answer not only what they know from the questions, but students can also write down and make differences from a series of numbers, while the control class only answers what they know from the questions. For the Fluency Indicator, the experimental class and control class were able to fulfill a good predicate. This is in line with the results of research conducted by Effendi & Farlina (2017) and research Amiruddini, Supandi & Purwandi, (2020), said the Fluency indicator meets the good category.

Based on the results of observations of the implementation of learning carried out by researchers, the learning activities were carried out in accordance with PMRI characteristics, especially with the implementation of the first PMRI characteristic and the second PMRI characteristic. The first characteristic of PMRI is learning using context, where the use of context in teaching and learning mathematics is actually not a form of applying a concept but rather a starting point for developing a concept that can direct students smoothly in expressing their ideas (Hadi, 2017). The second characteristic of PMRI is the use of a model where there is a model of and a model for. This characteristic can direct students to think smoothly because from the model of students are given situations that they are familiar with, then students are directed to create a model for where in this model students will create something abstract (Utari, 2021). so that by implementing these PMRI characteristics, students can meet the Fluency indicators in a very good category.

Flexibility

Table 4. Flexibility Indicators

Experiment Class	Control Class
91.13	71

From table 4 it can be seen that the Flexibility indicator. The experimental class has a higher percentage than the control class. The percentage in the experimental class was 91.13% in the very good category and in the control class the percentage was 71% in the good category, this is in line with research. This means that in the experimental class, students' ability to think flexibly is better than in the control class. The following is the answer of one of the students on the Flexibility indicator.

Figure 4. Experimental Class Answers

Figure 5. Control Class Answers

Look at the differences in students' answers in the experimental class and the control class. In the experimental class answers, students were able to make three answers in different ways with the final result being correct. The first way, students used a square number pattern formula, the second way used a formula that participants were accustomed to using in learning, and the third way, students used a flat shape formula. square (Nurlaela, & Ismayati, 2015). Meanwhile, the control class was only able to give two different answers, but one of the answers had the wrong final result. For the Flexibility Indicator, both the experimental class and the control class were able to meet the predicate of good. This can be influenced by the relationship between PMRI and creative thinking skills which carry out problem exploration activities which not only aim to determine the final answer but can also direct students to come up with several types of problem solving strategies (Wijaya, 2012).

Based on observations of the implementation of teaching and learning carried out by researchers and observed by observers, learning activities have been carried out in accordance with PMRI characteristics, especially with the implementation of the third PMRI characteristic, namely Utilization.

As a result of construction, students are given the ability to solve the given problem using the method they want. By providing freedom in solving problems, students are able to create several

solutions in solving problems, so that by implementing learning that is in accordance with the PMRi characteristics, students can meet the Flexibility indicators in the very good category.

Originality

Table 5. Origanility Indicators (Authenticity)

Experiment Class	Control Class
39.78	2.58

From table 5, it can be seen that in the indicator of the ability to think in an original way, the experimental class has a greater percentage than the control class. The percentage of the experimental class was 39.78% which was in the poor predicate and the percentage in the control class was 2.58% which was in the very poor predicate, this is in line with research (Meriza, Zulkardi & Susanty, 2023). This means that in the experimental class the students' ability to think in Originality is better than the control class. The following is the answer of one of the students on the Originality indicator.
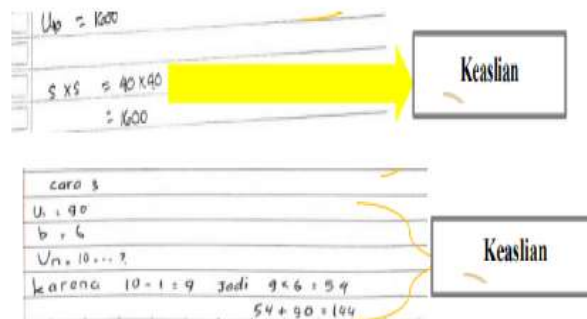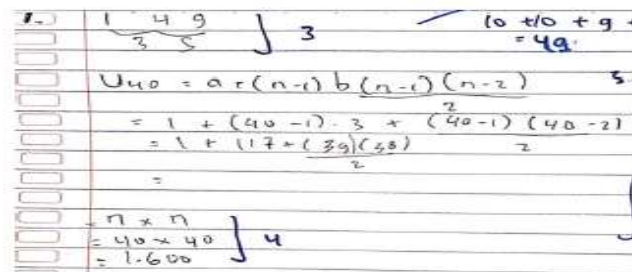

Figure 6. Experimental Class Answers

Figure 7. Control Class Answers

Look at the differences in students' answers in the experimental class and control class. In the experimental class answers, students can make different answers from other students, namely by entering the square formula to determine the tassels needed to weave a mat measuring 40 x 40 cm. Meanwhile, the control class was unable to provide different answers from other students. The research results of Effendi & Farlina (2017) state that the Originality indicator is the least that can be mastered by students. The difficulty faced by students in the Originality indicator is that students have not been able to solve questions using different steps (Hidayah et al., 2021; Şenol, & Yaşar, 2023).

