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Students' creative thinking ability in solving problems with double loop problem solving model

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Abstract

This study aims to test the completeness students' creative thinking abilities of Double Loop Problem Solving for, whether students' creative thinking skills in Double Loop Problem Solving learning are better than Problem Based Learning, the effect of learning independence on students' creative thinking abilities with Double Loop Problem Solving, and describing creative thinking abilities students in terms of learning independence. This research used mixed methods with sequential explanatory design. The quantitative research design used was Quasi-Experimental Design in the form of Posttest-Only Control Group Design The subjects of this study were six students of VIII C Class in SMPN 35 Semarang in the even semester of academic year 2018/2019. The data collection techniques used were: tests, questionnaires, and interviews. The results showed that: (1) students 'creative thinking ability in Double Loop Problem Solving learning achieves classical completeness, (2) students' creative thinking ability with the Double Loop Problem Solving model is better than Problem Based Learning, (3) learning independence has a positive effect on students' creative thinking ability in Double Loop Problem Solving learning, (4) students' creative thinking skills in terms of learning independence in Double Loop Problem Solving learning model as follows (a) Subjects with low group learning independence are less able to solve problems correctly and smoothly, with the different ways or answers, with their own thoughts, and with details; (b) Subjects of medium group learning independence are able to solve problems correctly and smoothly, less able to solve problems in different ways or answers, able to solve problems with their own thoughts, and less able to solve problems in detail; (c) Subjects of high group independent learning above are able to solve problems correctly and smoothly, with different ways or answers, with their own thoughts, and with details

1. Introduction

Mathematics is needed in various fields of science, for example in the fields of economics and engineering. When making tables, graphs, supply functions, demand functions, all use mathematical principles, since they are needed for various sciences, mathematics is taught from basic education to high education. Dewi et al (2014) by learning mathematics, students are expected to get used to dealing with various problems in daily life. To learn mathematics, creative thinking skills are needed, this is in accordance with Peraturan Menteri Pendidikan dan Kebudayaan Republik Indonesia Nomor 20 Tahun 2016 which mentions the process of organizing learning with creativity. The ability to think creatively is related to the ability to produce or develop something new, which is unusual and different from the ideas of most people. According to Siswono (2014), Creative thinking is a combination process of logical and different thinking that is used to bring or come up with a new idea. In creative thinking, someone will combine ideas that have been done to bring up new ideas.

Criteria for the creativity aspects used in this study refer to the criteria of creativity aspects from Mahmudi (2008). For fluency indicators, the characteristics are able to produce many relevant ideas or answers, able to have a smooth flow of thoughts. For indicators of flexibility (flexibility)

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characteristics are able to produce ideas, answers or questions that are varied, able to change the way or approach, and are able to have different thinking directions. Indicators of authenticity in thinking (originality) characteristics are able to provide unusual answers, other than others, which is rarely given by most people. The elaboration indicator (originality) has the characteristic of being able to develop, add, enrich an idea, be able to detail the details, and be able to expand an idea.

SMPN 35 Semarang is one of the junior high schools in Semarang City. Based on the results of the National Examination for State Junior High School for the academic year of 2017/2018, the mastery percentage of the SMP 35 Semarang matter for numbers 45.09%, algebra 46.24%, geometry and measurement 46.15%, statistics, and opportunities 43.44% which indicates that mastery of the material with the achievement low. Although the mastery of Geometry material and the measurement of Semarang 35 Junior High is higher than the provincial and national levels, it is written in the table that the mastery of the material is still low. As stated by a mathematics teacher in class VIII of SMP Negeri 35 Semarang that geometry is a subject matter that is difficult for students to understand. This is evidenced by the percentage of students who complete the geometry material by 60%. Student learning outcomes have not yet even reached classical completeness, which is 75% of the total students. One of geometry material is to build flat side space. Therefore, researchers want to research geometrical material that is flat side geometry.

Based on the results of interviews conducted by the researchers with seventh-grade mathematics teachers in SMPN 35 Semarang, it was found that about 40% of students had difficulty working on creative thinking questions. This is shown when the teacher gives a problem where the problem can be done in several ways, but students only work in a routine or as taught by the teacher normally.

