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# Mathematical Creative Thinking Ability in Term of Learning Independence in Creative Problem Solving Assisted Learning with Mobile Learning

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**Abstract**

This study aims to describe the mathematical creative thinking ability in terms of students learning independence in learning Creative Problem Solving (CPS) assisted by mobile learning. The design of this study is squential explanatory. The population in this study was grade VIII of SMP Negeri 6 Salatiga consisting of eight classes. Determination of the subject grouped based on the learning independence of students with high, medium, and low categories using purposive. The results of the study show that Creative Problem Solving (CPS) learning assisted by mobile learning with certain quality because at the planning stage all devices are used valid, at the stage of implementing Creative Problem Solving (CPS) learning assisted by mobile learning in minimal good criteria, and at the assessment stage effective of Creative Problem Solving (CPS) assisted by mobile learning. Description of mathematical creative thinking ability in terms of learning independence of students varies. This is indicated by the following results; from 10 students with high learning independence obtained 2 people with mathematical creative thinking ability in the high category and 8 in the medium category. From 15 students with moderate learning independence, the results are obtained 1 person creative mathematical thinking ability in the high category and 13 people in the medium category and 1 person in the low category. The result of the research show that from 3 students with low learning independence, all are having low mathematical creative thinking skill.



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## INTRODUCTION

Mathematical learning is not merely pursuing the goal of acquiring knowledge, but the attitude and skill are also important. In the standard of passing criteria, the dimensions of skills mentioned that graduates of SMP / MTs / SMPLB / Paket B should have the skills to think and act: creatively, productively, critical, independently, collaboratively, and communicatively through scientific approaches in accordance with which are studied in education units and other sources independently. Winda, et al. (2018) stated that one of the goals of learning mathematics is to carry out mathematical thinking processes. Problem-based learning faced by children in daily life will become more interesting and meaningful learning. Learning that demands students' creativity in solving problems of daily life will be an asset for students to face future challenges.

Kadir, et al. (2017) stated that mathematics in schools is a mean to educate students to become creative human beings. Wijaya (2018) emphasized that a rapidly developing modern society requires individuals who have the ability to think, act and communicate creatively. Student creativity is built through mathematics learning which starts by emphasizing the aspect of independence. Independence learning combined with the activeness of students to support the ability to think creatively is very dependent on the current conditions. The development of technology is so fast and rapid.

Communication technologies such as mobile phones have evolved into multifunctional smartphones. Facilities or features provided by smartphones are numerous and unlimited, such as games, email, social media, learning media, and many more. Even with the presence of the Android operating system, smartphone applications develop so easily without limits. This condition will be captured as a breakthrough in learning as more interesting, challenging and creative. As stated by Kadir, et al. (2017) that creative thinking is one of the fundamental abilities possessed by learners in the rapidly developing information and technology era today.

In this study the ability to think creatively is neededa in improving ideas to improve students' mathematical communication skills. Suyitno, et al. (2017) argues that one of the abilities students need to master in learning mathematics is to have the power of mathematical creativity. To assess students' creative thinking using the references proposed by Rahmazatullaili, et al. (2017) include: 1) fluency, namely the ability to generate many ideas; 2) flexibility (flexibility), namely the ability to express various solutions; 3) originality, namely the ability to provide ideas that are relatively new and rarely given by most people; and 3) elaboration, namely the ability to detailing the answers made.

This was supported by Hendriana, et al. (2018) concluded that there are four indicators of achievement in creative thinking, namely as follows: 1) fluency of thinking, namely the ability to generate many ideas and various kinds of answers in solving problems smoothly. 2) flexibility of thinking (flexibility), namely the ability to create a number of ideas, answers or questions that vary, can see the problem from a different perspective, look for different solutions to resolution, and be able to use a variety of thoughts with various approaches . 3) elaboration, namely the ability to develop ideas and add details of an object so that ideas become more interesting. 4) originality, which is the ability to come up with original or unique ideas originating from oneself. Based on these indicators, the following indicators are developed for mathematical creative thinking abilities, as seen in the following table 1.

