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Mathematical Creative Thinking Ability in terms of Mathematical Disposition in Creative Problem Solving Learning with an Open Ended Approach

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Abstract

This study aims to describe students' mathematical creative thinking skills based on mathematical dispositions in creative problem solving learning with an open-ended approach. This research is a mixed method research with a sequential explanatory model. The population in this study were students of class VIII SMP N 3 Pabelan Semarang Regency in the academic year 2020/2021 with a sample of class VIII A and class VIII C as the experimental class and the control class. The research subjects were two students each with high mathematical disposition, medium mathematical disposition and low mathematical disposition. The results showed that students' creative thinking skills in each category of disposition had similarities and differences. All disposition categories have fulfilled the fluency aspect. On the flexibility aspect, only students with high disposition category are fulfilled. Subjects with a low disposition category can only fulfill one and two aspects of creative thinking abilities.

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INTRODUCTION

Through mathematics students are prepared to be able to deal with changing circumstances that develop based on logical, critical, rational, honest, careful thinking and use mathematical thinking (Saputri et al., 2016). So that learning mathematics will help students to have the ability to solve problems in everyday life (Febriyanti & Irawan, 2017). Pratiwi et al (2019) argued that the students' abilities needed in learning mathematics include the ability to communicate, think critically and think creatively.

Mathematical creativity is one of the greatest assets of a nation to process, create and transform innovative ideas from other fields into new fields. The importance of mathematical creativity is also emphasized by Piaget in Norixa et al (2017) which states that the most important goal in education is not how to create the same generation as today, but also create a generation that has the ability to create something new and be creative.

In the industrial era, creativity is a necessity for everyone, especially in education. Because with creativity students will grow and be trained to explore, investigate, find and solve problems (Massyrova et al., 2015). So that creative thinking skills can help students solve problems of everyday life. Creativity is contained in a variety of domains, including mathematics. Mann (Runisah et al., 2016) summarizes the opinions of several academics who apply the concepts of fluency, flexibility, and originality to the concepts of creativity in mathematics.

However, in Siswono's research in Ulfah et al (2017) creativity rarely occurs in mathematics learning, because there are still teachers who place logic as a benchmark and think creativity is not so important in mathematics. The results of this study were reinforced by the results of the researcher 's interview with a mathematics teacher at SMP N 3 Pabelan which stated that the teacher in the learning process usually focused on values that met the minimum completeness criteria without paying attention to the abilities in mathematics, so that the teacher gave more answer-oriented questions. single and with certain completion steps because it causes students to be afraid to express their opinions or ideas for fear of being wrong and embarrassed in front of their friends.

Mathematical disposition is the character value in mathematics which looks at the attitude of students' confidence in answering math problems, reviewing their persistence and tenacity in math assignments. In addition, curiosity and respect for the usefulness of mathematics (Putra et al., 2017). The importance of this mathematical disposition is expressed by Sumarmo in Dina et al (2019) that the importance of developing mathematical dispositions in learning mathematics is the fact that students need the ability to appreciate the usefulness of mathematics and enjoyment in learning mathematics.

The process of learning activities carried out in the classroom greatly affects students 'creative thinking skills and mathematical dispositions, so that learning is needed with coherent and systematic stages to facilitate students to find and express their opinions in solving math problems and students' appreciation of mathematics (disposition) to be better. In line with that Rochmad & Masrukhan (2016) stated that the success of learning carried out in the classroom is because the teacher uses a learning model that is appropriate, varied, teaches well (good teaching).

The teacher as a facilitator and teacher in the learning process, it is necessary to apply a learning that can provide opportunities to improve students' creative thinking skills. Creative Problem Solving (CPS) is an alternative learning that facilitates the development of students' creative thinking. As stated by Huda in Muin et al (2018), the CPS learning model is the development of problem-solving learning. The stages in this learning model are systematic procedures for identifying challenges, creating ideas and implementing innovative solutions.