Besides requiring the ability to think creatively, learning is also required to be able to condition students to obtain new information that is not taken for granted from the teacher's explanation. Learners must be able to build their own concepts and principles that are learned. These conditions require learning independence that can be formed from normal learning. As stated in Permendikbud No 20 of 2016, in the 2013 curriculum the learning process in the education unit is held interactively, inspirational, fun, challenging, motivating, having students to actively participate, and provide sufficient space for initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students. Therefore, independent attitude is one of the attitudes developed in education in Indonesia. Learning independence contains three main characteristics, namely developing learning strategies, reflecting on learning to make it effective, and the interrelated motivational process (Zimmerman, 1990). Learning independence will help students to recognize themselves and be motivated in learning. According to Sumarmo (2011), students who have high learning independence (self-regulated learning) will demand themselves to learn critically, logically, and be full of openness. Students are said to be independent in learning if they meet the indicators of learning independence, this study will use the indicators of learning independence as follows: (1) have the initiative to study mathematics, (2) having intrinsic motivation in learning mathematics, (3) finding and utilizing learning resources, (4) making learning strategies, (5) evaluation of the process and learning outcomes, (6) diagnose mathematics learning needs, (7) formulating learning goals, (8) regulates the learning process, (9) having a self-concept.

To improve the ability to think creatively and independently in learning for students, alternative learning that can be done is by Double Loop Problem Solving. Theoretically, Double Loop Problem Solving is learning that emphasizes the main causal search (cause) of the emergence of a problem and is given the opportunity to gain knowledge, experience, discover, recognize various learning objectives. This learning also involves creativity and critical thinking (Jufri, 2015). The steps of Double Loop Problem Solving in this study according to Huda (2013) consist of 2 loops. The first loop of the learning phase is identifying problems not just symptoms, detecting immediate causes and quickly applying temporary solutions, evaluating the success of temporary solutions, deciding whether root cause analysis is needed or not. or not. The second loop of the learning phase detects the causes of problems at a higher level, designing solutions to the root causes

The purposes of this study are, (1) to test that students 'creative thinking abilities with the Double Loop Problem Solving model achieve classical completeness, (2) to test if the students' creative thinking skills in learning with the Double Loop Problem Solving model better than learning with Problem Based Learning , (3) to examine the

effect of learning independence on students 'creative thinking abilities with the Double Loop Problem Solving model, (4) to describe students' creative thinking abilities in terms of learning independence in learning with the Double Loop Problem Solving model

2. Methods

The research method used in this study was mixed methods of sequential explanatory design. The quantitative research design used was Quasi-Experimental Design in the form of Posttest-Only Control Group Design. An overview of quantitative research designs according to Cresswell (2012), there are two groups of samples, namely as an experimental and control group. The experimental group was given learning with the Double Loop Poblem Solving model, the control group was given learning with the Problem Based Learning model. After learning, the two groups were given a posttest

The population in this study were students of class VIII semester 1 of SMPN 35 Semarang in the academic year of 2018/2019. The sample in this study was students of class VIII E as an experimental group who were given treatment in the form of Double Loop Problem Solving learning model and the control group of students of class VIII B which was treated in the form of PBL learning model. The sampling was based on random sampling techniques. In addition to setting a sample, to support the results of this study the selection of interview subjects were also conducted. The selection of interview subjects was based on a purposive sampling technique. The subjects of the interview consisted of 6 students which are 2 students from the high learning independence group, 2 students from medium learning independence groups and 2 students from the low learning independence.

Data col lection methods in this study are: 1) test method, 2) questionnaire method, and 3) interview method. The instruments in this study were: 1) the instrument of creative thinking ability test, 2) the instrument of learning independence questionnaire and 3) the instrument of interview guide. The instrument analysis techniques of the ability to think creatively include the validity test, the reliability test, the test of the difficulty of the questions, and the test of the differentiation of the questions. Furthermore, the questionnaire for learning independence includes the validity and reliability tests.

