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Analysis of Creative Thinking Ability in Geometry Learning with the Problem Based Learning (PBL) Model

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Abstrak. This study aims to analyze and describe the ability to think creatively in geometry learning with the Problem Based Learning (PBL) model. The type of research used is descriptive-qualitative with research subjects 6 students selected by purposive sampling technique consisting of 2 students representing the group with high cognitive abilities, hereinafter referred to as the upper group with codes S-01 and S-02, 2 students representing the group with moderate cognitive ability, hereinafter referred to as the middle group with codes S-03 and S-04 and 2 students representing the group with low cognitive abilities, hereinafter referred to as the lower group with codes S-05 and S-06. The data collection techniques used were interviews, observation, document review, questionnaires and creative thinking ability test questions. There are five indicators of creative thinking skills analyzed, including: fluency, flexibility, originality, elaboration and evaluation. The results showed that the upper group met all indicators of the ability to think creatively at the level of lack of external relations, in the middle group 1 student met all indicators of the ability to think creatively at the level of lack of external relations, while the other 1 student did not meet the indicators of elaboration at the level of lack of internal relations and the lower group did not meet the elaboration and evaluation indicators at the level of lack-mixed relations.

Key words: Creative thinking ability, Geometry Learning, Problem Based Learning

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INTRODUCTION

Mathematics as one of the sciences that has an important role in everyday life as well as the development of science and technology. Mathematics has a power that can be applied to several aspects, including technology. The magnitude of the role of mathematics as a basic science can be seen in the magnitude of the demands for mathematical skills that must be possessed, especially in facing the 21st century. Mathematics learning in the 21st Century era is required to emphasize the four aspects of skills (4C), including; critical thinking skills, creative thinking, communication and collaboration (Toheri et al., 2019). This skill aspect means that students can use various techniques to generate useful new ideas, detail, refine, analyze, and evaluate their ideas in order to develop and maximize creative efforts and demonstrate the authenticity of findings (Im et al., 2015; Ndiung et al., 2021; Türkmen & Sertkahya, 2019). The learning process in educational units is held interactively, inspiring, fun, challenging, motivating students to participate actively, and providing sufficient space for initiative, creative, critical thinking, communication and collaboration in accordance with the talents, interests and physical and psychological development of students (Sapto et al., 2015). There are two things that need to be considered in the learning process. First, there is a demand for fun education and second, education should be developed with interest. In addition, it is also necessary to pay attention to the differences in the characteristics of students. Students may differ in how they process message symbols, store, and use information in response to an assignment. People have different ways of seeking and processing information, of viewing and interpreting.

The difference in the way a person processes information is better known as cognitive style. The reality on the ground states that current learning is still dominated by the teacher-centered learning paradigm. This unidirectional learning makes students always dependent on the work of the teacher, so that during the learning process students tend to be passive. Students only listen, take notes and are required to memorize and then asked to do practice questions. So that it causes students to become bored with mathematics, because students are not actively involved in the learning process. Students are not taught to learn independently as a result students always depend on the teacher when they are faced with problems. Learning

with teacher centered paradigm will cause student learning independence to be low. Students cannot explore their own abilities. Whereas students who have learning independence will be able to analyze complex problems, be able to work together individually and in groups and tend to dare to express ideas and ideas that are obtained during the learning process. In addition, independence can also train students to be more responsible and not always depend on others. The independence possessed by students can foster self-confidence and be faster in accepting and understanding subject matter. Learning mathematics has complex problems, some of the problems that make students have difficulty during the learning process are students still consider mathematics to be a difficult subject, and want to be avoided. One reason is that mathematics is a highly hierarchical subject. This does not mean that there is an absolute order that is needed to learn mathematics, but the ability to learn new material often requires an adequate understanding of one or more previously studied material.

