ANALYSIS OF STUDENTS’ DIFFICULTIES IN MATHEMATICAL CREATIVE THINKING ON PROBLEM-BASED LEARNING MODEL

Diana Sister, Edi Syahputra, Bornok Sinaga

Abstract: This study aims to analyze the level of students' creative thinking skills in the application of problem-based learning model. The subject of this study is seventh-grade students at SMP Al - Hikmah Medan. The object of this research is the level of students' mathematical creative thinking ability. The results show that the level of students' creative thinking ability on problem-based learning model from 32 students with 'very low' creative thinking ability is 13%, 'low' creative thinking ability is 6%, 'medium' creative thinking ability is 44%, 'high' creative thinking ability is 5%, and 'very high' creative thinking ability is 3%.

Index Terms: Analysis, Creative Thinking, Problem Based Learning

1 INTRODUCTION

Mathematics is a study of structure that includes connections, patterns, and shapes. Simply put, mathematics is about ideas, structures, and connections that are logically organized so mathematics is related to abstract concepts. In short, mathematics deals with abstract ideas or concepts that are strategically structured and deductive reasoning. This fact, of course, brings implications to the learning process. According to James [1], "mathematics is the science of logical study of shapes, arrangement, measure, many related concepts to the vast number of things divided into three areas: algebra, analysis, and geometry". In mathematics, materials learned are the basic sciences that develop whether in content and application. Thus, the teaching of mathematics in school is a catalyst in education and mathematics plays a vital role in everyday life. The learning process in the 2013 curriculum requires students to actively participate and provide sufficient space for students’ creativity, interests, and talents. Technology also became the main focus of the 2013 curriculum [2]. According to E.R. Hilgard [3], learning is a change in reaction to the environment. Changes in this scope include knowledge, skills, behaviors, and these are gained through experience. Therefore, teachers need to encourage students to use their skills in developing ideas. Education has always been a topic of discussion, whether among teachers, parents, and also educational professionals. It is reasonable because everyone concerned wants the best education for students, children or the next generation. Accordingly, math is one of the most important basic lessons learned by students as math will lead them to think creatively and thoroughly and can be beneficial to solve the problem in everyday life. According to Cornelius [4], there are five reasons the importance of learning mathematics as mathematics is a way of thinking, can solve problems in everyday life, can develop creativity and can increase awareness of cultural development. Creativity is one of the human’s amazing abilities to understand and deal with situations or problems differently from one another. Creative ability enables humans to bring together, connect or integrate unrelated facts, ideas, or things into a new idea or product that is useful for problem solving. Activity is closely related to the development of the individual's cognitive capacity because it is an embodiment of the development of the human brain. Nevertheless, based on the results of the assumption, it analyzes various possibilities supporting this intuitive conclusion. Wallas [5] argues that creativity is the creation of new generalizations or discoveries, or the expression of new ideas. There are several stages from the perspective of Wallas’ theory in his book "The Art of Thought." Wallas states that the creative process has four stages: preparation, incubation, illumination, and verification. The importance of creative thinking is expressed by [6] stating that “Students who are able to think creatively are able to solve problem effectively”. [7] expresses that the definition of thinking is very diverse, including (1) the activity of the mind to manage knowledge received through the senses and is purposed to seek the truth; (2) conscious use of the brain to discover, debate, consider, estimate, and reflect on particular subject; (3) activities involving concepts and symbols used as the substitution to objects or events; (4) speaking to the inner self by considering, reflecting, analyzing and discussing a reality using concepts or other meanings. [8] elaborates skills involved in creative thinking including cognitive skills of problems and opportunities identification, designing adequate and different problems, identifying relevant and irrelevant data, issues and productive opportunities; generating many ideas (fluency), different ideas (flexibility) and new products or ideas (originality), examining and evaluating the relationship between choices and alternatives, changing old behavior and thinking, forming new relationship, expanding and renewing plans or ideas. Affective skills embodied in creative thinking include experiencing problems and opportunities, tolerating uncertainty, understanding the environment and others’ creativity, open, bold, risking, self-control, curiosity, expressing and responding

- Diana Sister, State University Of Medan, Indonesia, E-mail: dianainwansyah10@gmail.com
- Prof. Dr. Edi Syahputra, M.Pd, State University Of Medan, Indonesia, E-mail: edisyahputra01.es@gmail.com
- Prof. Dr. Bornok Sinaga, M.Pd, State University Of Medan, Indonesia, E-mail: bornok.sinaga@yahoo.com
to feelings and emotions and anticipating something unpredictable. Whereas the metacognitive skills embodied in creative thinking include designing strategies, setting goals and decisions, predicting based on incomplete data, understanding creativity and things others do not understand, diagnosing incomplete information, constructing multiple judgments, controlling emotions and developing elaboration of problem solutions and plan.