**Table 1.** Indicators of mathematical creative thinking

| Indicator Creative Thinking | Description of Indicator |
|---|---|
| fluency | The ability to generate many ideas, ideas that are relevant in solving mathematical problems.<br>The ability to solve mathematical problems correctly and smoothly. |
| flexibility | The ability to express various mathematical problem solving strategies.<br>The ability to create a number of ideas, answers or questions that vary, and can see the problem from a different perspective. |
| originality | The ability to provide ideas that are |

| | |
|---|---|
| | relatively new and rarely found by most people in solving mathematical problems<br>The ability to solve mathematical problems using their own language. |
| elaboration | The ability to expand answers to mathematical problems<br>The ability to detail the answers made to get a mathematical problem resolution |

Suhendri (2010) internal factors are factors that originate within students themselves, such as: motivation, emotional intelligence, logical-mathematical intelligence, self-confidence, independence, attitudes and others. Tahar and Enceng (2006) define learning independence as learning activities carried out by individuals with freedom to determine and manage their own teaching materials, time, place, and utilize various learning resources needed.

The syntax of the Osborn-Parnes model (Huda, M., 2013) of the Creative Problem Solving (CPS) process is as follows: Step 1: Objective Finding, students are divided into groups. Students discuss the problem situation posed by the teacher and instruct a number of goals or objectives that can be used for their creative performance. Step 2: Fact Finding, students brainstorm all facts that may be related to the goal. The teacher lists every perspective produced by students. The teacher gives students time to reflect on what facts they think are most relevant to the goals and solutions to problems. Step 3: Problem Finding, one of the most important aspects of creativity is to redefine the problem so that students can get closer to the problem so that it allows them to find clearer solutions. Step 4: Finding Ideas, in this step, students' ideas are listed so that they can see the possibility of being a solution to the problem situation. Step 5: Solution Finding, at this stage, ideas that have the greatest potential are evaluated together to produce ideas that are suitable as solutions to problem situations. Step 6: Acceptance Finding, at this stage, students begin to consider real issues with ways of thinking that have begun to change.

Creative Problem Solving (CPS) learning with mobile learning is learning using Creative Problem solving (CPS) models with predetermined syntax assisted by mobile learning media in the form of android-based applications and website-based Moodle Learning Management System (LMS). Moodle LMS can be directly installed on the webserver or installed for localhost. Software or Moodle Learning Management System (LMS) applications can be downloaded at www.moodle.org with several options namely moodle mobile or moodle desktop. In addition, mobile learning assisted learning builds applications with ExeLearning version 2.1.3 where the software can be downloaded for free at http://exelearning.net/en/descargas/.

Fill in the content such as: application information, instructions for using, competence, learning objectives, material, practice questions, games, evaluation, discussion forums or other. Learning materials that can be included such as pictures, videos, animations, or others. While the forms of tests that can be entered include short, true or false, multiple choice, description or other forms of test. Content in the form of a learning process that stimulates mathematical creative thinking abilities. In this study, it can be accessed at http://kelas8.smpn6salatiga.sch.id. Android-based mobile learning applications can be downloaded at gg.gg/materitesis.

One effort to overcome these problems, the teacher designs learning based on problems and assisted with Moodle LMS (Learning Management System) and android applications (with ExeLearning software version 2.1.3 and Phonegap) with the hope of quality and effective learning and then reviewed from the attitude of learning independence is expected to be able to describe the ability of mathematical creative thinking of students in class VIII of SMP Negeri 6 Salatiga. Based on the problems that have been described, research is needed on the application of Creative Problem Solving (CPS) learning assisted by mobile learning to determine students' mathematical creative thinking abilities in terms of learning independence.

