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The Influence of Discovery Learning with Scientific Approach on Students' Creative Thinking Ability

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Abstract. This research was a pre-experimental study with a One Group Pretest-Posttest Design. The experimental samples in this study were students of class VIII₅ in SMP Negeri 29 Makassar. The purpose of this study was to determine the description of students' creative thinking abilities if discovery learning with a scientific approach was applied in the classroom. The data in this research were obtained using a test instrument about mathematical creative thinking. The results showed that the students' creative thinking ability in mathematics generally was at level 3, namely creative. While for fluent and flexible indicators, respectively were at level 2 which was quite creative and level 3 which was creative. It showed an increase in students' creative thinking abilities if discovery learning with a scientific approach was applied.

Keywords: Discovery Learning, Scientific Approach, Creative Thinking Ability, Mathematics

1. Introduction

The 2013 curriculum that is currently used in Indonesia requires the creativity of teacher in providing teaching [1]. Since introduced in 2013 until now, the 2013 curriculum has continued to experience improvements in accordance with the development of education and technology. The implementation of the 2013 Curriculum is expected to produce human resources which are productive, creative, innovative, and effective through strengthening the competence of attitudes, knowledge and skills [2]. The use of the 2013 curriculum requires teachers to use a scientific approach in all subjects including mathematics so that the learning can be optimal [3]. In general, the scientific approach is composed of several sequential activity steps, including observing, asking questions, gathering information, conducting experiments, processing data, and communicating results [4]. The scientific approach has high effectiveness in improving the student learning outcomes in each cognitive aspect such as knowledge, understanding, and application so that it can hone students' creative thinking skills [5]. The scientific approach is also able to facilitate students to construct their own knowledge or concepts [6]. However, in reality there are still many teachers who do not apply a scientific approach in their learning [7]. Teachers tend to teach using direct teaching so that students depend on the teacher. It causes the lack of students' creative thinking skills, especially in solving math problems [8]. This is also in line with [100] which states that the low of student creative thinking ability is due to teacher-centered learning, students tend to be passive in receiving lessons, and a lack of responsibility in students.



The learning model that can be applied to improve students' creative thinking skills is the discovery learning model [9]. According to [10] discovery learning is a mental process where students are able to assimilate a concept or principle. The meaning of mental processes are observing, digesting, understanding, classifying, making assumptions, explaining, measuring, making conclusions, and so on. In Discovery learning, students are expected to be able to organize their own problems [11]. By using discovery learning, the teacher can direct students to solve mathematical problems. Another benefits of discovery learning are students can understand concepts well, learning situations are more conducive and active, and students' creativity can be more honed [11]. That is why the researchers suspect that discovery learning with a scientific approach can improve students' creative thinking abilities.

Discovery learning that is used by researchers in conducting this research is the teacher acts as a guide by providing opportunities for students to learn actively. In Discovery Learning, teaching materials are not presented in the final form, but students are required to carry out various activities to collect information, compare, categorize, analyze, integrate, reorganize materials and make conclusions. Discovery Learning emphasizes the discovery of concepts or principles which are unknown previously. So students must exert all their thoughts and skills to find mathematical problem solutions through the analysis process. In Discovery Learning, the researcher uses a scientific approach hopefully that students can better understand the taught material so that students' creative thinking skills can be more honed.

2. Methodology

This research is a pre-experimental study using one treatment group without a control class. In this study the authors used Discovery Learning with a scientific approach to see students' creative thinking. Before being given treatment, the experimental class was first given a pretest, after that it was given treatment to see the posttest learning outcomes. This research design uses pretest posttest control group design which can be seen in Figure 1, where O_1 is a pretest for students' creative thinking tests before being given treatment, X is a treatment in the form of implementation of discovery learning with a scientific approach, and O_2 is a post test in the form of students' mathematics creative thinking test after being given treatment. The population in this study were all students of class VIII SMP Negeri 29 Makassar, while the sample of the study was students in the class VIII₅ based on the mathematics teacher's recommendation. According to the teacher, they had the best mathematics scores among the other classes.



Figure 1. Design's Frame

This study used an instrument in the form of mathematics creative thinking ability test. The questions used have been validated by experts and declared fit for use. The data that has been obtained is then processed by calculating the Gain Score [12]. The gain index is calculated by the gain index formula, namely:

$$g = \frac{\text{posttest score} - \text{pretest score}}{\text{ideal score} - \text{pretest score}}$$

For normalized gain classification can be seen in table 1 below.

