IMPROVING STUDENTS’ MATHEMATICAL CREATIVE THINKING ABILITY AND MOTIVATION THROUGH PROBLEM-BASED LEARNING MODEL

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This study aims to determine the mathematical creative thinking ability of students after being taught with the Problem Based Learning (PBL) learning model. This research is a quasi-experimental research that compares two learning models, namely, the problem-based learning model and the conventional learning model, and is designed as follows: (i) a research sample of 60 students was selected as the research sample, and (ii) the data from the research test of students’ mathematical creativity ability was carried out 2 (two), namely pretests (before learning) and posttests (after learning). From the results of the research, it can be concluded that the average pretest score of mathematical problem solving ability also increased in the control class, especially for fluency indicators, but from the average of the two classes, the average in the experimental class was higher than the control, which was 53.33%. The average N-gain of creative thinking abilities of students taught with PBM was 0.48 and in students teaching with conventional learning. It was known that the increase in student motivation that obtains a PBM is higher than those whose learning uses ordinary learning. Therefore, it is important for schools to socialize PBM to be applied in the learning process so that it can improve students' mathematics skills, especially the ability to think creatively mathematically and student learning motivation.

INTRODUCTION

The Ministry of National Education formulates that mathematics is the fruit of human thought whose truth is general or deductive and does not depend on the scientific method that contains inductive processes. Mathematical truths are universal according to their universe (Khoiriyah, 2018; Sfard, 2021). Mathematics has advantages compared to verbal language (Irawan & Febriyanti, 2016; Prochazkova, 2021). Mathematics is able to develop a numerical language that allows people to make measurements quantitatively (Buyung & Burhanuddin, 2023; Resnick, 2020).

In Permendiknas Number 22 of 2006 concerning Competency Standards and Basic Competencies of the 2006 Curriculum, it is stated that mathematics needs to be given to all students starting from elementary school to equip students with logical, analytical, systematic, critical, and creative thinking skills as well as the ability to work together. The importance of developing creativity in mathematics is also found in the 2013 Curriculum. The 2013 curriculum is one of the paradigm changes in learning from conventional learning to one that activates students and trains students' creative thinking skills (Cintia et al., 2018; Saputri & Febriani, 2017). Creative thinking is an important factors of learning objectives because merely providing students with knowledge
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will not help them much in everyday life (Rasnawati et al., 2019; Sopiah et al., 2020). Hence, learning should be able to develop students' attitudes and abilities that can help to face future problems creatively (Ardeniyansah & Rosnawati, 2018; Kim & Lee, 2022).

Creative thinking is a thought process that produces a wide variety of possible answers (Purwaningsih & Supriyono, 2020). Creativity is one of the main parts of learning mathematics, because the essence of mathematics is creative thinking (Hadar & Tirosh, 2019; Sitorus & Masrayati, 2016). Creative thinking is one of the important thinking skills and is needed by students to face problems in the learning process (Mahanal & Zubaidah, 2017). It contains aspects of cognitive and metacognitive skills including identifying problems, structuring questions, identifying relevant and irrelevant data, productive, generating many different ideas and new products or ideas and containing dispositions (Ulger, 2018; Wahyudi et al., 2021). The characteristics are defined by being open, daring to take a position, acting quickly, behaving or taking the view that something is part of a complex whole, utilizing other people's critical ways of thinking, and a sensitive attitude towards the feelings of others (Soeviatulfitri & Kashardi, 2020).

In addition to students' creative thinking abilities, another factor that affects the improvement of student learning outcomes is the learning motivation that exists in students. Learning motivation is the drive that occurs in a person to carry out learning activities so that they have the desire to learn and achieve learning goals by obtaining higher learning achievement (Middleton & Spanias, 1999; Silalahi et al., 2022). Motivation affects the rate of learning success or failure and in general learning without motivation will be difficult to succeed (Cook & Artino, 2016). Therefore, learning must be adjusted to the needs, drives, motives, interests possessed by students. The use of motivation in teaching not only complements the elements of learning, but also a factor that determines effective learning (Deci et al., 1991; Yu et al., 2021). There are several motivational functions in learning, namely providing strength in learning power, giving a clear learning direction, being able to overcome obstacles, realizing independent learning, encouraging continuous learning, fostering the desire to excel and improving the quality of learning (Marbun, 2021).