Quantitative data analysis in this study was the analysis of sample data, data analysis of creative thinking skills test results, analysis of questionnaire results and analysis of qualitative data. Analysis of sample data used the mathematics grade semester VIII grade of SMPN 35 Semarang in the Academic Year 2018/2019 which included the normality test, homogeneity test and average test for two. Data analysis of the creative thinking ability test used the value of the creative thinking ability test which includes the classic assumption test that is normality test and homogeneity test, then proceed with the completeness proportion test, two average difference test, two proportion difference test, and regression analysis test. Analysis of interview data to determine students' creative thinking skills in terms of learning independence of each category. After the students' creative thinking skills test data and the learning independence questionnaire data are obtained, the students are grouped into 3 categories that are students with high, mediu, and low group learning independence, then each student has two categories from each category to be interviewed about the answers test each other's creative thinking abilities. Qualitative data analysis techniques used in this study were data reduction, data display, and conclusion: drawing/verification. The validity test of the data in this study was through triangulation techniques conducted by comparing test data and interview data on the research subjects

3. Results & Discussions

Learning activities in the experimental group were carried out during four meetings and one meeting to test the ability to think creatively. Learning in the experimental group was conducted from 1 April 2019 to 9 May 2019 and the creative thinking ability test was carried out on the 9 May 2019 and the control group on 9 May 2019 with 80 minutes each. Then, the experimental class students were asked to fill out the learning independence questionnaire to find out their learning independence scores.

The results of students' creative thinking abilities tests were then tested for its normality and homogeneity. The normality test used the Kolmogorov-Smirnov test with the help of SPSS 16, the results show that the value of the creative thinking ability test comes from a normal distribution population. Homogeneity test using the Levene test with the help of SPSS 16, obtained

the results that the ability to think creatively test data have the same or homogeneous variants. Next, the proportion test is conducted to find out that students' creative thinking abilities in groups using the Double Loop Problem Solving learning model achieve mastery learning. The learning mastery in this study is that if the mathematics learning outcomes of SMPN 35 Semarang students is more than 75% of the number of students in the group with Double Loop Problem Solving learning creative thinking ability test scores are more than or equal to 70. In this study, the proportion test was conducted by using a one-party proportion test that is a left-side test and the results are obtained that the students' creative thinking abilities in groups using Double Loop Problem Solving learning achieve mastery learning. The next test was the average two similarity test and the two proportional similarity test. This test was conducted to find out that students 'creative thinking skills in groups that use Double Loop Problem Solving learning are better than students' creative thinking abilities in groups that use PBL learning. The average two similarity test uses the right-side test and the results show that the average test of students' creative thinking abilities in groups that use Double Loop Problem Solving learning is more than the average tests of creative thinking abilities of students in groups that use PBL learning. The similarity test of the two proportions used the right-side test and the results show that the proportion of students who passed the learning in class using Double Loop Problem Solving learning is more than the proportion of students who passed the learning in groups using PBL learning. Furthermore, from the results of the two average similarity test and the proportion similarity test, it was concluded that the students 'creative thinking skills in groups using Double Loop Problem Solving learning are better than the students' creative thinking abilities in groups using PBL learning. Next, test regretion. This test was conducted to determine whether learning independence affects the ability of students to think creatively in groups using Double Loop Problem Solving learning. The data used in this test are student learning independence questionnaire scores as independent variables expressed by X and students' creative thinking ability test scores as bound variables expressed by Y. The form of the regression equation obtained in this study is $Y = 21.187 + 0.992X$ and the effect magnitude of student independence on the ability to think creatively students in groups with Double Loop Problem Solving learning is 53,% while the remaining 46.2% is influenced by other factors not discussed in this study.

Factors that influence the success of Double Loop Problem Solving learning is that because it makes learning challenging. This is because, in learning, students are required to solve problems with two loops, the first loop students must observe the problem, determine the strategy and write down the solution, then double-check the strategy and solution, then write down the mistakes they have made and their corrections. In the second loop, students look back at the problem, determine the return strategy and write a solution based on the chosen strategy. Another thing that cannot be ignored is the provision of LKPD, LTPD, quizzes and homework material for surface area and volume of cubes and cuboids, the teacher's assistance in providing stimulus so that students can find solutions to problems and other things that are not observed by researchers that can improve students' creative thinking skill. This is in line with the results of research by Nanang (2016) which states that the increase in the ability to think creatively in mathematics is influenced by various factors, including learning provided by the teacher, the media used, and the conditions of learning. In addition, Lestari (2014) also revealed that students who find their own solutions to a problem have higher creativity compared to students who only passively accept material from teachers.