Table 1. Normalized Gain Classification

Gain Normalized Coefficients	Classifications
$g < 0,3$	Low

$$0,3 \leq g < 0,7$$

$$g \geq 0,7$$

Middle
High

The creative thinking criteria used in this study used the level of mathematical creative thinking results of research conducted by [13] which can be seen in table 2. The level of students' creative thinking based on the scores obtained can be seen in table 3. The scoring rubric for creative mathematical thinking used is in accordance with [14] which can be seen in Table 4.

Table 2 Level of creative thinking in mathematics

TBKM	Information
Level 4 (Very Creative)	Students are able to solve a problem with more than one alternative answer or different solutions smoothly and flexibly or students are only able to get one new answer (not usually made by students at the general thinking level) but can solve it in various ways (flexible). Students tend to say that finding another way is more difficult than finding another answer.
Level 3 (Creative)	Students are able to make a new answer, but cannot arrange different (flexible) ways to get it or students can arrange different (flexible) ways to get various answers, even though the answer is not new. In addition, students can make different problems smoothly even though the problem-solving method is single or can make various problems with different solutions, even though the problem is not new
Level 2 (Creative Enough)	Students are able to make one answer or make problems that are different from the usual habit., although not flexible or fluent, or students are able to arrange different solutions even though they are not fluent in answering or making problems and the resulting answers are not new
Level 1 (Less Creative)	Students are able to answer or make various problems (fluent), but unable to make answers or make different problems (new), and cannot solve problems in different ways (flexible)
Level 0 (Not Creative)	Students are not able to make alternative answers or solutions or make different problems fluently (fluently) and flexibly. Errors in solving a problem are caused because the concepts related to the problem are not understood or remembered correctly

Table 3. Guidelines for TBKM level based on Siswono (2008)

Score	Level
$80 < N \leq 100$	Level 4 (Very Creative)
$60 < N \leq 80$	Level 3 (Creative)
$40 < N \leq 60$	Level 2 (Enough Creative)
$20 < N \leq 40$	Level 1 (Less Creative)
$0 < N \leq 20$	Level 0 (Not Creative)

Table 4. Mathematical creative thinking

Aspects assessed	Remarks	Score
<i>Fluent</i>	Does not answer or give ideas (using one concept and more than one answer) that are not relevant for problem solving	0
	Provides an idea that is relevant to problem solving but expresses it less clearly	1
	Provides an idea that is relevant to problem solving and completely and clearly	2
	Provides more than one idea that is relevant to problem solving and its expression is less clear	3
	Providing more than one idea that is relevant to problem solving, the disclosure is complete and clear and fast	4
<i>flexible</i>	Does not answer or provide answers in one or more ways but all are wrong	0
	Providing answers only one way and there are errors in the calculation process until the result is wrong	1
	Providing answers in one way the calculation process and the results are correct	2
	Provides answers in more than one way (various) but the results are wrong because there are errors in the calculation processes	3
	Giving answers in more than one-way (various) calculation process, the result is correct and fast	4

3. Results and Discussion

3.1 Description of Learning

The application of discovery learning with a scientific approach to the ability to think creatively in mathematics learning in students at SMP Negeri 29 Makassar emphasizes the findings made by students themselves through guidance from the teacher, in this case the researcher. Discovery learning also invites students to become scientific so that in this learning the scientific approach is used, this approach is used to help students better understand the material being taught. Thus students will know automatically the subject matter of the material being taught. The discussion of the material was carried out in 5 meetings.

The results of observations on the implementation of discovery learning with a scientific approach to students' creative thinking abilities showed an increase in each meeting. This is because at the end of each meeting, the teacher (researcher) looks at the data from the observations of each meeting so that it is possible to improve the implementation of the learning given at the next meeting. At the beginning of the meeting, the teacher (researcher) experienced difficulties, this was due to conventional learning that was often used by the school teacher, but the researcher still guided students to be consistent with

the learning given. This can be seen in every learning step given the students always ask questions and many of the students say "can you give us an example". However, the teacher still tries to direct students to find their own solutions to the problems given based on the discovery learning steps. So that at the following meetings students begin to get used to it and begin to study independently and discuss the material being studied with their friends. Some students have been able to master and understand the stages of the learning model process given, so that the learning atmosphere is better and orderly.

Discovery learning with a scientific approach went well in the middle of the 2nd meeting, at the first meeting most students had difficulty adjusting the learning given, the stage that confused students was the 3rd stage, namely information gathering where this stage aims to prove whether it is true or not. what they conclude, in this case the researcher helps students by repeating these stages and providing justification for what students have previously obtained. During the learning process, questions that arise from students are not directly answered by the teacher, but the teacher provides feedback that leads students to explore the initial concepts that students have previously had. This method is an effort to involve students optimally in building their own knowledge. Activities carried out by the teacher in the implementation of learning with the given learning are no longer just the delivery of knowledge (knowledge transfer) from the teacher to the students. The teacher no longer acts as the main source of students in learning but the teacher plays a role in facilitating, guiding, and motivating students in constructing their knowledge and being able to interact positively with other students.