Motivation in learning serves as a driver of learning activities in achieving optimal learning outcomes. Motivation provides encouragement and direction in the activities carried out to be in accordance with the formulation of the goal (Dörnyei, 2000). Many factors affect student learning motivation. Thus, the motivation to learn in students is strongly influenced by stimuli from outside themselves and the will that arises in themselves. Learning motivation that comes from outside itself will have a major influence on the emergence of intrinsic motivation in students (Larson & Rusk, 2011). This shows that the importance of cultivating students' mathematical creative thinking skills and motivation through creative activities in mathematics learning.

In fact, the application of learning in Indonesia has not encouraged students to think creatively, because students are still fixated on the material or concepts in the book and are still glued to educators, so they cannot develop properly. Most schools do not encourage learners to expand their thinking by creating new ideas and rethinking existing conclusions (Ginting et al.,
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2019). As a result, the creative thinking ability of elementary level students is still relatively low because they are only fixated on educators.

Based on the results of TIMSS, it is stated that the level of creative thinking ability of Indonesian students is relatively low because only 2% of Indonesian students can do high and advanced category questions that require creative thinking skills in solving them. The results of the study are evidence that students' creative thinking skills are low.

The questions tested in TIMSS refer directly to the mastery of topics in the school curriculum such as Algebra, SPLDV, Geometry, Measurement in complex situations, and Arithmetic and their application in everyday life. While PISA is more focused on mathematical literacy which is shown by the ability and expertise of students in using the mathematics they learn to solve problems in everyday life. Learners' mathematics learning difficulties should be overcome as early as possible because almost all fields of study require appropriate mathematics. One of the causes of low creative thinking ability and student motivation is influenced by the learning model used by teachers.

The learning that has been used by the teacher has not been able to activate students in learning, motivate students to express their ideas and opinions, and even students are still reluctant to ask the teacher if they do not understand the material presented by the teacher. In addition, teachers are always pursued by time targets to complete each subject without paying attention to the competence of their students as a result of which meaningful learning that is expected does not occur.

One of the creative, innovative and effective learning in improving students' problem-solving skills is problem-based learning (PBL). Problem-based learning applies constructivism theory, this can be seen as an active process, providing opportunities for students and teachers to take part in working together to construct Donnely's knowledge. Problem-based learning can improve students' memory in the long run (Marbun, 2022).

Problem-based learning (PBL) essentially presents students with authentic and meaningful problem situations, which can serve as a foundation for student investigation or investigation (Marbun, 2022). PBL refers to 5 main steps, namely student orientation to problems, organizing students to learn, guiding individuals and groups, developing and presenting work, and analyzing and evaluating the problem solving process. Based on the description above, it is clear that learning with the PBM model begins with a problem, then students deepen their knowledge of what they already know and what they need to know to solve the problem.

Based on the description above, the author is interested in conducting research on improving the ability to think creatively mathematically and motivation of junior high school students through problem-based learning. Researchers wanted to find out whether the increase in mathematical creative thinking ability of students who obtained problem-based learning models was higher than students who obtained conventional learning and whether the increase in motivation of students who obtained problem-based learning models was higher than students who obtained conventional learning. This research is expected to be input material for students to be actively involved in learning, trained to carry out the process of constructing their own knowledge so that there is an
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increase in student mathematical communication, input materials and knowledge provisions for researchers as teachers in teaching mathematics in the future, as well as input and comparison materials for other researchers who want to study similar topic.

METHOD

This research is a quasi-experimental research that compares two learning models, namely the problem-based learning model and the conventional learning model. This study aims to see how to increase the ability to think creatively mathematically and motivate students through the Problem Based Learning (PBL) model and is designed as follows:

1) Conduct pre-tests on students.
2) Conduct learning with the same material in the sample class, namely classes that are given learning using the LKS-assisted Problem Based Learning (PBL) model.
3) Conduct the final test (Post-test) on students. This test aims to determine the mathematical creative thinking ability of students after being taught with the Problem Based Learning (PBL) model.