So far, the teacher gives problems to students with routine problems as an exercise or assignment that is always oriented towards the end goal, namely the correct answer. So that the processes or procedures that have been carried out by students in solving the questions get less attention. Because of this, in this study the researcher was interested in using a learning model with an open-ended approach.

Bernard & Chotimah (2018) say that the open-ended approach is an approach that is not oriented towards the end result and this approach directs students to answer problems in many ways and possibly with many correct answers.

The formulation of the problems in this study was to describe students' mathematical creative thinking skills based on mathematical dispositions in creative problem solving learning with an open-ended approach. The goal to be achieved is to analyze creative thinking skills based on students' mathematical dispositions.

METHODS

The research method used in this study is a mixed method with a sequential explanatory model, namely a combination method combining quantitative and qualitative methods sequentially, where the first stage of research is carried out using the quantitative stage and the second stage is carried out by qualitative research. The design used in this study was the posstest control group design. The population in this study were students of class VIII SMP N 3 Pabelan Semarang Regency in the odd semester of the 2020/2021 school year. The sample in this study were students of class VIII A as an experimental class who were given treatment in the form of creative problem solving learning with open-ended approaches and the control class, namely class VIII C, was given treatment in the form of creative problem solving learning. This sampling is based on cluster random sampling technique. The research subjects were two students each with high mathematical disposition, medium mathematical disposition and low mathematical disposition.

Data collection methods in this research are test methods, documentation, questionnaires, observation sheets and interview guidelines. Quantitative data analysis techniques began with item analysis, preliminary data analysis, then hypothesis testing. Initial data analysis was to determine whether the two sample groups had the same initial ability, and it was found that the students' initial abilities of both classes were the same. While the hypothesis testing includes individual completeness test, classical completeness test, average difference test, and test of the effect of disposition on mathematical creative thinking ability. Prior to testing the hypothesis, a prerequisite test was carried out including the normality test using the Kolmogorov-Smirnov test and the homogeneity test using the Levene test with the help of SPSS 25.0. Qualitative data analysis techniques were carried out using qualitative descriptive methods including data validity, data reduction, data presentation and drawing conclusions.

RESULT AND DISCUSSION

Quality of Learning

The quality of learning includes the planning, implementation and assessment stages. At the planning stage of the assessment, three expert validators with a scale of 5. Validated devices include syllabus, lesson plans, student activity sheets (LKS), observation sheets, student response sheets, mathematical disposition questionnaires, mathematical creative thinking skills test questions and interview guides. Each device received the lowest average score of 4.27 for the syllabus and the highest 4.5 for the lesson plans, which means that the interpretation for each device is in the very good category so it is feasible to use. For the test results of the instrument test of the mathematical creative thinking ability of 6 questions, 4 questions were selected for the posttest based on the results of validation, difficulty level, distinguishing power and reliability as well as indicators containing students' mathematical creative thinking abilities.

At the implementation stage, learning is said to be of quality if the observation sheet by the observer and the student's response sheet to learning is in the minimal good category. The observer who assessed the mathematics teacher at the school where the research was held, carried out the research as many as 3 meetings with an average score that increased in each meeting, namely 4.2 at the first meeting, 4.4 and 4.67 for the second and third meetings with interpretation. very good. While the student response sheet to learning obtained a score of 94.125 with very good interpretation.