## METHODS

This research was conducted at Salatiga Junior High School 6. Website address of Salatiga Junior High School 6 at http://smpn6salatiga.sch.id. This study uses a mixed method with sequential

explanatory design that is this strategy is applied by collecting and analyzing quantitative data in the first stage which is followed by collecting and analyzing qualitative data in the second stage which is built based on quantitative initial results with more weight / priority given to quantitative data (Creswell: 2014).

There were to samples in this study namely the experimental class and the control class. Where as in the qualitative stage, the research subjects were selected using purposive techniques based on the learning independence of students with high, medium, and low categories.

This study has two phases, namely the first phase, the researcher collected quantitative data and then analyzed so that later the results of the quantitative data will be obtained which is then used to continue the second phase of obtaining qualitative data. This research was conducted through three stages, namely, the initial stage, the quantitative stage, and the qualitative stage. The initial stage includes observation, formulation of learning tools and research instruments, validation of learning tools and instruments.

The Mathematical Creative Thinking Ability Test instrument, before being used to retrieve data in the experimental class and the control class, was first tested. This is done to determine the level of difficulty, reliability validity, distinguishing features, as well as the readability of the questions and the time spent working on the questions as a whole. The trial data are analyzed and revised if necessary. The quantitative phase includes the students' initial ability test, the implementation of Creative Problem Solving (CPS) learning assisted by mobile learning, the provision of a learning independence questionnaire, and a mathematical creative thinking ability test. After giving the questionnaire the students' learning independence was grouped in the high, medium, and low categories. Then each category was interviewed regarding the Mathematical Creative Thinking Ability Test. The final stage includes interviews, data analysis, and drawing conclusions from the research that has been done.

Quantitative data analysis is used to find out the quality of Creative Problem Solving (CPS) learning assisted by mobile learning, while for effectiveness includes completeness of learning outcomes, the proportion of experimental class completeness exceeds 75%, the average Mathematical Critical Thinking Ability experimental class is better than the control class and the average the independence of learning the experimental class is better than the control class.

## RESULT AND DISCUSSION

Qualitatively learning Creative Problem Solving (CPS) assisted by mobile learning is said to be of quality, because based on the results of the validation of the device conducted by the validator states that the device used in the study is valid because it is in the minimal good category. Then the implementation of learning conducted by researchers in the classroom is also in the excellent category, this is indicated by the observer's evaluation at each meeting at a minimum in either category. This is in line with the opinion of Herman (2007) which states that the main focus in efforts to improve the quality of learning is to position the teacher's role as a designer and organizer of learning so that students have the opportunity to understand and interpret mathematics through learning activities.

Based on the results of the research, the Mathematical Critical Thinking Ability Test in the experimental class averaged 73.39 and for the control class an average of 67.60. The completeness achievement for the experimental class was 85.57% while the completeness achievement in the control class was only 60%. The test results of students' mathematical creative thinking ability after the normality test is obtained Sig. 0.209, it means that the mathematical creative thinking ability of the experimental class and control class students is normally distributed because the value (Sig.) = 0.20> 0.05. From the calculation, it is obtained zhitung = 1.31 and this is located in the rejection area of H0 so that H1 is accepted, meaning that the percentage of students who reach completeness of at least 65 on Creative Problem Solving (CPS) learning assisted by mobile learning exceeds 75%. Based on the average difference test of mathematical creative thinking abilities obtained significance value (Sig.) = 0.283 then H0 is rejected, meaning that the achievement of mathematical creative thinking ability of students taught by learning Creative Problem Solving (CPS) aided by mobile learning more than mathematical

creative thinking abilities students who are taught with Problem Based Learning (PBL) learning. Based on the different test the average learning independence of students after the independence score is converted into interval data with the successive interval method or the Method of Successive Interval (MSI). These steps can be done with the help of Microsoft Excel by adding the Add In Method of Successive Interval (MSI) by downloading the stat97.xla software freely through Google Search. Obtained significance value (Sig.) = 0.092 then $H0$ is rejected. That is, the achievement of learning independence of students taught by learning Creative Problem Solving (CPS) assisted by mobile learning is more than learning independence of students who are taught by learning Problem Based Learning (PBL).