Based on observations of the implementation of teaching and learning activities carried out by researchers, the learning activities observed by observers have been carried out in accordance with PMRI characteristics. The low results of the Originality indicator are probably caused by group learning because in this indicator students must have different methods from other students, while the learning is carried out in groups so answers from the LKPD that meet the Originality indicator are obtained. from the thoughts of several group members.

Elaboration

Table 6. Elaboration Indicators

Experiment Class	Control Class
88.7	67.9

From table 6, it can be seen that the Elaboration indicator in the experimental class has a higher percentage than the control class. The experimental class percentage was 88.7% which was in the very good category and the control class percentage was 67.9% which was in the good category, this is in line with research.(Ramadhani, Firmansyah, & Haerudin, 2017). This means that in the experimental class, students' ability to think in elaboration is better than in the control class. The following is the answer of one of the students on the Elaboration indicator.
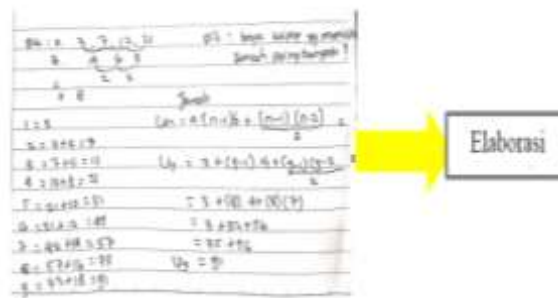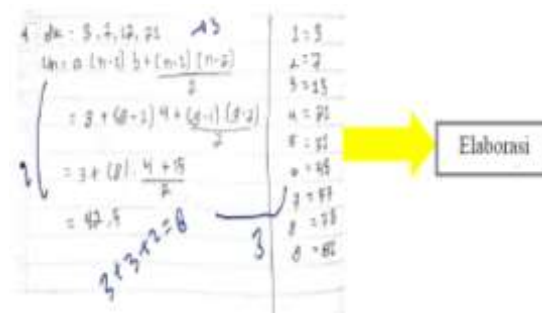

Figure 8. Experimental Class Answers

Figure 9. Control Class answers

The differences in the answers of experimental class and control class students can be seen. In the experimental class answers, students were able to detail the steps to solve the questions clearly. Meanwhile, in the control class, when participants were taught to make answer steps, they were still not able to do it in detail. This is in line with Hidayah et al., (2021), which said that students were unable to solve questions in detail because students were unable to understand the problems contained in the questions, such as questions that were too long and difficult to understand.

Based on the results of observations of the implementation of learning carried out by researchers who were observed by observers, learning activities were carried out in accordance with PMRI characteristics, especially with the implementation of the first characteristic of PMRI, namely the use of context where students can explore their knowledge in detail in solving problems, so that learning can be carried out in detail. In accordance with these PMRI characteristics, students can meet the Elaboration indicators in a good category.

The results of the research carried out show that the average posttest score of students in the experimental class is higher than the score of students in the control class, these results can show that there is a positive influence of implementing the PMRI approach. However, this is not in line with research conducted by Suciati et al., (2021) shows that the ability to think creatively mathematically using the PMRI Approach has experienced a low increase due to the lack of maximum time for learning

activities. However, if we look at the characteristics of the PMRI approach, learning using the PMRI approach should be able to enable students to think creatively.

This creative thinking can be influenced by several factors, one of which is study time. Mathematics teaching and learning activities in the morning can improve students' ability to understand the material. This is in line with research Aziz & Ali (2019), who said there was an influence on students' learning outcomes by teaching and learning in the morning. Studying mathematics in the morning can influence students because the students' bodies are still fresh and fit, their brains are still fresh to understand the material, they still have good focus, and they are enthusiastic about understanding the lesson, they still have good focus, and they are more enthusiastic about understanding. lessons, and it is easier to understand the material presented compared to when studying mathematics when during the day the students are tired, lethargic, sluggish, bored, sleepy, hungry, and less focused on learning activities (Aziz & Ali, 2019; Revina, & Leung, 2021; Şanal, & Elmali, 2023). According to Lestari (2015), also stated that the conditions for studying mathematics in the morning are still fresh because not doing much activity can help students concentrate on studying mathematics, this makes students' results improve. So there is an influence of the PMRI approach implemented in the morning on creative thinking abilities.

The novelty of this study is that it introduces a new experiment of PMRI learning in the morning on students' creative thinking abilities. The study also provides empirical evidence of the positive impact of PMRI on students' creative thinking abilities, as measured by a validated test and observation. The study contributes to the literature on mathematics education and creative thinking by highlighting the role of PMRI in enhancing students' creative thinking abilities in the morning. The limitation of this study is that it only uses a posttest-only control design, which does not measure the pretest scores of the students. This may affect the validity and reliability of the results, as there may be differences in the initial levels of creative thinking abilities between the experimental and control groups. Future research may use a pretest-posttest control design, which can measure the changes in creative thinking abilities before and after the intervention.

CONCLUSION

From the research results, it shows that the results of the t test calculation using the SPSS application obtained a significance value of 0.00, which means a value of $0.00 < 0.05$, so there is an influence of Indonesia's realistic mathematics education approach on the creative thinking abilities of class VIII students at Lais State Middle School.

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