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Mathematical Creative Thinking Ability Observed from Student Learning Motivation in Jigsaw Cooperative Learning Assisted by Problem Cards

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Abstract

The study aims to test the completeness Jigsaw cooperative learning assisted by problem cards for student's mathematical creative thinking ability, to test the mathematical creative thinking abilities of students in Jigsaw cooperative learning assisted by problem cards compared with conventional learning, and analyze mathematical creative thinking abilities of students in Jigsaw cooperative learning assisted by problem cards observed from student's learning motivation. The study uses *mixed methods sequential explanatory* design. Subjects in this study are six students of Junior High School in Semarang of class VIII B represent each group of learning motivation. Data collection methods used as follows: questionnaire, test, and interview. The result shows that: (1) student's mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem cards reaches learning completeness, (2) student's mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem cards higher than mathematical creative thinking ability in conventional learning, (3) student's mathematical creative thinking ability observed from learning motivation are: (a) student with high learning motivation able to achieve all mathematical creative thinking ability indicators; (b) student with average learning motivation able to achieve fluency and elaboration indicators, but not achieve the flexibility and originality indicators; (c) student with low learning motivation less able to achieve fluency, flexibility, originality, and elaboration indicators.

1. Introduction

Education is the primary asset to increase the human resource's quality. A country would be a developed country if they have a good quality education. The standard content of elementary and junior education (Permendikbud No. 21 of 2016) mentioned that one of the purposes of national education is to develop the student to be a creative human being. A subject that is very important and has the potential to develop intelligence and creativity is Mathematics. Suherman et al (2003) said that the establishment of a critical and creative thinking attitude is the most important thing from the purpose of mathematics.

Education should be focused on student creativity development so that they can fulfill the personal and public needs (Munandar, 2012). According to Dwijanto (2007) as quoted by Pratiwi et al., (2018) creativity means the power of thought. The power of thought as the ability to create a new thing is nearly impossible so that creativity is a combination of things that already exist. While according to Siswono (2010) creativity (creative thinking or divergent thinking) is the ability to find many possible correct answers for a problem, where the emphasis is the quantity, the appropriate, and diversity answers. The more possible correct answers given, the more creative the person.

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In the mathematics scope, Ervynck as quoted by Kadir (2017) define that creativity in a framework of mathematical knowledge as an ability to solve problems or to develop thinking in structures, taking into account of the peculiar logic- deductive nature of the discipline, and of the fitness of the generated concepts to integrate into the core of what is important in mathematics. So that in the context of mathematics learning, creative thinking ability is the ability that can ease the student to find a diverse solution for problem-solving.

According to Torrance as quoted by Lestari & Yudhanegara (2015), there are four indicators of mathematical creative thinking ability. The indicators are (1) *fluency*, have many ideas/thoughts in the various category; (2) *flexibility* to has various ideas/thoughts; (3) *originality*, have the new idea/thought for problem-solving; (4) *elaboration*, able to develop idea/thoughts to solve a problem in detail.

The creative thinking ability is the high level of thinking ability that has to be developed in mathematics learning and should be owned by the student in learning mathematics. Based on the result of the PISA survey in 2015 in the mathematics field, Indonesia is ranked on 62 of 70 countries. According to Provasnik et al. (2016) mathematics score released by TIMSS 2015, Indonesia is ranked 51 of 55 countries. Indonesia's mathematics score is below average mathematics international score. It shows that the student is still unable to develop the strategy and approach to face the latest situation, so we can say that the student's creative thinking ability is still low. This also strengthened with the interview result that has been done to the teacher of Junior High School 30 Semarang, that grade VIII student's creative thinking ability especially in geometry materials still has to be improved. In learning, teachers already gave mathematics questions or cases that have several solutions. Some students able to solve the question in their way or not taught by their teacher, but most of them still use the way their teacher taught them. Some of the students have a great interest in mathematics so that they can explore their knowledge to find another solution and different from the general way.

