Creative thinking skill of students through realistic mathematics education approach

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Abstract. Creative thinking is one of the abilities students need to have because, with this ability, students can encounter every problem. However, not every student has this ability. This study aims to determine the effectiveness of using realistic mathematics learning approaches to improve students' creative thinking abilities. This research is quasi-experimental. This research was conducted in one of the junior high school in class VII. Researchers conducted two tests on students, namely pretest and posttest. Each time after teaching the teacher together, the researchers evaluate learning to improve students' abilities. The average result of the ability to think creatively at the pretest is 17.61. The average result of the ability to think creatively at the posttest is 30.09. Using the N-Gain test shows that realistic mathematics learning approaches are practical enough to increase students' creative thinking abilities.

1. Introduction

Creativity is a skill that plays a role in daily life, such as work, school, art, and coping the problem [1-6]. Rominger [1] have opinion that Creativity is a skill relevant in many contexts of everyday life. Weber [2] said that different creativity and thinking conceptualized as a very useful approach to apply solving everyday problems. In Vuong’s [3] research the focus is on the ability to revise initial misinterpretations in sentences with temporary syntactic ambiguity, so creativity is needed to explain the extent of this differences in executive control can contribute pretty good understanding of language. Agnoli [4] has opinion, measurement of creative behavior is a difficult to find, creativity is a complex and diverse construction. Boccia [5] argue that creativity is not only about exceptional realization, such as scientific discovery or artwork production, but also daily activities, such as finding new solutions and thinking away from the usual idea. Fink [6] explain neuroscientific studies in the field of creativity mainly focused on tasks drawing on basic verbal divergent thinking demands response to other types of creative behavior, involving more real-life creativity demands in the context of emotion regulation and well-being. Creativity cannot come just like that, need practice in developing alternative solution, authenticity in solving problems and generating solution to open problems [7,8]. To be able to solve open problems need to develop how to think creatively [9,10]. Creative thinking is a series of cognitive activities used by someone following particular object, problems, and conditions, or efforts to resolve specific issues or event based on capacity individual [11]. Another opinion suggest that the ability to think creatively mathematics is an ability in mathematics which includes fluency, flexibility, authenticity, and elaboration [12]. Four cognitive components of creativity (creative thinking) are assessed through: fluency (have many ideas in solving problems), flexibility (generation of various types of plans), originality (level unusual responses), and elaboration (enrichment of ideas) [13]. In this study,
researchers define that the ability to think creatively is ability to solve problems in term of fluency, flexibility, originality, an elaborative.

Creative thinking is one of the abilities that has not been considered in learning mathematics [14]. This can have an impact on the lack of students’ creative thinking skills. Siswono’s research results state that the level of creative thinking of junior high school students is still included in low creativity [15]. Results of preliminary tests of research conducted by Wijaya on 64 high school students in the city Semarang in 2018 is related to the ability to think creatively, showing a small proportion of students (±29%) who enter the criteria are very creative and creative [16]. Based on an interview with one of the teachers in the junior high school where the study was found that the level of critical thinking of students is still low. One reason is the input or students who enter the middle school come from the area around the middle school. Other interview results show that students are still having trouble with comparison material. Other studies are also consistent with the results of this interview [17]. Hamidah’s research results state that the use of a realistic approach to mathematics education (RME) can help students identify information and understand the meaning of a proper comparison [17].

RME is a teaching approach in mathematics which is developed in the Netherlands, this approach presents a realistic learning process [18-20]. The definition of RME is learning that utilizes concrete contextual and object problems for understand the concept of the problem that occurred [21]. According to Zulkardi, there are two important things that must be connected with reality and mathematics as human activities. First, mathematics must be relevant to everyday life situations. However, the word “realistic” not only shows the real world, but also indicates a real imaginable problem for students. Second, mathematics as a human activity is important to consider, because RME is an approach to learning mathematics that places students’ reality and environment as a starting point for teaching [22]. In this study, the RME approach is an approach that uses the real world or something that can be real imagined to understand and solve mathematical problems.