Practice questions are proved to increase the ability to think creatively with the quantity and quality of questions must be sufficient. The exercises are done in groups and individually. Group exercises are done while working on the LTPD, with groups allowing students to exchange ideas and help one another. Individual question exercises are done while working on quizzes, individual problem exercises allow students to improve their creative thinking abilities. This is in line with the results of the study of Nasution et al (2015) which states that there are differences in the ability to think creatively between students who are given problem-based learning and students who are given conventional learning, wherein the increase in mathematical creative thinking abilities of students who are given problem-based learning is higher than on improving the creative thinking abilities of students who are given conventional learning. In line with that in Rahayu's research (2014) the results of the study showed that the Double Loop Problem Solving model with a character-charged PMRI approach to improve the

problem-solving ability of class X trigonometry material is a valid, effective, and practical learning model. In his research, Fajriah (2019) revealed that learning with Double Loop Problem Solving with a good quality RME approach in mastering mathematical communication, reasoning, argumentation, designing problem-solving strategies. Kurniasari (2014) also revealed that the learning model added to the problem-solving steps revealed by Polya had a better role than an expository learner to develop students' creative thinking abilities.

The result shows that learning independence has a positive effect on students' creative thinking abilities. So the higher the level of student learning independence, the higher the students' creative thinking abilities and so does the contrary. Learning independence influences students' creative thinking abilities in the learning of Double Loop Problem Solving. This is in line with Nur's research (2016) which revealed that there is a positive relationship between learning independence and the ability to think creatively.

The result of the study shows that the ability to think creatively with high learning independence for question number 1, 2, 3, 4 fulfilled the indicators of fluency, flexibility, originality, and elaboration. This is because in question all numbers students can convey the purpose of the problem, the process of solving the problem, the process of getting an idea well so that it is considered that the student meets the fluency indicator. Also, students can provide answers or other ways to solve problem all numbers so that students can be said to meet indicators of flexibility. Students also explain if working on problems with their thoughts so that students say meet the indicators of originality. When working on problems, students can work in detail and can explain it when asked by the teacher so that it is said to meet the elaboration indicator. This is in line with the results of Uswati's research (2018) which states that subjects with high learning independence can meet all indicators of creative thinking abilities. In line with that Mursidik et al (2015) which mentions the ability of students to think creatively for high categories on the aspect of fluency is very good because it can solve problems without difficulty. Besides elaborative students are very good, which means students can clarify the settlement in detail and precisely. According to Abida et al (2017) students with high learning, independence can work on problems coherently and correctly and can explain the process of working on problems correctly. Also, students can work on problems with many different and correct answers. Correspondingly, Arifah (2016) mentions the ability to think creatively for upper groups able to solve problems smoothly, in more than one way, correctly and in detail. In learning, students from high learning independence groups are very active in small and classical group discussions, are more confident both in asking and responding without being appointed first, are disciplined in collecting assignments, and can participate in all learning activities very well. The attitude possessed by students with high learning independence is thought to be one of the factors that results in students having good creative thinking abilities with information on achieving indicators of students' creative thinking abilities outlined earlier.

The results of the study show that the ability to think creatively with medium learning independence group for question number 1 meets the fluency indicator, lacks flexibility, fulfilled originality and lacked elaboration. This is because in question all numbers students can convey the purpose of the problem, the process of solving the problem, the process of getting an idea well so that it is said the student meets the fluency indicator. Also, students must be given a stimulus by the teacher first when asked to provide answers or other ways to solve problem number 1 so it is said students do not meet the indicator of flexibility. Students also explain working on problems with their thoughts so that students say meet the indicators of originality. When working on problems, students are less able to work in detail and must be given a stimulus when asked to explain the shortcomings along with their justifications so they are said to be inadequate to elaboration indicators. In question number 2 students meet the fluency indicator, meet the flexibility indicator, meet the originality indicator and not meet the elaboration indicator. This is because in question number 2 students can convey the purpose of the problem, the process of solving the problem, the process of getting an idea well so it is said that students meet the fluency indicator. Also, students can provide answers or other ways to solve questions number 2 so that students say they meet indicators of flexibility. Students also explain working on problems with their thoughts so that students say meet the indicators of originality. When working on problems, students lack in writing the length of the cube's ribs and can explain their shortcomings after being given a stimulus by the teacher so they are said to lack the

