International Journal of Multicultural and Multireligious Understanding

http://ijmmu.com
editor@ijmmu.com
ISSN 2364-5369
Volume 7, Issue 8
September, 2020
Pages: 318-325

Efforts to Increase Creativity in Solving Mathematical Problems Through Scratch Media

Atin Supriatin; Zulela MS; Endry Boeriswati

Department of Elementary Education, Universitas Negeri Jakarta, Indonesia

http://dx.doi.org/10.18415/ijmmu.v7i8.1879

Abstract

The basis of all mathematical activity is problem-solving. One of the important factors that can help students find new knowledge and strategies in solving problems is creativity. This study aims to describe the increased creativity of elementary school students in solving math problems through the use of Scratch media in the mathematics learning process in the classroom. This research is action research conducted in three cycles. Each cycle consists of four basic steps: planning, implementation, monitoring, and evaluation. The subjects in this action research were 25-grade students in one of the elementary schools in Palangkaraya City. The research was conducted from July to November 2019. Data collection was carried out by means of observation and giving tests. Observations were made to obtain data about student activities in the process of implementing actions through observation sheets, where the data collection process was assisted by collaborators. Giving tests are carried out to measure students' creativity in solving math problems. The success criterion used in each action cycle is when students classically have reached the minimum category of creative enough (level 3) at least 75%. The data validation technique used triangulation techniques and data analysis techniques used descriptive analysis techniques. The results showed an increase in creativity from pre-cycle to the third cycle, namely: pre-cycle by 16%, cycle I by 52%, cycle II by 68%, and cycle III 76%. Based on the results obtained, it can be concluded that learning mathematics through the use of Scratch media can increase creativity in solving math problems of elementary school fifth-grade students with an increase of 60%.

Keywords: *Creativity; Solving Mathematical Problems; Scratch Media*

Introduction

The basis of all mathematical activities and the main means of developing mathematical knowledge is problem-solving (NCTM, 2000; Rey, 2009). A student in solving math problems must have a good conceptual understanding of the content received, have the ability to think deeper to solve problems, and have various strategies that can be used in solving problems. One of the important factors that can help students solve various maths problems is creativity. Therefore, one of the important skills that need to be cultivated and improved in schools is student creativity (Jonsdottir, 2017). Creativity in general can be defined as a person's ability to create new ideas or combine old ideas to create something new that can be used in solving problems. Creativity in mathematics is defined as the ability to see and

choose solutions in mathematics (Sriraman & Lee, 2011). In mathematics learning, creativity in solving mathematical problems is the ability of students to produce various strategies and unique or unusual solutions in a detailed and systematic manner. Creativity is one of the main assets of one's success. Creative individuals will be more open-minded to their own ideas and the ideas of others. In addition, someone who is creative will be able to make breakthroughs and create new things in solving the problems they face. Creativity is a way of thinking and acting to make something original (Mayesky, 2009), inventive, and new (Cropley, 1999). Creativity requires a balance between synthetic, analytical, and practical abilities (Sternberg and Williams, 1996; Rachmadtullah, et al ,2018 ; Sumantri, et al 2016, Saputra, et al 2019). When viewed from a cognitive aspect, it refers to certain skills, such as fluency, flexible thinking, originality, and elaboration skills (Piffer, 2012). Until now, the problem of creativity in solving math problems is still not the focus of the attention of teachers in schools. Runco revealed that there is no doubt that creativity is very useful in solving various problems (Runco, 2015). Sophisticated, mathematics learning still emphasizes mastery of the material, the limited time, and the material load that relatively develops creativity (Budiharti & Jailani, 2014). The same thing was conveyed by Souza, that an environment that is too controlled by the teacher and excessive structure will hinder creativity (Souza, 2000). This is one of the reasons that students' creativity in the classroom is rarely touched.

In the learning methodology, there are two most prominent aspects, namely the model/method and learning media as teaching aids. Learning media can be categorized as external factors that influence the learning process in the classroom, both for teachers and students. The value and use of instructional media can enhance the learning process and learning outcomes achieved in the learning process. The use of teaching aids, educational props, and learning media in schools has begun to adapt to technological developments. The development of information technology has influenced the use of various types of media as a tool in the learning process (Sanaky, 2009; Saputra et al 2020; Rachmadtullah et al 2019). Some researchers suggest that to support developing and increasing creativity in solving math problems, namely through the application of technology in learning mathematics in the classroom (Henriksen et al., 2016; Marakas and Elam, 1997).