In this design there are two randomly selected groups that are used as experimental classes and control classes, as in the following table shows the research design to be carried out as follows:

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Treatment</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experiment</td>
<td>O1</td>
<td>X</td>
<td>O2</td>
</tr>
<tr>
<td>Control</td>
<td>O1</td>
<td>O2</td>
<td></td>
</tr>
</tbody>
</table>

Information:

O1 = Pretest
O2 = Posttest
X = Treatment in the form of learning with PBM

This research was conducted at SMP Negeri 1 Siantar. The reason for choosing the location of this study is because similar research had never been carried out at the school. From the 5 existing classes, a draw was made with the numbering of each class. So that 2 classes were selected as a research sample, namely 60 students. Thus, the group sampling technique was carried out randomly (Cluster random sampling). The random selection stage was possible because based on information from the principal and teachers, the distribution of students in each class is evenly distributed heterogeneously.

The instrument used to obtain the data needed in this study is a test. The attitude scale model used is the Likert attitude scale model. For data analysis, researchers used normality tests, homogeneity tests, and hypothesis tests.
RESULT AND DISCUSSION

Description of Creative Thinking Ability Test Results

Students’ creative thinking ability is the ability of students to be fluent in understanding problems, flexibility, originality and elaboration. The data from the research test of students' creative thinking ability was carried out 2 (two) times, namely pretests (before learning) and postes (after learning). For the test of students' creative thinking ability consists of 4 points of the same questions both pretest and postes (pretest and postes are the same). After scoring based on problem solving indicators on pretests and postes, an average score per indicator was obtained in each lesson. For more details will be presented in the following table.

Table 2. PBM Group Critical Thinking Ability Test Results and Usual Approach

<table>
<thead>
<tr>
<th>No</th>
<th>Indicator</th>
<th>Average Troubleshooting</th>
<th>PBL</th>
<th>Post</th>
<th>PBL</th>
<th>Post</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Pretest</td>
<td>Postes</td>
<td>Pretest</td>
<td>Postes</td>
</tr>
<tr>
<td>1</td>
<td>Kelancaran (Fluency)</td>
<td>5</td>
<td>11.4</td>
<td>5.266</td>
<td>8.931</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Flexibility</td>
<td>2,133</td>
<td>5,33</td>
<td>1,733</td>
<td>3,310</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Original</td>
<td>1,56</td>
<td>6.433</td>
<td>1,2</td>
<td>4,034</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Processing</td>
<td>2</td>
<td>4,3</td>
<td>1,3</td>
<td></td>
<td>3</td>
</tr>
</tbody>
</table>

From the table above, it appears that from the pretests obtained the highest average of 5 for the smoothness indicator, the lowest average of 1.56 for the Original indicator. As for postes, the highest average was obtained 11.4 for the smoothness indicator, the lowest average elaboration was 5.33. In this experimental class, the average score of the pretest and postes creative thinking ability test when compared to the maximum score is quite different, especially on the fluency indicator. So when viewed from the average score, it can be seen that the average score of postes is higher than the average pretest score for each indicator, especially on the fluency indicator.

In addition to the above from Table 2 it also appears that from the pretest obtained the highest average of 5.266 for the smoothness indicator, the lowest average of 1.2 for the original indicator. While the highest average postes 8.931 for the smoothness indicator and the lowest average 3 for the elaboration indicator. So it can be concluded that the average score of mathematical problem solving ability also increased in the control class, especially for fluency indicators, but from the average of the two classes, the average in the experimental class was higher than in the control class.

After processing pretest data, postes and N-Gain creative thinking skills, an average score (X average) and standard deviation (SD) of N-Gain were obtained. For more details, the following is described.
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Table 3. Average Gain of Creative Thinking Ability of PBM Group and PB Group

<table>
<thead>
<tr>
<th>Learning</th>
<th>Creative Thinking Ability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
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<td></td>
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</tbody>
</table>

In the table above, it can be seen that the highest value of N-gain in the experimental class was 0.7048 and in the control class was 0.2147. As for the average N-gain value of the experimental class of 1.4493 and the control class of 0.876. So the average N-gain of the experimental class was higher than the average N-gain in the control class. From this gain, the average difference in N-gain between the experimental class and the control class was 0.5733. Table 4.2 also shows that the standard deviation value for the experimental class is higher than the standard deviation for the control class, which is 0.5206 in the experimental class and 0.3137 in the control class.

Description of Student Learning Motivation on Learning

Student motivation was measured after being given treatment. Motivation scale questionnaires were given to the experimental class and the control class, respectively. In the experimental class, the motivation scale questionnaire was attended by 30 students and in the control class, it was attended by 30 people. The size of the central symptom and variations in data on student motivation in experimental and control classes can be seen in the following table.