One of the materials considered by students as difficult material is geometry, especially about plane slices, distances and angles in geometric shapes. Problems that often arise in learning geometry materials include, (1) Understanding images and Three Dimensions in the two-dimensional field requires a fairly high level of abstraction; (2) The concepts that must be given to students also have a high level of difficulty because they must be related to other concepts in mathematics such as trigonometry and triangles; (3) The teaching patterns and methods used are still mostly lecture methods or conventional strategies; (4) The media and learning resources used are still very limited, both in terms of quantity and quality. Therefore, students tend to find it difficult to understand this material so that the level of success or creative thinking skills of students in this material is relatively low. This is because students have difficulty in analyzing, drawing and understanding concepts to solve three-dimensional story problems due to the lack of student creativity in solving problems. Therefore, a strategy is needed so that mathematics learning is oriented to students' creative thinking. Creative thinking is one of the skills that must be possessed by students.

Davis (Siswono, 2011) says there are 6 reasons why mathematics learning needs to emphasize thinking, namely: (1) Mathematics is so complex and broad to be taught by rote, (2) Students can find original solutions when solving problems. , (3) Teachers need to respond to student contributions that are original and surprising (surprised), (4) Learning mathematics by rote and routine problems will make students unmotivated and reduce their abilities, (5) Authenticity is something that needs to be taught, such as making original proofs. of theorems, (6) Real everyday life requires mathematics and requires creativity in solving it.

One alternative in overcoming the problem of learning mathematics is to apply innovative learning models, including using the Problem Based Learning (PBL) model. The PBL learning model can be used to overcome the lack of creative power of students because PBL learning emphasizes that learning must explore the abilities and skills of students (Kardoyo et al., 2020; Lee, 2005; Lou et al., 2017; Mashuri et al., 2019; Teguh Budianto, 2021).

The basis of this research lies in the application of the PBL model with the teacher's role in learning, namely helping students in the process of finding new knowledge so that it runs smoothly. The teacher does not transfer the knowledge he already has, but helps students to form their own knowledge. Learning using the PBL model requires students independently or in groups to actively make discoveries to build knowledge for themselves, this approach will be more optimal if students are encouraged to think creatively. Another thing that needs to be considered is the place of learning activities. PBL learning activities in this study were carried out by exploring cognitive and affective and psychomotor abilities (Arifin et al., 2020; Kardoyo et al., 2020; NCTM, 1989; Purnomo et al., 2015). Students need to see and understand the relationship between mathematics when they are in the classroom and outside the classroom, and not see it as separate units. Students are stimulated to integrate the realities of everyday life with mathematical concepts that they get in class (Fitriana, 2019; Surya, 2019).

METHODS

The research method used in this research is descriptive-qualitative with the aim of analyzing and describing the creative thinking process in geometry learning with 6 students selected by technique as the research subject. purposive sampling. There are four indicators of creative thinking analyzed, including; Fluency,

Flexibility, Originality, Elaboration and Evaluation (Handoko, 2017; Purnomo et al., 2015; Siswono, 2005). The data collection techniques used were interviews, observations, tests of creative thinking skills and document review. Interviews were conducted to clarify and confirm students in solving creative thinking ability test questions and revealing creative thinking processes in accordance with learning objectives. As well as to obtain data related to the difficulties in solving test questions and the inhibiting factors of the creative thinking process. Interviews were conducted using an interview guide sheet containing open-ended questions and referring to the research objectives. Another data collection technique used in this research is to make observations that aim to obtain data about student activities in learning activities and to determine student activities in the creative thinking process. Creative thinking ability test questions are given to students to find out whether students' thinking processes in solving questions have met the indicators of creative thinking through a study of student answer sheets. The study of student answer sheets was carried out with the aim of knowing how the stages of students' creative thinking were as data to be described and analyzed.

RESULTS AND DISCUSSION

Creative thinking process data retrieval is done through interviews, observations, creative thinking ability test questions and document review. In observation activities, observers make observations and provide an assessment of student activities during the learning process by using observation sheets. While the interview process was carried out after the learning activities ended with the aim of obtaining data about difficulties or obstacles as well as the causal factors faced by students during learning. Data from interviews are used as input for researchers so that the next learning activities can run better. Observations, interviews, and document review focused on 6 selected students who were selected through purposive sampling technique through consideration and representation based on cognitive abilities. The selection of 6 students was then grouped to represent the level of cognitive ability. Each group consists of 2 students who have high cognitive abilities and hereinafter referred to as the upper group with codes S-01 and S-02, 2 students are selected from the group with moderate cognitive abilities hereinafter referred to as the middle group with codes S-03 and S - 04 and 2 students represent the low cognitive ability group hereinafter referred to as the lower group with codes S-05 and S-06. Data collection techniques to analyze the creative thinking process were carried out through observation and interviews. The technique of collecting data is through observation, namely observers or observers make observations and provide an assessment of the creative thinking process during the process of learning activities by using observation sheets. While the interview process is carried out after the learning activity ends with the aim of clarifying and confirming to students about the obstacles faced by students during learning or difficulties in solving problems given by the teacher.