The results of research conducted by other researchers [23] show students' creative thinking abilities which uses learning by learning RME (Realistic Mathematics Education) is better than students who use conventional learning. Other research results are the implementation of realistic mathematics education assisted by Sketchpad Geometry in junior high schools can improve students' creative thinking abilities [24]. Other research findings provide information that there are cognitive differences the achievements of students who use RME and students who learn by using conventional learning [25]. Therefore, this study was conducted to find out whether using RME was effective to increase the junior high school students' creative thinking. Previous research has discussed the effectiveness of education depending on resources countries that tend to focus on fiscal and material resources [26]. Effectiveness in teaching is very diverse, one of which is effective learning is learning in accordance with the objectives of the program, conformity with students being taught, and in accordance with the context of the learning environment [27]. In another opinion that learning is said to be effective if it can achieve the minimum criteria for mastery learning [28]. In this study, the effectiveness of the RME approach in mathematics learning comparative material can be said to be effective if the average score of students' creative thinking abilities reaches 30. Research on increasing critical thinking using the RME approach is still rare, so researchers assume that this research needs to be done.

2. Method

This research is a quantitative study with a quasi-experimental research method. The form of design used is one group paired design. The design research in this research picture as in Table 1.

| Table 1. Design Research |
|--------------------------|
| R | O₁ | T | O₂ |

Explanation:
R : Randomization sampling
O₁ : Pretests
T : Treatment
O₂ : Posttest [28]
This research was conducted at Indramayu 1 Junior High School, in the even semester of the 2019/2020 school year. Sampling uses a purposive sampling method, while class selection for research is chosen by the teacher. Based on the provisions of the teacher, selected class VII.I with a total of 33 students as classes subjected to learning using the RME approach. Researchers have done treatment in class VII.I for three meetings. The data of this study were obtained from written test results in the form of question details. This description question is made based on indicators of the ability to think creatively to be measured and adjusted to the subject of comparison. Before the questions are given to students, pretest and posttest questions, this instrument is first examined by an expert validator / consultant in this case a team of researchers who have become experts in mathematics education. Furthermore, to check the validity, the reliability of the questions to be tested was carried out empirical tests in class VIII.A at the school where the study with a total of 33 students. Based on the calculation of the product moment correlation test obtained 6 valid items out of 6 items tested with the results of one high criteria, four medium criteria, and one low criteria. Problems with a low level of validity are then not used in the matter of pretest and posttest. The results of the reliability coefficient of the instrument (r11) of 0.430, so the reliability of this instrument is classified as moderate. After obtaining an instrument declared valid and reliable, then this instrument is then given to the experimental class as a matter of pretest and posttest to see whether the Realistic Mathematics Education (RME) approach is effective in increasing students’ creative thinking abilities. To calculate the increase in the value of the pretest against the posttest value using the n-Gain test. The n-gain test formula proposed by Hake [29].

\[ G = \frac{S_{post} - S_{pre}}{N_{max} - S_{pre}} \]

Next, in Table 2 is the category of increase using N-Gain [29]:

| Criteria   | Interval       |
|------------|----------------|
| High       | \( G \geq 0.7 \) |
| Medium     | \( 0.3 \leq G < 0.7 \) |
| Low        | \( G < 0.3 \)   |

Based on Table 2, the increase in students’ creative thinking ability can be categorized high if the N-Gain score is greater than 0.7. Categorized as intermediate if the N-Gain score is greater than equal to 0.3 and smaller than 0.7, and categorized as low if the N-Gain score is smaller than 0.3. In this study data analysis using SPSS to determine the effectiveness of increased learning using the RME approach.