Heruman (2009) explains that the difficulty of learning mathematics especially caused by certain characters and mathematics has an abstract object. Many students individually are not understanding the mathematics concept, so that the students are less motivated to study mathematics. Motivation has an important part in a learning activity. According to Uno (2008) states that motivation is the power, whether it's from the inside or the outside that courage a person to reach certain goal that previously has been set. Learning motivation of each person is different with others. It can be classified in high, average, or low. According to Sardiman (2014), result of learning will be optimal if there is right motivation.

One of the right ways to increase the student's creative thinking ability is to choose the effective learning method. According to Slameto as quoted by Adhiwibowo (2018) states that creativity is the learning result in cognitive skill so that to be creative can be learned through the learning-teaching process. Tampubolon (2014) argued that the learning process is developing activity and student's creativity through various interactions also learning experiences. Cooperative learning according to Slavin (2015) as quoted by Turgut (2018) is a learning model where students cooperate in small groups and help student's learning. One of cooperative learning type that focused on a small group is Jigsaw cooperative learning.

Jigsaw cooperative learning is cooperative learning that is developed by Aronson, Blaney, Stephan, Sikes, and Snapp (1978) to help students separate the materials into several subtopics, and then integrate all the subtopics into a meaningful whole (Dat, 2016).

In Jigsaw cooperative learning, students are divided into several groups that the member has heterogeneous characteristics. The feature of Jigsaw cooperative learning is there will be an expert group and origin group. The student that gets the same topic will be merged and discuss in their new group called expert group. So that every student from their origin group is responsible for a topic. Every student is responsible to learn the topic given and teach to their group member so that they can interact and help each other (Yoselin *et. al.*, 2016). The basic thought of this learning technique is to give the chance to students to share with their friends, teach and to be taught by fellow students (Anwar,2014).

To support the application of Jigsaw cooperative learning, we need learning media or learning support tools. One of the learnings supporting tools that can be used is problem cards. Thus, in this study problem cards will be used as learning tools. In this case, a problem card is the learning tool in the form of the card contains mathematical thinking learning ability with cubes and blocks material.

Based on the explanation above, so this study aims to: (1) know whether mathematical creative thinking ability student in Jigsaw cooperative learning assisted by problem cards reach the completeness

of studying, (2) know whether mathematical creative thinking ability student in Jigsaw cooperative learning assisted by problem cards better than mathematical creative thinking ability in conventional learning, (3) describe mathematical creative learning ability observed from student's learning motivation.

2. Method

The research method used in this study is a combination method *(mixed methods) sequential explanatory design*. Quantitative research design uses *True Experimental Design* the form *Posttest- Only Control Design*. There is a description of the quantitative research design can be seen in Table 1.

Table 1. Research Methods

Class	**Action**	***Posttest***
Experiment	X	T
Control	-	T

Information:
X: Application Jigsaw cooperative learning assisted by problem card
T: Mathematical creative learning ability posttest

The population in this study is 8th-grade students of Junior High School 30 Semarang in the second semester 2018/2019 period. Sample in this study is grade VIII B students as experiment group that is treated with Jigsaw cooperative learning and grade VIII C students as a control group treated with conventional learning. This sampling is based on a *simple random sampling* technique. The subject of the study is elected based on a *purposive sampling* technique.

In this case, students were given a learning motivation questionnaire. Then, classified in students with high, average, and low learning motivation. There are 6 subjects chosen to be analyzed, two with high learning motivation, two with average learning motivation, and two with low learning motivation.

Data collection methods in this study are questionnaires, tests, and interview methods. The purpose of the interview is to know the student's mathematical creative thinking ability on each category of learning motivation level.

Data analysis in the study is a prerequisite test analysis, data analysis of mathematical creative learning ability test result, and qualitative data analysis. Prerequisite test analysis includes a normality test to know whether both sample groups are from a normal distributed population, homogeneity test to know whether homogeneous sample groups also average different tests to know whether the sample group has the same basic skill. Prerequisite normality test uses the *Kolmogorov Smirnov* test, homogeneity uses the *Levene* test, and similarity of two averages use *Independent-Sample T-Test* with SPSS 16.0 assistance and shows that sample group originated from a normal distributed population, homogeneous, and have the same basic skill.

