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Submission date: 27-Feb-2022 08:02AM (UTC+0700)
Submission ID: 1771588960
File name: Scopus 9_IOP.pdf (655.84K)
Word count: 2462
Character count: 13118

Open Ended Mathematical Problem Solving: an Analysis of Elementary Students' Creative Thinking Abilities

Open Ended Mathematical Problem Solving: an Analysis of Elementary Students' Creative Thinking Abilities

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Abstract. The purpose of this study is to describe the creative thinking ability of elementary school students in solving open-ended math problems. This type of research is qualitative that seeks to analyze students' creative thinking ability (CTA) in solving open math problems. The subjects of the study were the 5th grade of elementary school students. Research subjects amounted to 3 students with different mathematical abilities. Data collection techniques include observation, tests, and interviews. Data analysis is done by data reduction, data presentation, and verification or conclusion. Data validity technique is done by triangulation of data source. The results showed that students with high and medium level mathematical ability have good creative thinking ability (CTA), whereas students with low category math ability have less creative thinking ability (CTA). Those results of this study can give an idea that the ability to think creatively needs attention in learning mathematics.

1. Introduction

x implementation of learning activities. The habit of hard work and character are the 21st-century abilities which are believed to b an essential aspect of achieving success in life [1]. According to Bialik [2], there are four critical issues in 21st-century education implementation framework namely, knowledge, character, skill, and metacognition. Looking at the portance of these aspects, learning activities should ensure students have to have some abilities: (1) Learning a d innovation skills, (2) media, information, and technology skills, and (3) career and life skills [3]. Learning and innovation skills include communication skills, collaboration, critical thinking, and creative thinking (4CS) [4]. For individuals who have that competences can survive the challenge. Education must be responsive in facing the rapid pace of global development because school is a strategic aspect of developing these competencies, including the ability to think creatively. Therefore, all these abilities must be formed from an early age starting from elementary school.

Creative thinking ability is one of the abilities that must be mastered by students from an early age. This capability is important to be mastered because of the increasing competitive problems in life [5]. This ability is needed and desired in the workplace [6]. Therefore, learning should give students opportunities to develop that ability [7]. Mathematics learning should contribute positively to make students' creativity grow and develop [8]. Creative thinking skills are included in high order competence and basic skills continuation. Ervynce [9] states that creativity plays a role in advanced mathematical thinking. Basic skills in learning mathematics are usually done through convergent activities. In fact, that learning process is usually only mechanistic and routine.

Success in developing creative thinking ability in math learning in primary schools needs to be assessed. Creativity in mathematics can be measured by open ended questions that provides more than one answer. The open-ended approach is one of the learning approaches involving students to cultivate creative thinking skills and keep students active in learning activities [10]. This difference of creative thinking processes needs to be studied. So, it can be used as a reference for primary school teachers in developing mathematics learning.

2. Method

Based on the research objective which to know creative thinking ability of elementary school student in solving an open-ended math problem, the type of this research is qualitative. Qualitative is a research procedure which produces descriptive data in the form of written or oral that can be observed. This research was conducted at SDN Kawedanan 2, Magetan Regency, Indonesia academic year 2017/2018. The time of this study was held in the even semester of the academic year 2017/2018, ie February - July 2018. Research subjects amounted to 3 students with different mathematical abilities based on students' mathematics learning achievement. Data collection techniques include observation, tests, and interviews. Data analysis is done by data reduction, data presentation, and verification or conclusion. Data validity technique is done by triangulation of data source.

3. Result and Discussion

The data obtained in this research are test and interview. The purpose of the analysis is to know the students' creative thinking in solving open-ended math problems. In this case, the test is made in the form of description where the researcher aims to know the steps taken by the subject in completing the test questions. From the results of this test, the researchers analyze the answers of each subject. After the tests were completed, the researchers conducted interviews with subjects related to the answers to the tests. In this case, the interview is done directly, the researchers asked directly to the subjects related to their steps in obtaining answers from the test questions. So, it is obtained a picture of students' creative thinking ability that includes fluency (FLU), flexibility (FLE), originality (OR), and elaboration (EL) [11].