Upper Group Research Subjects (S-01)

The observation data of the S-01 creative thinking process from the first meeting to the fifth meeting is presented in the following figure:

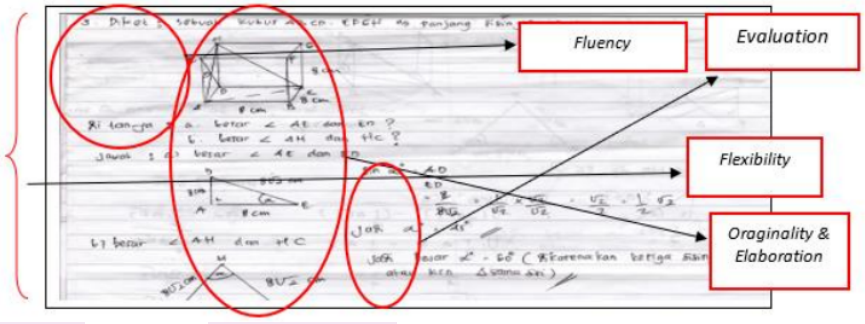

Figure 1. The results of creative thinking S-01

Based on the study of student answer sheets conducted by researchers, almost all indicators of creative thinking in S-01 experienced an increase in geometry learning through the Problem Based Learning (PBL) model. The results of data collection through observation or in-depth interviews obtained information that S-01 is a student who has a very good category of creative thinking processes, this is evidenced from the answer sheets of the questions given by the researcher.

From Figure 1, information is obtained that S-01 already has a good creative thinking process, seen in writing down what is known and asked. This has met the indicators of fluency, namely the skills to identify problems so that they can be used as information to make solutions. In addition, S-01 also has the ability to detail (elaboration) answers marked from the sequence (steps) of solving problems in detail. Painting a picture of a cube on an answer sheet is the idea of flexibility ability, namely the ability to interpret/interpret a problem with the help of pictures. S-01 is able to use the concept of evaluating answers marked by writing a summary of the answers that have been done, meaning that S-01 has evaluation skills. The same thing is also seen from the creative thinking process in subject 2 (S-02) which meets all the indicators of creative thinking at the level of lack-external relations, namely students have problems in relating from one level to the next with their conceptual understanding is developing (development understanding). In this category the S-01 and S-02 are able to evaluate some of their faults and correct them themselves. This shows that S-01 and S-02 in this category understand the concept, but these students have difficulty relating concepts from one level to the next.

Middle Group Research Subjects (S-03)

Information obtained based on observations of middle group subjects (S-03) is shown in the following figure:

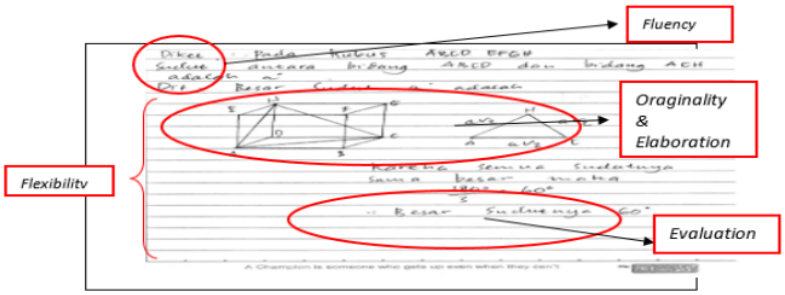

Figure 2. The results of creative thinking S-03

Based on Figure 2 above, it shows that almost all indicators of creative thinking on geometry learning through Problem Based Learning (PBL) model by S-03 is fulfilled. From data collection through observation or in-depth interviews, information is obtained that S-03 is a student whose creative thinking process is quite good, this is evidenced by the answer sheet of the questions given by the researcher.