Data analysis of mathematical creative thinking ability test result is used to answer the problem formulation of personal completeness and classical on Jigsaw cooperative learning assisted by problem cards for mathematical creative thinking ability and student's mathematical creative thinking ability on Jigsaw cooperative learning assisted by problem cards if compared with conventional learning using normality test by Kolmogorov- Smirnov test with SPSS 16.0 assistance, variant similarity test using Levene test with SPSS 16.0 assistance as a prerequisite test. Then, the data is tested using a proportion test and average different tests. After that, qualitative data analysis in the form of a student's mathematical creative thinking ability analysis observed by learning motivation. Mathematical creative learning ability refers to the mathematical creative thinking ability indicators which are fluency, flexibility, originality, and elaboration.

Qualitative data analysis techniques in the study are *data reduction*, *data display*, dan *conclusion: drawing/ verification*. The validity test for the study is obtained through a triangulation test. The triangulation that used for the study is technique triangulation. Technique triangulation was done by comparing test result data and interviewing to the study subject.

3. Results & Discussions

3.1. Learning motivation classification

Learning motivation classification is done to 36 students in experiment class (VIII B) by using the learning motivation questionnaire that has been validated by the expert and tested the validity and reliability. The questionnaire consists of 23 questions. Based on the questionnaire score interpretation, students who get ≥ 86 classified as a highly motivated student, 74-85 classified as an average motivated student, and < 74 classified as a low motivated student. Based on student classification result based on their learning motivation, 6 students have high learning motivation, 22 students have average learning motivation, and 8 students have low learning motivation.

Six students are selected as the subjects consist of 2 students with high learning motivation, 2 students with average learning motivation, and 2 students with low learning motivation. Then, all the 6 subjects who have been done the mathematical creative thinking ability test will be interviewed furthermore. The chosen subjects of each class are shown in Table 2.

Table 2. Subjek Penelitian

Learning Motivation	Student Code	Questionnaire Score
High	1. E-22	98
	2. E-29	91
Average	1. E-04	78
	2. E-15	80
Low	1. E-01	71
	2. E-35	66

3.2. The Completeness Jigsaw cooperative learning assisted by problem card for mathematical creative thinking ability.

Based on the mathematical creative thinking ability test result from the summary from experiment class (VIII B) was obtained that the highest score is 90, the lowest score is 52 and the completeness proportion is 88,89%. While the mathematical creative thinking ability from the controlled class of VIII C was obtained the highest score is 87, the lowest score is 45 and the completeness proportion is 70,58%.

Data were analyzed through several tests, there is a prerequisite test in the form of normality test using the Kolmogorov Smirnov and variants similarity using the Levene Test with SPSS assistance. In normality test was obtained that for experiment class sig = 0,139 > 0,05 and sig = 0,166 > 0,05 for controlled class, hence $H0$ is accepted. Thus, the data from the experiment and controlled class are originated from a normal distributed population. Then, in the similarity variants shows that the value of sig = 0,326 > 0,05 , hence $H0$ is accepted. So that the data from both the sample group has the same variants.

The study was continued by doing the learning completeness test with the average test and proportion test (one side, right side). The test is done to know that Jigsaw cooperative learning assisted by problem card is individually and classically complete for student's creative thinking ability.

Individual completeness in this study is if the average mathematical creative thinking ability in Jigsaw cooperative learning is more than a minimum limit score that has been determined which is 70. The average of mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card is 76,39. The first hypothesis in this study is the average mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem cards achieve the individual completeness, which is more than or equal with 70. The result of the individual completeness test is served in Table 3.

Table 3. Average Test Result

t_{count}	t_{table}	Conclusion	Meaning
4,494	1,689	$tcount > ttable$	the average of mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card is more than 70

Based on Table 3, $tcount > ttabl$. Hence, the average mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem cards reaches the minimum limit score that has been set, which is 70.

While the classical completeness in this study is if more than 75% of students get the score with a minimum limit of 70. The result of the class using Jigsaw cooperative learning assisted by problem cards is from 36 students in the class, 32 students of them (88,89%) get the score more than 70. The second hypothesis in this study is the percentage of classical learning completeness, mathematical creative thinking ability test in a class that using cooperative learning is more than 75%. The completeness test results are shown in Table 4.