The obstacles experienced in this study are the limitations of existing lesson hours. The learning that is given requires more time, especially in the fourth stage, namely data processing, this is because searching for information is very minimal, limited books, and internet limitations are not good enough at the school. Teachers need more time to guide and direct students at the data processing stage. To overcome this, the teacher provides additional time, so that the steps taken by the teacher sometimes provide assignments or homework that are similar to the sub-subjects being taught, so that students are freer to collect more information. This method is quite effective in overcoming the limited time available without neglecting the needs of students in the material being taught.

3.2 Results of Data Analysis and Clearance

Based on the results of the pretest, the value of students' creative thinking abilities in mathematics for each indicator is presented in Table 5

Table 5 Results of mathematical creative thinking ability pretest

creative thinking math indicators measured	average score	Average score	category level
Smoothness/fluent	1,47	18,13	Level 0 (Not Creative)
Dexterity/Fluent/flexible	1,25	31,25	Level 1 (Less Creative)

In the initial ability of students to think creatively as seen from the pretest, it shows that the indicator fluent shows the average score of 1.47 with a value of 18.13 which is at level 0 (not creative), i.e. students are not able to make alternative answers or solutions or create problems. different from fluently, the error in solving a problem is caused because the concept related to the problem is not understood or remembered correctly. Then on the indicator flexible obtained a score of 1.25 with a value of 31.25 which is at level 1 (less creative), namely students are able to answer or make various problems (fluent), but are unable to make answers or make different problems (new), and can't solve the problem in different ways.

After doing discovery learning with a scientific approach, the researcher gave a test at the end of learning about the ability to think creatively. Following are the posttest results for creative thinking in Table 6.

Table 6 Results of mathematical creative thinking ability *posttest*

Creative thinking indicators	mathematical indicators measured	Average Score	Average Score	Category Level
<i>Fluent</i>		3,83	47,88	Level 2 (Creative Enough)
<i>Flexible</i>		2,79	69,75	Level 3 (Creative)

In Table 6 obtained mathematics creative thinking ability of students to posttest on indicators smoothness /*fluent* showed an average score of 3.83 with a value of 47.88 students who are at level 2 (quite creative) that students are able to make a reply or create a different problem from the general habit, although not flexible or fluent, or students are able to arrange a variety of different solutions even though they are not fluent in answering or making problems and the resulting answers are not new. Whereas on the indicator of flexibility /*fluency/flexible* , the average score is 2.79 with a value of 69.75 which is at level 3 (creative), namely students are able to make a new answer, but cannot arrange a different (flexible) way to get it or students can arrange different (flexible) ways to get a variety of answers, even though the answers are not new. In addition, students can make different problems smoothly even though the way of solving the problem is single or can make various problems with different ways of solving, even though the problem is not new. Related to the improvement of students' mathematical creative thinking skills in grade VIII SMP Negeri 29 Makassar using N-Gain can be seen in Table 7.

Table 7. The results of the N-Gain categorization of students

Interval	Category	Frequency Creative	Thinking Ability Percentage (%)
$g \leq 0,3$	Low	6	25
$0,3 < g < 0,7$	Medium	18	75
$g \geq 0,7$	High	0	0

Based on table 7, it can be seen that out of 24 students, 6 students or 25% of students' creative thinking abilities in mathematics are in the low category and 18 or 75% of students are in the moderate category. However, overall N-Gain is an average of mathematical creative thinking skills. students are 0.42 which is in the medium category.

In general, students' creative thinking skills in mathematics are 6.63 with a value of 55.21 which is at level 3, namely creative and the impact of discovery learning with a scientific approach, namely increasing the creative thinking skills of students who are in the moderate category, this is shown by N-gain. students' creative thinking mathematics 0.42. Based on the research that has been carried out, the researcher can conclude that discovery learning with a scientific approach can make students' creative thinking abilities better.

4. Conclusions

Based on the research results it can be concluded that discovery learning with a scientific approach has a good and positive impact on the creative thinking abilities of grade VIII students of SMP Negeri 29 Makassar. This can be seen from the average score of the creative thinking ability of mathematics, which was initially at level 1, which is less creative, then changes to level 3, which is creative after being given treatment. When viewed from each indicator, the average score of the ability to think creatively in mathematics on the indicators of fluency is initially at level 0, which is not creative, but after being given treatment it changes to level 2, which is quite creative. While the average score of students' mathematical creative thinking ability on the flexibility / flexible indicator initially was at level 1, which was less creative, but after being given treatment it changed to level 3, which was creative. This is also supported by the N Gain value which is in the medium category.

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