The quality of the assessment stage is seen from the effectiveness of creative problem solving

learning with an open-ended approach to mathematical creative thinking skills. Prabawa & Zaenuri (2017) reveal that the effectiveness of a lesson is an indicator of the success of the learning being carried out. Before testing the effectiveness, the prerequisite test is conducted first, namely the normality and homogeneity test using SPSS 25.0. Based on this test, the data obtained came from a population with a normal and homogeneous distribution. Based on the results of the research that has been done, the results of the completeness test are at least a test of the ability to think creatively with standard normal $\alpha = 5\%$ obtained $t_{hitung} = 2{,}886 > t_{tabel} = 1{,}703$, then H_0 rejected. So the average mathematical creative thinking ability of students exceeds the actual pass limit, namely 67.357. The results of the classical mastery test to test whether the proportion of students who reached the actual passing limit had reached 75%, using the z test was obtained $z_{hitung} = 1{,}66 > z_{tabel} = 1{,}64$ so that rejected H_0 and accept H_1 which means that the proportion of completeness of mathematical creative thinking skills using creative problem solving learning with an open-ended approach exceeds 75%, completeness achievement of the experimental class and control class is 78.5% and 57.69%. The comparative test of the average creative thinking ability using the t test was obtained $t_{hitung} = 1{,}80027 > t_{tabel} = 1{,}67469$ so that rejected H_0 and accept H_1 which means that the average creative thinking ability of students obtained using creative problem solving with an open-ended approach is better than the average creative thinking ability of students who are treated using creative problem solving, namely the experimental class has an average of 67.357 and 60.153 in the control class.

Students who are taught using creative problem solving learning with an open-ended approach obtain an average above the actual pass limit, based on the classical completeness test, the results show that the proportion of students who score more than 59 has exceeded 75%. In addition, the researcher also tested the average difference between the experimental class and the control class and the average result of the experimental class students 'mathematical creative thinking ability in solving questions was better than the control class students' creative thinking ability. These statements show that creative prblem solving learning with an open-ended approach can be said to be of quality. This is because the learning syntax guides students to get used to thinking creatively in solving the problems given, and the open-ended approach aims to provide opportunities for students to solve problems according to their own ideas so that they can develop students' creative thinking power with the freedom they have.

Based on this description, it shows that creative problem solving learning with an open-ended approach can be said to be of high quality. In creative problem solving learning, learning activities involve active student participation, where the teacher is more active in interacting by giving open-ended questions until students get used to expressing their opinions without having to be afraid of being wrong and not being stuck on a single answer. This is in accordance with Vygosky's theory put forward by Vygotsky in Supriyadi (2016), namely the process of increasing understanding in students occurs as a result of learning, social interactions which are able to provide opportunities for students to optimize their learning process, express their arguments so that it will guide students to think towards a higher stage. Creative problem solving learning consists of six stages, namely (1) objective finding, (2) fact finding, (3) problem finding, (4) idea finding, (5) Solution finding, (6) acceptance finding. According to Shoimin in Zulyadaini (2017), these stages are systematic stages to organize students in creative problem solving. The use of an open-ended approach in this study as an effort to improve students' creative thinking skills refers to several studies (Damayanti & Sumardi, 2018; Palah et al, 2017; Romli et al, 2018; Sabrina et al, 2018) which say that the open approach -ended effectively to improve mathematical creative thinking skills in students. This is reinforced by Ulinnuha et al (2019) that the use of open-ended problems can help students practice creative thinking skills. Because open-ended learning increases the ability of students to solve questions and explore answers creatively (Rohaeti et al., 2019). Other studies also say that the use of open-ended can make students more active in learning (Novia, 2016) and

can increase self-confidence for students to work on problems at a higher level (Faridah & Aeni, 2016).

Description of Mathematical Creative Thinking Skills in Terms of Mathematical Disposition

Next is a qualitative analysis of mathematical creative thinking skills in terms of student dispositions. The questionnaire was given to control class students and then grouped according to high, medium and low categories. The following are the results of the mathematical disposition questionnaire of 28 students presented in Table 1.

Table 1. Results of Mathematical disposition Grouping

Group	Many students	Precentage
High disposition	3	10,7%
Moderate disposition	12	42,9 %
Low disposition	13	46,4 %
Total	28	100 %

Based on Table 1, many students with high dispositions are 3 students with a percentage of 10.7%, students with moderate dispositions are 12 students with a percentage of 42, 9% and students with low dispositions are 13 students with a percentage of 46.4%. Based on the mathematical disposition scale analysis, 6 research subjects were selected to be further investigated regarding the mathematical creative thinking ability. The following is a description of mathematical creative thinking skills in terms of mathematical dispositions.