Table 4. Statistical Data on Student Motivation in the Experimental and Control Classes

<table>
<thead>
<tr>
<th>Types of Capabilities</th>
<th>Score</th>
<th>Experimental Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Ideal</td>
<td>( X_{\min} )</td>
<td>( X_{\max} )</td>
</tr>
<tr>
<td>Motivation</td>
<td>80</td>
<td>49</td>
<td>74</td>
</tr>
</tbody>
</table>

From the table above, it can be concluded that the average motivation of students in the experimental class and the control class is different, the average motivation of the experimental class is 60.87 and the control class is 56.93.

When considered, the average motivation score of students in the experiment was higher than that of the control class with a difference of 3.94. This indicates that the motivation of students in
the experimental class towards learning mathematics is better than the motivation of students in the control class. If a student's motivation score is greater than 58, then the student belongs to the category of students who have positive motivation. If the student's motivation score is lower than 58 then the student belongs to the category of students who have negative motivation. Based on these categories, in the control class, 16 students had positive motivation and 14 students had negative motivation.

<table>
<thead>
<tr>
<th>Table 5. Percentage of Experimental Class Motivation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 6. Percentage of Control Class Motivation Category</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

From Table 5 and Table 6 above, it can be concluded that students' positive learning motivation towards mathematics was more in the experimental class, which was 63.33% compared to the control class, which was 53.33%. While negative learning motivation was more in the control class, which was 44.67% compared to the experimental class, which was 36.67%.

Mathematical Creative Thinking Ability

The ability to think creatively is an effort by someone to solve mathematical problems by involving thinking and reasoning skills and using the knowledge they already have which in the process of finding these answers include fluency, flexibility, and originality.

From the results of the study, it was found that the average pretest score of creative thinking ability of students who obtained PBL was 8.53 and in students who obtained conventional learning amounted to 8.20 then after learning was carried out postest, and the average results of the postest score of creative thinking ability of students taught with PBL amounted to 23.40 and postest results taught with conventional learning amounted to 16.27. Then the N-gain of creative thinking ability of students taught with PBL was 0.48 and in students taught with conventional learning 0.20, from the results of N-gain it was known that the increase in creative thinking of students taught with the PBL approach was higher than students taught with conventional learning.

Based on testing using the t test, mathematical problem solving ability with a significant value (sig) $\alpha = 0.000$ was obtained. Since the level of significant value of creative thinking ability is smaller than $\alpha = 0.05$, it can be concluded that the increase in creative thinking ability of students taught with the PBM model is higher than there are students taught with conventional learning.
Student Learning Motivation

Learning motivation relates to how students solve mathematical problems. It requires confidence, diligence, interest, and flexible thinking to explore various problem-solving alternatives. In the context of learning, learning motivation is concerned with how students ask, answer questions, communicate mathematical ideas, work in groups, and solve problems. From the results of the study, it was found that the average learning motivation score carried out on the group of students who obtained a problem-based learning model was 60.87 and students who obtained a conventional learning model was 56.93.

Based on testing using two-track ANOVA, learning motivation was obtained with F count on learning factors (PBL and Conventional Learning) is 5.270 significant values (sig) α = 0.026. Because the significance value level < 0.05 (0.026< 0.05), so that H0 which states that there is no increase is rejected. Based on the results of the study, it can be concluded that there is an increase in student motivation that obtains a problem-based learning model higher than conventional learning.

CONCLUSION

Increased mathematical creative thinking ability of students whose learning uses PBL is higher than those whose learning uses conventional learning. The highest indicator of creative thinking ability in PBL learning occurs in the fluency indicator. Increased learning motivation of students whose learning uses PBM is higher than those whose learning uses ordinary conventional learning.

To support the success of PBL implementation, more interesting teaching materials are needed designed based on contextual problems which are the initial requirements that must be met as an opening to the learning process in order to be able to generate student stimulus in the learning process implemented. For further research, this research should be completed by examining other aspects in detail that have not been reached at this time, such as mathematical disposition factors and student learning interests. For schools to socialize PBL to be applied in the learning process so that it can improve students' mathematical skills, especially the ability to think creatively mathematically and student learning motivation.

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