From Figure 2, information is obtained that S-03 is skilled in writing down what is known and asked. This has met the indicator of fluency, namely the ability to identify problems. In addition, S-03 is also skilled at painting pictures of cubes on the answer sheet as a manifestation of the idea of flexibility, namely the ability to interpret/interpret a problem with the help of pictures. S-03 is able to use the concept of evaluating answers marked by writing a summary of the answers that have been done, meaning that S-03 has evaluation ability. However, the ability to detail answers in a coherent manner with the steps is not quite right. This condition shows that the creative thinking process of S-03 is at the level of lack-internal relations, namely problems in understanding concepts from each level with limited conceptual understanding. In this category, S-03 made an error in completing the task due to lack of understanding of the concept which was marked by making mistakes in all or part of the completion of the task and not being able to evaluate his own mistakes. As a result of this, they also have difficulty in relating concepts,

namely from one concept to another, due to lack of understanding of the initial concepts of formal definitions. Meanwhile, based on observations, reviewing answer sheet documents, observations and interview results, data obtained that S-04 in the creative thinking process meets all indicators and is at the level of lack-external relations marked by the ability to evaluate some of its mistakes and fix it yourself.

Lower Group Research Subjects (S-05)

The study of the creative thinking answer sheet for subject 5 (S-05) is presented in the following form:

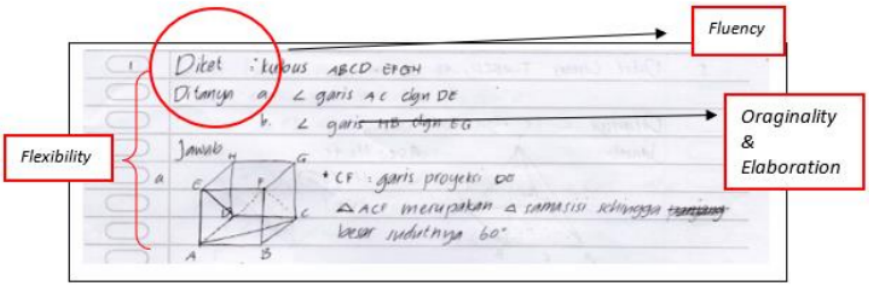

Figure 3. The results of creative thinking S-05

Based on the answer sheet above, there are indicators of creative thinking in S-05 that have not been fulfilled, namely evaluation indicators. From Figure 3, information is obtained that S-05 is good at writing down what is known and asked. This has met the indicators of fluency, namely the ability to identify problems so that they can be used as information to make solutions. However, S-05 is not good enough in detailing (elaboration) the answer, it can be seen from the sequence (steps) of solving the problem which is not yet detailed even though the final answer is correct. Painting a picture of a cube on the answer sheet is the idea of flexibility skills, namely being able to interpret / interpret a problem with the help of pictures. S-05 is not good at evaluating answers, it can be seen from the final results that are not concluded, meaning that S-05 has not had good evaluation skills. This shows that S-05 belongs to the category of lack-mixed relation level due to problems in relating from one level to the next and problems in understanding the concept of each level. In this category, S-05 is said to not understand the concept because he made an error in every task completion, was unable or had difficulty relating from one concept to another and the initial concept so that he needed intense scaffolding and his conceptual understanding was initial understanding. . Meanwhile for S-06 based on observations, reviewing answer sheets and interviewing the creative thinking process is almost the same as S-06, namely at the level of lack-mixed relations where S-06 has not met the indicators of creative thinking on understanding evaluation.

CONCLUSION

Based on the findings of the data obtained through interviews, test questions, observations and interviews, it can be concluded that the creative thinking process in Problem Based Learning (PBL) geometry learning includes; First, the upper group which represents students with high cognitive abilities and is represented by S-01 and S-02 fulfills all indicators of creative thinking at the level of lack of external relations. Second, in the middle group which represents a group of students with moderate cognitive abilities, S-03 meets all the indicators of creative thinking at the level of lack of external relations, while S-04 does not meet the elaboration indicator at the level of lack of internal relations and Third, the lower group which is representative of the group with low cognitive ability, S-05 does not meet the elaboration and evaluation indicators, while S-06 does not meet the evaluation indicators at the lack-mixed relations level.

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