The results of previous research also revealed that the use of technology was able to help and stimulate students' creativity to generate diverse ideas and solutions in solving mathematical problems (Hwang et al., 2007). One technology that is expected to support the improvement of students' creativity in solving a mathematical problem that Scratch media. With Scratch, teachers and students can create their own animations, games, works of art, and others (Kadir & Nurcito, 2011). A number of research results have been carried out in the use of Scratch, including research conducted by Pinto in Portugal. The results of his research stated that the Scratch application program succeeded in motivating elementary school students in grades 5 and 6 in improving their learning process. In addition, the Scratch application program has succeeded in increasing student concentration, creativity, and collaboration (Pinto & Escudeiro, 2014).

Another research result, conducted by Resnick et al. States that digital fluency should mean designing, creating (creative), and mixing, not just browsing, chatting, and interacting. Scratch is able to develop digital fluency (Resnick et al., 2009; Syofyan,et al 2019; Supriatna et al 2019; Rachmadtullah et al 2019;Siregar et al, 2019;Rasmitadila et al, 2018). In addition, the results of Kobsiripat's research indicate that Scratch can be used as an interactive medium that can lead to the development of student creativity. Creativity can be stimulated when students receive instructions from learning activities through Scratch so that they generate clever, clever ideas, and initiatives (Kobsiripat, 2015). From some of the research results, it can be seen that Scratch media is able to develop the creativity of its users. Based on this description, it is important to know and describe the increase in mathematics creativity of elementary school students in solving math problems through the application of Scratch media.

Method

This research is action research conducted in three cycles. Each cycle consists of four basic steps: planning, implementation, monitoring, and evaluation. The subjects in this action research were 25-grade students in one of the elementary schools in Palangkaraya City. Students who are selected as research subjects are taken by considering that these students have taken informatics technology subjects. The research was conducted from July to November 2019. Data collection was carried out by means of observation and giving tests. Observations were made to obtain data about student activities in the process of implementing actions through observation sheets, where the data collection process was assisted by collaborators. The test was given at the end of each cycle to measure students' creativity in solving math problems. The test is structured in the form of questions describing regulated so as to collect data about students' creativity in solving mathematical problems (Treffnger, 2002). The components of creativity that are measured are the components of fluency, flexibility, originality, and elaboration. The success criterion used in each action cycle is when students have classically reached the minimum category of creative enough (level 3) at least 75%. The data validation technique used triangulation techniques and data analysis techniques used descriptive analysis techniques.

Results and Discussion

The results of the data analysis show that there has been an increase in student creativity in solving math problems after using Scratch media in learning mathematics. Table 1 below shows the improvement of students' creativity in solving mathematical problems based on the percentage level of creativity in every action.

Tabel 1. Increased Creativity Students in Mathematical Problem Solving

	Percentage of Creativity Level					Total Number of Levels 3, 4, 5	Success Criteria ≥ 75%
	Level 1 (Not Creative yet)	Level 2 (Not Creative yet)	Level 3 (Not Creative yet)	Level 4 (Not Creative yet)	Level 5 (Not Creative yet)		
Pre- Cycle	36%	48%	16%	0%	0%	16%	Not yet fulfilled
Cycle I	20%	28%	40%	12%	0%	52%	Not yet fulfilled
Cycle II	0%	32%	48%	16%	4%	68%	Not yet fulfilled
Cycle III	0%	24%	56%	16%	4%	76%	Not yet fulfilled

Based on table 1, students' creativity in solving math problems has increased after taking action in the form of applying scratch media in learning mathematics. Although there has been an increase in action in cycle I and cycle II, the success criteria for that cycle have not been achieved. In the implementation of cycle III actions, the expected success indicators are achieved. This can be proven that before the action was taken there were 9 students who were not at the creative level or 36%. Meanwhile, after the action was carried out at the end of cycle III, there were no students who were at the level not yet creative. Likewise, at a less creative level, 12 people or 48% of the actions were taken. Meanwhile, after the action was carried out as many as 6 people 24%. At the creative level, 4 people or 16% are taken

before the action. Meanwhile, after the action was carried out as many as 14 people 56%. At the creative level, 0% before action. Meanwhile, after the action was carried out as many as 4 people or 16%. At a very creative level, 0% before action. Meanwhile, after the action was carried out as many as 1 person or 4%. When viewed classically, the level of creativity before the implementation of the action (pre-cycle) is at the level of 16%. However, after going through the implementation of the action in cycle I increased to 52%, likewise in cycle II increased to 68%, and in cycle III the percentage was 76%. Thus the acquisition of the level of creativity before the implementation of the action (pre-cycle) and after the implementation of the last action (cycle III) has increased by 60%.