3.1 Creative thinking ability of high category students (S-01)

Problem number one measures fluency aspect, S-01 in answer number one can come up with one idea when the students answer by applying apple weight is 1 kg. S-01 also gives the weight of rambutan is 0.25 kg. So, S-01 assumes that the weight of apples is balanced with rambutan, then rambutan needed is four pieces. Since S-01 is only able to come up with one idea in solving the problem at number 2, it means the subjects belong to the right category (FLU2). But, the interview shows that S-01 can solve the problem by bringing up more than one answer by applying a weight of apple and rambutan to another size. So, the result of the interview shows S-01 in the fluency aspect belonging to the excellent category (FLU1).

Problem number 2 is a matter of measuring the indicator of creative thinking on flexibility and elaboration aspects, on the answer of number 2, S-01 appears that S-01 only uses the beam volume formula in solving the problem, ie using p x l x t, so that S-01 belongs to either category (FLE2), this is reinforced by interviews that show that S-01 is only able to use one way to solve the problem.

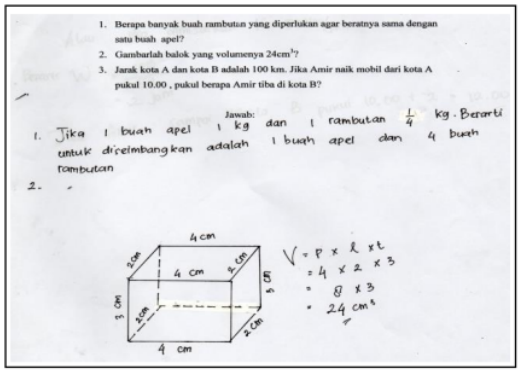

Figure 1. S-01's work result number 1 and 2

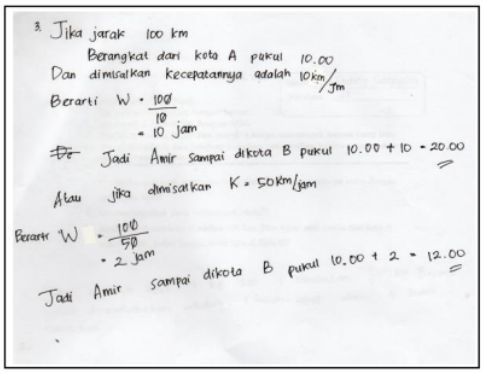

Figure 2. S-01's work result number 3

From the elaboration aspect, S-01 elaborates the idea by completing the picture with a size based on the calculation of length, width and height did completely and correctly, so that S-01 belongs to excellent category (EL1), the interview result reinforces that S-01 draws with the appropriate size calculation length, width, and height.

Problem number 3 is a matter of measuring the originality aspect, S-01 in answering problem number 3 uses a general solution that is the formula speed, distance and time. So that, the subjects belong to the right category (OR2). This is supported by an interview that shows the method used such as the formula of speed, distance and time which is the way of the learning result by the teacher.

3.2 Creative thinking ability of medium category students (S-02)

Problem number one measures the aspect of fluency, S-02 in answer number one able to come up with one idea where the students answer with apple weight apple is 1 kg. S-02 also gives the weight of rambutan is 1 oz. So, rambutan needed is four pieces. Thus, S-02 can come up with one idea in solving this problem means S-02 on the smoothness aspect belonging to the right category (FLU2). This is supported by interviews that confirm S-02 cannot convey another idea or answer.