3. Result and Discussion

Based on research that has been done, data obtained from the results of the pretest and posttest can be seen in Table 3.

| Test   | Lowest Score | Highest Score | Mean  | Variance  | Standard Deviation |
|--------|--------------|---------------|-------|-----------|--------------------|
| Pretest| 12           | 28            | 17.61 | 14,371    | 3,791              |
| Posttest| 22          | 37            | 30.09 | 19,648    | 4,433              |

Table 3 shows that it can be seen that the average pretest and posttest scores of students are different. It can be seen that the score of students’ creative thinking at posttest is better than pretest. This can be seen also from the lowest score and the highest score. However, the trial was carried out to continue, namely the effectiveness test and the N-Gain test. Before the effectiveness test is done, the normality test is done first. Based on data analysis using SPSS, the normality test results are as follows.
Based on the Table 4, the normality test with Lilliefors analysis at level $\alpha = 0.05$ the result of score pretest and posttest indicate class VII. I normally distributed. This can be seen from the value of $\text{sig } \alpha = 0.101 \geq 0.05$ in pretest and $\text{sig } \alpha = 0.115 \geq 0.05$ in posttest. Furthermore, the effectiveness of the RME approach will be tested in studying comparative material. Test the effectiveness conducted with the One sample t test. Researchers used the one sample t test because in this study the score of students' creative thinking abilities could be said to be effective if the average score of students' creative thinking abilities exceeded 30 or 75% of the maximum score. The results of the effectiveness of the RME approach can be seen in Table 5.

### Table 5. The Results of One-Sample Test

| Result | t  | df | Sig. (2-tailed) | Mean | 95% Confidence Interval of the Difference | Lower  | Upper |
|--------|----|----|----------------|------|------------------------------------------|--------|-------|
| posttest | .118 | 32 | .907 | .091 | -1.48 | 1.66 |

Interpretation of Table 5 for reading the output the test process one sample comparison through the following steps. The form of the one sample comparative test hypothesis on this research is $H_0 = \mu - 30 = 0$ and $H_a = \mu - 30 > 0$. The right formulation for this test is test two parties with an error level of 0.05 or 5%. Analysis of the results: the output shows $\text{sig } \alpha = 0.907 = 90.7\% > 5\%$. This means accept $H_0$, in other words, the use of RME is less effective in learning comparative material. Next will be discussed about the N-gain test.

### Table 6. The Results of N-Gain Test

| Calculation | Statistic |
|-------------|-----------|
| Mean        | .5619     |
| Median      | .5789     |
| Variance    | .030      |
| Std. Deviation | .17335 |

Based on Table 6, it can be seen that the mean of N-Gain is 0.5619. Median score is 0.5789. Variance or lots of data deviating from the mean is 0.03. Based on Table 2 about category of increase using N-Gain which is compared to Table 6. The improvement of students’ creative thinking ability is in the medium criteria.

Some of the deficient of this research is related to not good increase caused by several things. This can be attributed to some observers' notes. In this study, the observer is a mathematics teacher who usually teaches class VII.I. The following will display some notes from the observer.
At the first meeting, it can be seen in Figure 1 that the researcher got two comments from the observer. Based on these comments, the researcher repairing on the next meeting by attention to writing symbols, writing clearly the problem, writing the formula before answering and managing time so that all material can be received and concluding the result of discussion at the end of the meeting. Then at the second meeting, researchers also received comments from observers.

In Figure 2 can be seen that researchers received many comments. The response of these comments is (a) preferably before teaching giving apperception so that students are enthusiastic in learning, (b) the researcher and students together conclude the material that has been discussed, (c) the researcher does not give a test at the end of the second meeting because it will give a final test, and (d) the researcher will convey further material before leaving the class. Next the observers' observations will be conveyed at the third meeting.

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Figure 3 explains about the result of the third meeting, there was only one comment from the observer, that is the classroom conditioning at the beginning of class time. But this can be overcome immediately and learning can take so on. The results of this study are in line with Muhtadi's research, that the use of the RME approach can improve students' creative thinking abilities and independence [30]. Other studies also argued, a valid, practical and effective RME can develop junior high school students' mathematical creative thinking ability [31]. Other research results also state that the use of the RME approach can improve students' creative thinking abilities [32].

4. Conclusion
The initial conditioning in learning using the RME approach and the exposure of conclusions still needs to be corrected. However, with these deficiencies, students can still reach the minimum standard of creative thinking ability targeted by researchers. The researcher concludes that learning using the RME approach is sufficiently effective to improve students' creative thinking.

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