The following is an example of student work on the test instrument given to measure students' creativity in solving math problems. The tests given are as follows:

Look at the picture!

a. Arrange the group of square units above into one unified whole (at least 2 different forms of arrangement). Then give at least 2 different colors on the part of the square unit group.
b. Mention symbol simplest fractions formed from any type of similar color to the entire square.

The following picture is one of the results of student work that meets the indicators of creativity.

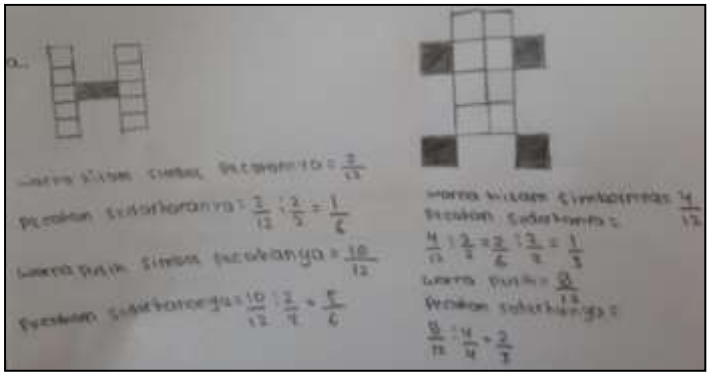


Figure 1. Results of student work that meets the creativity indicators

From the results of student work, it can be seen that students have provided more than one solution when asked to make a square group arrangement. In addition, the solutions given are also relevant to the problems given. These students are considered fluent in providing various solutions to a mathematical problem. In the second part, students give the fraction symbol that matches the picture up to the simplest fraction symbol with the correct strategy. These students were considered to be flexible in providing strategies for the solution. This student was also judged to have provided an original solution because the solution given was relatively unique to his class level and tended to be different from his classmates. Overall, these students have presented solutions in detail and clearly. It is assumed that students have described or detailed solutions in a clear and detailed manner.

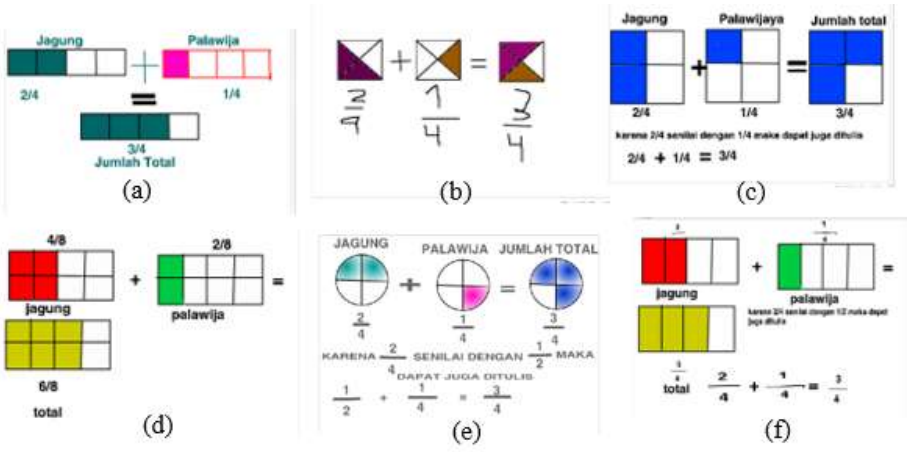
When viewed from student activities in using Scratch media during mathematics learning in class, it appears that there is an increase in student activity in each cycle as shown in table 2.