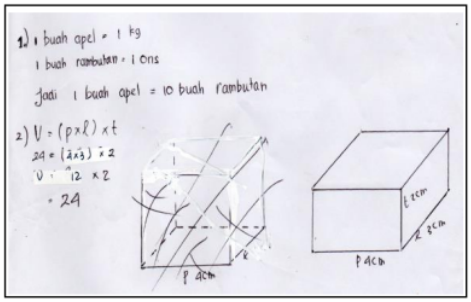

Figure 3. S-02's work result number 1 and 2

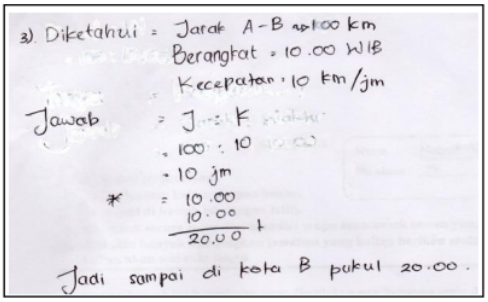

Figure 4. S-02's work result number 3

Problem number 2 is a matter of measuring the indicator of creative thinking on the aspects of flexibility and elaboration, on the answer of the number 2, S-02 it appears that the subjects only use the beam volume formula in solving the problem, ie using p x l x t, by letting p = 4, l = 3, t = 2 to obtain v block 24. S-02 belongs to category FLE2. This is reinforced by an interview that shows S-02 is only able to use one way of solving problems and unable to use other methods. From the detail aspect, S-02 completes the drawing of the calculation result of length, width, and height correctly. So, S-02 belongs to category EL1, and it is reinforced by interview result shows S-02 is only able to use volume formula in solving the problem.

Problem number 3 is a matter of measuring the originality aspect, S-02 in answering problem number 3 uses the general solution that is the formula speed, distance and time with a rate of 10 km/h. So, the subjects belong to the good category (OR2). This is supported by an interview that shows the method used is the formula of speed, distance and time which is the way of the learning result by the teacher.

3.3 Creative thinking ability of low category students (S-03)

Problem number one measures the aspect of fluency, S-03 in answer number one can come up with one idea where students answer by applying apple weight is 1 kilogram. S-03 also gives the weight of rambutan is 100 grams. So, the weight of apples is divided by the weight of rambutan is 10. So, rambutan needed is ten pieces.

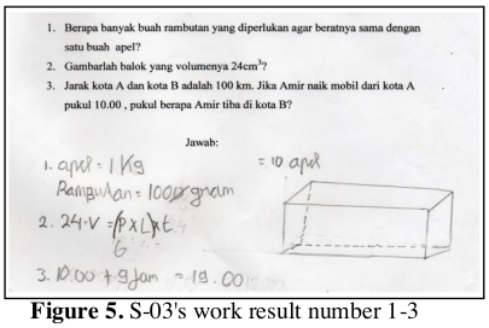

Figure 5. S-03's work result number 1-3

But, the result of the interview shows that S-03 cannot come up with an idea/answer because the written answer is the result of cheating a friend. Thus, S-06 tends to fall into the less category (FLU3). Problem number 2 is a matter of measuring the indicator of creative thinking on the facet of flexibility and elaboration, in the answer number 2, S-03 appears the subjects used the formula as a way, but the way is not able to be used to solve the problem. It is reinforced by the results of an interview that shows S-03 cannot reveal the right way to solve the problem of number 2 so that S-03 only pertains in category FLE3. The results are automatic from the aspects of elaborative thinking S-03 entry in the category EL3 (less).

Problem number 3 is a matter of measuring the originality aspect, S-03 in answer number 3 does not use and lead to completion. It is supported by the results of an interview that shows S-03 cannot convey ideas that lead to completion. So that, S-03 belongs in the category of less (OR3). It agrees with previous research, which states that low ability students need more attention [5,12]. The teacher must pay attention to creative thinking ability because this ability is desired in the world of work [6], [13,14,15].

Conclusion

Creative thinking ability of elementary school students in open-ended mathematical problem-solving in high category students is in very good criteria, especially in the aspects of fluency (FLU) and elaboration aspects (EL). Likewise, the ability to think creatively in students in the medium category, the students do not experience problems, especially in the element of elaboration (EL). The thing that needs attention is the ability of students to think creatively for low categories. Overall, the ability to think creatively in all aspects of both aspects of fluency, flexibility, originality, and elaboration is in poor criteria. Overall, for low ability, students still need guidance and attention by the teacher. Therefore, mathematics learning must facilitate students to make students' creative thinking skills can develop [5], [7,8].

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