Overall students with high dispositions can solve creative thinking problems well. This is indicated by (1) the subject has fulfilled the fluency aspect because it can understand the questions well, explain the work results and write clear conclusions on the answers, (2) do not fulfill the flexibility aspect because in answering questions there are errors in calculating and not carefully reading the questions because the subject has a headache (3) the originality aspect has been fulfilled because it can form a unique and different pattern, (4) the elaboration aspect is fulfilled because it can explain in detail and coherently for each answer procedure. This finding is inversely proportional to the findings of Mahmudi & Saputro (2016) which revealed that problem-solving abilities tend to be associated with dispositions because students have persistence, interest and high curiosity. However, subjects with high disposition did not read the whole problem and only assumed through pictures because they had a headache. This is in line with the results of Dasmaniar's (2018) research which states that the problems that occur in students, namely health, economy, parenting in the family, time use, self-confidence, etc. have implications for how to analyze students on a problem and student learning achievement. Based on the results of the interview, it is known that the two subjects with high disposition categories are quite confident when answering questions. This is in line with the results of research (Syarifah et al, 2018) which states that students with high dispositions have an attitude of confidence in solving math problems.

The results of student research with moderate disposition show that aspects of (1) fluency have been met because the subject can understand, work on and conclude answers clearly, (2) flexibility has not been fulfilled because the subject misinterprets the questions and uses the usual strategies to solve the questions, (3)) originality has not been fulfilled because the subject made a pattern by changing slightly from the problem, and (4) elaboration has been fulfilled because it can use logic and explain in detail how to work on the problem. This finding is in line with the results of research by Akbar et al. (2017) who revealed that students with moderate dispositions tend not to be able to understand the problem and are not careful when checking the results of the answers to solving math problems.

The results of the research of students with low dispositions show that the aspect of (1) fluency has been fulfilled because the subject can understand and work on the questions well, (2) flexibility has not been fulfilled because they do not understand what is meant by questions related to the characteristics of number patterns so they cannot use the right strategy to solve the problem, (3) originality is not fulfilled because the subject makes a pattern with a simple form and does not understand the question commands well, (4) elaboration is also not fulfilled because the subject cannot use logic to understand the

problem and cannot explain in detail the results his job. This finding is in line with the research of Akbar et al. (2017) which revealed that students with low dispotion did not have good problem-solving skills.

Based on the explanation above regarding the ability to think creatively in terms of students 'mathematical dispositions, this is in line with the NCTM statement (2000) which states that students' attitudes and beliefs in solving math problems have an influence on student work results in solving math problems. In addition, students with high dispositions will have a responsible person, have the willingness and confidence to help students achieve their best results (Widyasari et al, 2016). But, it also needs to pay attention to other factors, namely external and internal students during the learning process because they can interfere with students (Dasmaniar, 2018). Because in this study students with high disposition categories have been able to achieve three aspects of creative thinking skills, but there are still things that are lacking due to student health factors. Meanwhile, students with poor dispositions with moderate and low categories can only fulfill two aspects of creative thinking skills due to lack of understanding of problems, not being careful and giving up just by looking at long questions. This is in line with the research of Sarifah et al (2018) which states that students with a poor disposition category cannot understand the problem, causing student identification of the problem not to be resolved and have an impact on the next steps, eventually students will find it difficult and give up with a makeshift answer .

CONCLUSION

Based on the results of the analysis and discussion, it shows that the descriptions of creative thinking abilities in terms of students' mathematical dispositions show mixed results, which means that students' dispositions are not the single factor that affects students' creative thinking abilities. Other factors include internal and external factors of students that can affect the student learning process and results.

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