Table 4. Proportion Test Result

$zcount$	$z(0{,}5-\propto)$	Conclusion	Meaning
1,924 501	1,64	$zcount > z(0{,}5-\propto)$	Proportion number of students who complete the test mathematical creative thinking ability is more than 75%

Based on Table 4, $z_{count} > z_{(0,5-\propto)}$. Thus, mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card achieves the classical completeness. Because 88,89% of the student pass the mathematical creative thinking ability.

This matter is in line with Yoselin's study (2016) that her study result shows that the class that is taught with Jigsaw learning achieve the individual and classical completeness. Jigsaw type application in mathematics learning gives a positive contribution to the development or enhancement of mathematical creative thinking ability and problem-solving ability.

3.3. Student's mathematical thinking ability in Jigsaw cooperative assisted by problem card compared with the conventional.

The study using the average difference test. Average difference and proportion difference test (one side, right side) are used to test the student's mathematical creative thinking ability jigsaw type assisted by problem card are higher than student's mathematical creative thinking ability in conventional learning, or not.

The third hypothesis in the study is the average results of student's mathematical creative thinking ability assisted by problem cards from the average mathematical creative thinking ability of the students who joined a conventional class. The average of Jigsaw cooperative learning assisted by problem cards and the conventional are 76,39 and 71,61. The calculation of the average difference test shown in Table 5.

Table 5. Result of Average Difference Test

t_{count}	t_{table}	Conclusion	Meaning
2,108	1,66	$tcount > ttable$	Student's mathematical creative thinking ability on cooperative class jigsaw type assisted by problem cards is better than student's mathematical creative thinking ability on conventional class

Based on Table 5, thus $tcount \geq ttable$ So the average of student's mathematical creative thinking ability in cooperative class Jigsaw type assisted by problem card is more than the average student's mathematical creative thinking ability in a conventional class.

The fourth hypothesis in the study is the proportion number of students who passed the mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card test is more than the proportion number of students who passed mathematical creative thinking ability tests in conventional learning. The result is class with Jigsaw cooperative learning assisted by problem card 32 out of 36 students in the class (88,89%) get the score more than or equal with 70, while in conventional class 24 out of 34 students (70,58%) get the score more than or equal with 70. The calculation of the average difference test shown in Table 6.

Table 6. Proportion Difference Test Result

$zcount$	$z(0,5-\propto)$	Conclusion	Meaning
1,913	1,64	$zcount \geq z(0,5-\propto)$	Proportion number of students who passed the mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card mor than the proportion number of students who passed the mathematical creative thinking ability in conventional learning.

Based on Table 6, thus $zcount \geq z(0,5-\propto)$ So proportion number of students who passed the mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem card more than the proportion number of students who passed the mathematical creative thinking ability in conventional learning.

This matter is in line with Isman's study (2014) shows that there is the enhancement of the student's mathematical creative thinking ability who gets the Jigsaw cooperative learning is better than the student who gets conventional learning.

Based on the explanation above, it shows that cooperative learning jigsaw type assisted by problem cards can be used to develop a student's mathematical creative thinking ability in their studies. This matter is in line with the study of Florentina & Leonard (2017) states that student's creative thinking ability can be more improved also increased if they're taught using jigsaw model

learning, because jigsaw model learning is a learning model that attempted to understand the materials by giving different perspectives, in every member so that they will be directed to think and they will find various answers.

3.4. Mathematical Creative Thinking Ability Observed From Student's Learning Motivation.

The result of mathematical creative learning ability test and interview results were analyzed with notice the mathematical creative learning ability indicators consists of : (1) Fluency (fluency) is the ability to solve mathematics problem appropriately and have a smooth flow of thought, so that the problem solving will be efficient; (2) flexibility (flexibility), is the ability to answer mathematics problem through many completion strategies; (3) authenticity (originality), is the ability to answer mathematics problem with their own language, ways, or ideas; and (4) elaboration (elaboration), is the ability to answer to the problem given in detail also able to bring the ideas or even new problem. Here is the description of the student's mathematical creative thinking ability observed from their learning motivation.