Table 1. Increasing Student Activities in Using Scratch Media

Cycle	Average Value	Category	Description
Cycle I	2	Enough	- Mostly can illustrate fraction symbol by using rectangle shape - A small portion can illustrate using a fractional symbol square shape - Symbol can indicate fractions by using a variety of colors - Resulting in solutions to problems that are likely to be the same - Not able to explain the problem solving in detail
Cycle II	2,8	Good	- Can illustrate the fraction symbol by using rectangular and square shapes - A small portion can illustrate using a fractional symbol by using a circle shape - Symbol can indicate fractions by using a variety of colors - Resulting in solutions to problems that are likely to be the same - Only a small portion can describe solving the problem in detail
Cycle III	3,4	Good	- Can illustrate the fraction symbol by using rectangle, square and circle shapes - Can show fraction symbols by using a variety of colors - Produces multiple problem solutions - Most of them are able to explain problem solving in detail

Table 2 above illustrates that there has been a change in student activity in using Scratch media in each cycle. Changes in student activity indicate an increase in student activity in each cycle. In the first cycle, the student activities are in a sufficient category. This situation causes student creativity in solving math problems not developing as expected. This happens because in cycle I students are not used to using Scratch media in solving math problems. In cycles II and III, student activity is in a good category. This situation causes student creativity in solving problems continues to increase in the expected direction. This happens because students are used to using Scratch media so that students have the ability to explore all aspects of Scratch media in solving math problems.

The following are some examples of the results of student activities using Scratch media against Student Worksheets given in the learning process in class.



Based on the results of students' activities using Scratch media in Figure 2 above, it shows that students have been able to illustrate the fraction symbol using various shapes and colors. Students have also been able to provide various solutions, this shows that students' creativity has changed for the better.

The description of the research results above has shown that the use of Scratch media is successful and can increase students' creativity in mathematics problems in elementary school students. This increase occurred at the level of creativity and student activity in solving math problems through Scratch media. Learning mathematics through the use of creative Scratch media in solving problems of people who think about the thinking activities of students who have been able to find mathematical problems based on their own thoughts. This is consistent with one of the elements of creativity, namely (Runco and Pritzker, 1999). In addition, students have also been able to produce various answers with various strategies in detail based on the results of the thinking itself from the mathematical problems presented. This has shown the characteristics of the creative elements, namely fluency, flexibility, originality, and elaboration (Piffer, 2012). The factors that influence this increase are students are given the opportunity to explore their mathematical abilities in finding problems that affect the problem. This statement is in line with Marji's statement that the Scratch program supports problem-solving skills and encourages direct and independent learning through exploration and discovery (Marji, 2014). In addition, increased creativity occurs due to the advantages of Scratch media, including: (1) Scratch can introduce mathematical operations abstraction and can empower students to use graphic elements to solve mathematical problems (Chang et al., 2016) ; (2) Scratch can be used to create effective educational tools such as math problems (Chiang, n.d.); and (3) Scratch can develop fluency in technology, mathematical skills and problem problems (Maloney et al., 2004). The use of Scratch media in learning mathematics in the classroom has been able to create a learning environment that can stimulate students to increase their creativity in solving math problems. This is consistent with the results of classroom observations which show that the learning environment that has been created can support developing creativity in providing a variety of unique solutions and strategies that are described in detail and systematically. This is in line with previous researchers that creativity is the result of interactions between individuals and their environment. Each individual will influence and influence the environment in which the individual is located, thus changing both within the individual or the environment can support or hinder creative endeavors. The implication is that creativity can be increased through education in the learning process (Munandar, 2014).

Conclusions

The results of this study concluded that the use of Scratch media in mathematics learning was able to increase creativity in solving math problems in elementary school students. This is shown by the increased ability of students to provide various unique solutions and strategies in detail and systematically in solving mathematical problems. Other results also show that through the use of Scratch media in learning mathematics it can increase student activity in good categories. This can be shown by being directly involved in finding mathematical problem solving on their own.

Based on the results of the research, it can be argued that: (1) The researcher will replicate this research in different schools / classes or materials that need to pay attention to the selection of the same problem for each cycle or meeting; (2) For further research, it is necessary to anticipate on the basis of this research by taking into account the facts of the subject and the location of the study.

Acknowledgments

The author would like to thank you for all the students who have participated in data collection. The author also wants to thank the supervisor who has provided direction and input in conducting this research.

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