Based on the data obtained that the mathematical creative thinking ability of students with high learning independence is an average of 78.4 and the average score of learning independence is 92.0. For the mathematical creative thinking ability of students with moderate learning independence, the average is 74.13 and the average score for learning independence is 78.6 and for the mathematical creative thinking ability of students with low learning independence, the average is 53.0 and the average score independence of learning 54.67.

Qualitatively, mathematical creative thinking ability in terms of learning independence obtained results that students who have high learning independence are 10 people. There are 15 students who have independent learning in the medium category. Students who have low learning independence are 3 people. This shows that the description of the ability to think creatively in mathematics in terms of learning independence of students varies. This is indicated by the following results; from 10 students with high learning independence obtained 2 people with mathematical creative thinking ability in the high category and 8 in the medium category. From 15 students with moderate learning independence, the results are obtained; 1 person creative mathematical thinking ability in the high category and 13 people in the medium category and 1 person in the low category. From 3 students with low learning independence obtained 3 people with low category mathematical creative thinking skills.

Mathematic critical thinking reviewed from learning independece resulted as follows: students with high learning independence is not guaranteed to get high creative thinking ability. However, the are students with medium learning independence who resulted in high mathematic creative thinking ability. There are also students with medium learning independence who resulted in low mathematic creative thinking. This is because the model used in learning can stimulate the students to learn, this is supported by research results from Budiyanto AM and Euis Eti Rohaeti (2014). The results of his research show that the mathematical creative thinking ability of students who get the PBL approach (at a good level) is better than students who get conventional learning (at a moderate level), not there are differences in student learning independence in the two learning groups, and both are at a fairly good level, and there is sufficient association between mathematical creative thinking abilities and student learning independence where students also show positive perceptions of problem based learning.

Creative Problem Solving (CPS) learning assisted by mobile learning has different impacts on students. This is supported by Agung Fitriyanto & A. P. Budi Prasetyo (2016) in his research concluded that among others 1) students who get learning with the Scientific approach through the CPS model have reached the KKM; 2) the creative thinking ability of the experimental class is better than the control class.. Another study by Jumaisyaroh, et al. (2013) concluded that the increase in learning independence of students who were given problem-based learning was higher than those who were given direct learning. The use of the Creative Problem Solving (CPS) learning model assisted by mobile learning was also strengthened in Asep Nanang's research (2016) which states that convincingly problem-based learning has a far better impact in terms of achieving creative thinking abilities and student learning independence.. It was also stated, the increase in students' mathematical creative thinking ability was influenced by various factors, including: the learning provided by the teacher, the media used, and the learning conditions. Wijayanti & Susongko (2017) concluded that SAVI-based CPS learning models are effectively

used in distance learning in space. This means that the use of mobile learning in Creative Problem Solving (CPS) learning provides varied learning outcomes.

This means that the use of mobile learning in Creative Problem Solving (CPS) learning provides varied learning outcomes. The results of the research by Huri Suhendri & Tuti Mardalena (2013) show that there are significant differences in the improvement of creative thinking skills and learning independence between students who have problem based learning (PBL) and students who have conventional learning.

## CONCLUSIONS

Based on the discussion that has been described, it can be concluded that learning Creative Problem Solving (CPS) is assisted by mobile learning with certain quality towards the mathematical creative thinking ability of class VIII students in solving problems of mathematical creative thinking ability. Creative Problem Solving (CPS) learning assisted by mobile learning produces resulted in a description of Mathematical Creative Thinking Ability in terms of the learning independence of students who vary. This shows that Creative Problem Solving (CPS) learning assisted by mobile learning has effect on students ability on creative thinking which varies.

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