[9] states “students may encounter difficulties in solving math problems. In mathematics learning there are three categories of difficulty that students encounter: (1) difficulty in using concepts, (2) difficulties in learning and applying principles, and (3) difficulties in learning verbal problems”. Hence, students’ difficulty in mathematical creative thinking is continuously connected with the understanding of mathematical objects, which are the difficulty in terms of facts, concepts, principles, and procedures. The fact difficulty is the inability to understand the presentation of the mathematical concept in words or symbols. The conceptual difficulty is the students’ inability to express ideas that allow them to understand, conclude, and apply those in example and non-example form. The procedure difficulty is the students’ inability to describe the steps in solving math problems. And, the principle difficulty is the inability of students to connect two or more mathematical objects in the form of axioms, theorems or rules. Learning models that support and can accommodate this are Problem Based Learning. According to [10] that “this model is an approach to learning students on authentic (real) problems so that students can compile their own knowledge, develop high skills and inquiry, independent students, and enhance their confidence”. One of the main features of the Problem Based Learning model according to [11] is “focusing on interdisciplinary linkages, with the intention that the problems presented in problem based learning might be centered on certain subjects but students can review the problem in many ways or link with other disciplines to solve it. By applying the Problem Based Learning model can encourage students to learn actively, passionately and students will be more open to mathematics, and will realize the benefits of mathematics because it is not only focused on the particular topic being studied. A learning model is very important to support the creation of students' creative thinking abilities with facilities designed by the teacher according to the level of thinking of students in the classroom. Therefore, there is a need for learning that codifies active students in learning mathematics. One model that supports the formation of a student-centered learning including Problem Based Learning (PBL). The problem based learning model is a student-centered learning model. Problem based learning begins with the emergence of problems in the learning process in order to provoke students to think about finding solutions to these problems.

2 RESEARCH METHODS

This research is qualitative. The subject of this study is seventh-grade students at SMP Al-Hikmah Medan. The object of this research is the students’ mathematical creative thinking ability with the application of PBL (Problem Learning Based). The instruments used include students' mathematical creative thinking ability tests and interview guidelines. The purpose of this study is to analyze students’ level of difficulties in mathematical creative thinking on problem-based learning model at SMP Al-Hikmah Medan.

3 RESULTS

3.1 LEVEL OF MATHEMATICAL CREATIVE THINKING

Following the use of PBL in the learning model in relational and functional materials, the meeting continued with a test to find students’ mathematical creative thinking skills. Answer sheets assessed based on scoring guidelines were evaluated based on fluency, flexibility, originality, and elaboration. Based on the assessed results (appendix), the level of students’ mathematical creative thinking ability is presented as follows:

<table>
<thead>
<tr>
<th>No</th>
<th>Score Interval</th>
<th>Number of Students</th>
<th>Percentage</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0 ≤ SKBKM &lt; 50</td>
<td>4</td>
<td>13%</td>
<td>Very low</td>
</tr>
<tr>
<td>2</td>
<td>50 ≤ SKBKM &lt; 65</td>
<td>6</td>
<td>19%</td>
<td>Low</td>
</tr>
<tr>
<td>3</td>
<td>65 ≤ SKBKM &lt; 75</td>
<td>14</td>
<td>44%</td>
<td>Medium</td>
</tr>
<tr>
<td>4</td>
<td>75 ≤ SKBKM &lt; 85</td>
<td>5</td>
<td>16%</td>
<td>High</td>
</tr>
<tr>
<td>5</td>
<td>85 ≤ SKBKM ≤ 100</td>
<td>3</td>
<td>9%</td>
<td>Very high</td>
</tr>
</tbody>
</table>

From 32 students, it is found that the level of mathematical creative thinking ability among medium students has the highest proportion and followed by low ability students. The results of the research by [12] suggest that the analysis of the problem-solving task data from each of the research groups indicates that they tend to be in the ‘less creative’ group, meaning that they meet one or two creative product criteria, which is novelty or flexibility. If compared to the study, the results of 32 students' mathematical creative thinking skills at SMP Al-Hikmah Medan are placed in a ‘medium’ level with a score of 42.0 or 66.

Thus, the mathematical creative thinking ability of ‘very low’ students is 13%, ‘low’ ability is 19%, ‘medium’ ability is 44%, ‘high’ ability is 16%, and “very high” ability is 9%.