elaboration indicators. In question number 3 it meets the fluency indicator, it doesn't meet the flexibility indicator, it meets the originality indicator and it meets the elaboration indicator. This is because in question number 3 students can convey the purpose of the problem, the process of solving the problem, the process of getting an idea well so it is said that students meet the fluency indicator. Also, students must be given a stimulus by the teacher when asked to provide answers or other ways to solve problem number 3 so that students are considered that they do not meet the indicator of flexibility. Students also explain if working on problems with their thoughts so that students say meet the indicators of originality. When working on problems, students lack writing formulas but can write them down when asked by the teacher so they are said to meet the elaboration indicator. In question number 4 students meet the indicators of fluency, flexibility, originality, and elaboration. This is because in question number 4 students are able to convey the purpose of the problem, the process of solving the problem, the process of getting an idea well but not right because it is wrong in using a formula that should have a surface area volume, but when asked to justify students can give the correct answer in solving the problem so it is said students meet the fluency indicator. Also, students can provide answers or other ways to solve problem number 4 so that students say they meet indicators of flexibility. Students also explain if working on problems with their thoughts so that students say meet the indicators of originality. When working on problems, students can work in detail and explain it so that it is said to meet the elaboration indicators. This is in line with research by Mursidik et al (2015) which states students with learning independence are on the fluency aspect both being able to come up with ideas in solving mathematical problems and not experiencing trouble. Aesyi et al (2015) also revealed subjects on learning independence being unable to solve problems with different or new solutions. In learning, students from learning independence groups are only active in small group discussions and there is no initiative to be classically active or respond to teachers without being appointed, occasionally late in collecting assignments, and overall being able to participate in all learning activities properly. The attitude of students with moderate learning independence is thought to be one of the factors that results in students having good creative thinking abilities with information on achieving the indicators of students' creative thinking abilities that have been described previously.

The results of the study show that the ability to think creatively with low learning independence group independence for question number 1, 2, 3, 4 meets the fluency indicator, did not meet the flexibility indicator, met the originality indicator and did not meet the elaboration indicator. This is because in question all numbers students can convey the purpose of the problem, the process of solving the problem, the process of getting an idea well so that it is said that the student meets the fluency indicator. Also, students are not able to provide answers or other ways to solve problem all number so it is considered that the students do not meet the indicator of flexibility. Students also explain if working on the problem with their thoughts, it is proven by students being able to explain how they solved the problem so well that it said students meet the indicators of originality. However, when working on problems, students are less detailed and when asked to mention their shortcomings the students are less able so that they are said to lack the elaboration indicators. This is in line with research by Mursidik et al (2015) which explains that the ability to think creatively for the low category as a whole is in the poor category. In learning, students from low learning independence groups are less active in both small and classical group discussions, are often late in collecting assignments, and as a whole have not been able to participate in all learning activities properly. Students in the learning independence group are low, often left behind in each learning activity. The attitude of the students with low learning independence is thought to be one of the factors that causes students to have a good enough creative thinking ability with information on the achievement of the indicators of students' creative thinking abilities that have been described previously.

4. Conclusion

Based on the results of research and discussion of the research results regarding students' creative thinking abilities in terms of learning independence in Double Loop Problem Solving learning obtained the following conclusions. (1) Students' creative thinking abilities in Double Loop Problem Solving learning achieve classical completeness. (2) The ability of students' creative thinking in learning with the Double Loop

Problem Solving model is better than learning with Problem Based Learning. (3) Learning independence has a positive effect on students' creative thinking abilities in learning with the Double Loop Problem Solving model. (4) The description of students' creative thinking abilities in terms of learning independence in the learning of the Double Loop Problem Solving model is as follows, a) subjects with low group learning independence are less able to solve problems correctly and smoothly, less able to solve problems with different ways or answers, less able to solve problems with their thoughts, and less able to solve problems in detail, b) subjects of the medium group learning independence are able to solve problems correctly and smoothly, less able to solve problems with different ways or answers, able to solve problems with their thoughts, and less able to solve problems in detail, c) subjects with high group learning independence are able to solve problems correctly and smoothly, able to solve problems with different ways or answers, able to solve problems with their thoughts, and able to solve problems on their own in details.

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