3.4.1. Students with high learning motivation

Students with high learning motivation able to answer the question well. In fluency indicators, students with high learning motivation can give the coherent and right answer, the student also capable to explain the steps fluently. When we finish the problem that needs the flexibility, students with high learning motivation can provide more than an answer differently. When we need originality to solve the problem, the student with high learning motivation can solve the problem in unique ways by their own mind. And when they solve the elaboration problem, the student with high learning motivation to explain the answer coherently, in detail, and fluently.

Therefore, the student with high learning motivation will not face serious difficulties to finish creative thinking ability questions given. They can achieve all the indicators of mathematical creative thinking ability optimally. According to Sardiman (2014), the result will be optimal if there is the right motivation.

3.4.2. Students with average learning motivation.

Students with average learning motivation will find few difficulties when resolving the problem. The student will understand the problem, but they might not understand the steps to resolve the problem well so that the answer might be wrong in certain questions. In fluency indicator, students with average learning motivation, able to provide the coherent and right answer, also they can explain the process of how to complete the problem fluently. When solving the problem that involves flexibility, the student with average learning motivation will provide only one correct answer and won't give another different answer. When completing the problem that involved originality, they will finish the problem in a basic

way. And when involve the elaboration, students with average learning motivation will be able to explain the solution and answer in detail and fluently.

Therefore, the student with average learning motivation will achieve two of all indicators which are fluency and elaboration indicators. According to Ermistri (2017), with their learning motivation that they have will raise the desire to study so that their creativity will be increased.

3.4.3. The student will low learning motivation

The student with low learning motivation is unable to complete mathematical creative thinking ability questions. In fluency indicator, the student with low learning motivation will not answer coherently fluently, there will be found some errors so that the final result still not correct, also students are not fluent enough to explain the steps of the solution. When doing the problem that involves flexibility, the student with low learning motivation will just write the answer randomly because they're lack of cubes and blocks concept understandings, so they only stick on the formula given. When they solve the problem that involves originality, the student with a low learning average will solve the problem in basics way and there will be found some errors so that the result will not be found yet. And when they do the elaboration question, the student with low learning motivation could not explain the solution and answer in detail and coherently.

Therefore, students with low learning average are difficult to solve the creative thinking questions given. Students with low learning motivation could not achieve all the indicators of mathematical creative thinking ability. This matter is in line with Akhsani's study (2017), the student with low learning motivation tends to be effortless if they find some difficulties so that they don't master the mathematical creative thinking ability well.

The average score from 6 students with high learning motivation is 87,5, the average from 22 students with average learning motivation is 77,5 and the average from 8 students with low learning motivation is 65.

Based on the analysis of mathematical creative thinking ability test and interview results for each category of learning motivation, student's mathematical creative thinking ability with high learning motivation is better than student's mathematical creative learning ability with both average and low learning motivation.

While the student's mathematical creative thinking ability with average learning motivation is higher than every average indicator of a student's mathematical creative thinking ability with low learning motivation. This matter is in line with Ermistri's study (2017) said that there is a significant connection between learning motivation and grade VII student's mathematical creative thinking that is strong and positive.

4. Conclusion

Based on the result and discussion of the study, the conclusion can be found as follows: (1) student's mathematical creative thinking ability in Jigsaw cooperative learning assisted by problem cards reaches learning completeness, (2) student's mathematical creative learning ability in Jigsaw cooperative learning assisted by problem card is higher than student's mathematical creative thinking ability in conventional learning, (3) student's mathematical creative learning ability observed from learning motivation are: (a) student with high learning motivation able to achieve all mathematical creative thinking ability indicators; (b) the student with average learning motivation able to achieve fluency and elaboration indicators, but not achieve the flexibility and originality indicators; (c) the student with low learning motivation less able to achieve fluency, flexibility, originality, and elaboration indicators. Teachers can apply Jigsaw cooperative learning assisted by problem cards to achieve the individual and classical completeness, also, to achieve a better learning result than learning with discovery learning model.

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