3.2 DESCRIPTIONS OF STUDENTS’ DIFFICULTIES IN CREATIVE THINKING USING PROBLEM BASED LEARNING (PBL) MODEL

3.2.1. DESCRIPTION OF DIFFICULTY IN MATHEMATICAL CREATIVE THINKING PROCESS OF VERY HIGH ABILITY STUDENTS

High ability student, which is labeled S-26, stated that learning
using the Problem Based Learning (PBL) model made learning easier to understand and comprehend. Also, mathematical creative thinking tests were completed well. These results are shown in Figure 2:

FIGURE 2. ANSWERS OF MATHEMATICAL CREATIVE THINKING TEST OF THE STUDENT CODE S-26

From the interview and the answers above, apparently student as the subject was very knowledgeable about his or her work despite working in only two techniques but there was the originality of being able to complete the question in different ways. The student was not confident because there were more various ways of solving in the previous question, which was three ways. But, there were only two ways for number three. Thus, it is concluded that the student already understood the facts, concepts, principles, procedures, and was even capable of mathematical creative thinking but he or she required to be more confident. The student showed the eagerness to achieve more perfect work.

3.2.2. DESCRIPTION OF THE DIFFICULTY OF MATHEMATICAL CREATIVE THINKING PROCESS OF HIGH ABILITY STUDENTS

For high ability students, student code S-18 stated that learning using the Problem Based Learning (PBL) model gave him or her a strong sense of learning so he or she could respond well to mathematical creative thinking tests. This result is shown in Figure 3:

FIGURE 3. ANSWERS OF MATHEMATICAL CREATIVE THINKING TEST OF THE STUDENT CODE S-18

Based on the interview, it appears that the student as a subject was very knowledgeable about the question and the solving though there were only two ways, which were elaborated very detail. So, it shows that the student had a good grasp of facts, concepts, principles, procedures, and was even capable of mathematical creative thinking.

3.2.3. DESCRIPTION OF THE DIFFICULTY OF MATHEMATICAL CREATIVE THINKING PROCESS OF MEDIUM ABILITY STUDENTS

After For middle ability students, student code S-10 stated that there was a problem found during group discussion using Problem Based Learning (PBL) model. This result is depicted in Figure 4:

FIGURE 4. ANSWERS OF MATHEMATICAL CREATIVE THINKING TEST OF THE STUDENT CODE S-10

3.2.4. DESCRIPTION OF THE DIFFICULTY OF MATHEMATICAL CREATIVE THINKING PROCESS FOR LOW ABILITY STUDENTS

For low-ability students, student code S-15 expressed he or she did not understand the material using Problem Based Learning (PBL) model. The student was not so much involved or active in learning, in which student merely expected to be taught and did not raise any questions in the group. This is shown in figure 5:

FIGURE 5. ANSWERS OF MATHEMATICAL CREATIVE THINKING TEST OF THE STUDENT CODE S-15

3.2.5. DESCRIPTION OF THE DIFFICULTY OF MATHEMATICAL CREATIVE THINKING PROCESS OF VERY LOW ABILITY STUDENTS

For very low ability student code S-19, he/she stated that it was exciting to get acquainted with the teacher though his/her learning desire was average. It appears that student as a subject was already familiar with mathematical facts and concepts but only worked as he/she pleased. This is shown in Figure 6:

FIGURE 6. ANSWERS OF MATHEMATICAL CREATIVE THINKING TEST OF THE STUDENT CODE S-19

4 CONCLUSIONS

Based Following the description of students’ answers to the questions, it is concluded that the students had prepared themselves to solve problems by thinking, finding answers,
asking people and so on (preparation phase), finding and gathering data/information (incubation phase), creating new ideas (illumination stage), and answering student worksheet properly and expeditious learning process (verification/evaluation phase). Analysis of difficulty in mathematical creative thinking research elaborates the difficulty in administering the principles and verbal problem solving concurrently with the inability to point out problem-solving typified by the presence of principle and procedures difficulty including the inability to plan solutions; inability to perform discovery activities; inability to abstract patterns; inability to articulate meaning and inability to apply principles. Students' lack of idea contribution, the inability to solve problems from a different perspective, the inability to solve problems in his way, and the inability to develop or elaborate a situation were found in this research. Whereas they were capable of understanding facts and mathematical concepts. It is distinguished by the absence of facts and concepts difficulty which include the ability to memorize names, symbols technically; the ability to express the meaning of terms that represent a particular concept; the ability to group objects as examples of objects that are not exemplary to them.

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