Mathematical creative thinking ability viewed from students’ learning interest and adversity quotient through creative problem-solving learning model

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Abstract. The study aims to: (1) find the increase of mathematical creative thinking ability through the CPS learning model; (2) find the increase of mathematical creative thinking ability through the CPS learning model viewed from learning interest; (3) find the increase of mathematical creative thinking ability through the CPS learning model viewed from Adversity Quotient (AQ); (4) determine the effect of learning interest and AQ students towards mathematical creative thinking ability; and (5) describe mathematical creative thinking ability viewed from learning interest through the CPS learning model. This study used a mixed-method. The results showed that: (1) students' mathematical creative thinking ability increased through the CPS learning model; (2) students with high interest increased moderate creative thinking ability, students with moderate interest increased moderate creative thinking ability, students with low interest increased creative thinking abilities low; (3) students with AQ climber, camper, and quitter increased moderate creative thinking ability; (4) there was a significant influence between student’s learning interest and AQ towards mathematical creative thinking ability; and (5) students with high interest at level 4 of mathematical creative thinking (LMCT), students with moderate interest at level 3 of LMCT, and students with low interest at level 1 of LMCT.

1. Introduction

Students are required to mastering of 21st skills in order to face the challenges of the 21st century. There are critical thinking and problem solving, communication, collaboration, creativity and innovation as a part of 21st skills [1-3]. These capabilities are better known as 4C capabilities. One of the attempts to improve this ability is through the process of learning. The appropriate learning process can encourage students to develop these abilities as well as improve higher-order thinking skills.

In the education system, students must have creative thinking because it is an important ability [4]. In learning mathematics, students are educated to be critical and creative because in learning mathematics five processes of mathematical ability are developed, namely communication, reasoning, problem solving, understanding, and fluency. In mathematics learning, these processes are useful for developing self-confidence, creative thinking, and information [5]. This shows that creative thinking ability is an essential part to develop learning in school.

Creative thinking is a mathematical ability used to solve mathematical problems, it is especially so when the solutions to problems are not easy to find and the ideas needed to find the solutions are very suitable to solving the problems [6]. Mathematical creative thinking skills have an important role to the problem-solving process in middle school students [7].
Although creative thinking ability is pivotal, in fact this ability has not been mastered properly by Indonesian students. Based on the results of The Global Creativity Index 2015, it shows that from the assessment of all creativity which includes aspects of technology, talent and tolerance, Indonesia's creativity index is far below the average of other countries, namely with a score of 0.202 on the 115th rank out of 139 countries [8]. With this low ranking, it is need to pay special attention to the government, society and educators in developing the creative potential of their students deeply.

From the interview with a mathematics subject teacher of SMPN 1 Talang showed that the students’ mathematical creative thinking ability has to be developed. Based on a study of the results of the 2019 National Examination analysis, it was found that in general junior high school students can work on routine questions. They master routine questions both involving stories and related to calculations only [9]. However, many students have difficulty understanding irregular questions, especially the level of reasoning which requires a more complex thinking process that emphasizes creativity.

Seeing the condition of the results of GCI, Mathematics National Examination, and the results of interviews, it is necessary to improve the learning process by developing appropriate learning, so the students have the opportunity to get used to thinking creatively. One of them can be through by choosing the right learning model named CPS (Creative Problem Solving). The CPS learning model focuses on problem-solving skills followed by students’ creative strength. Through CPS students are given the opportunity to understand the concepts by solving a problem, students become active in learning and can develop thinking skills and ability to solve problems. [10] stated that CPS process provides a great range of flexibility to solve problems. Students’ mental strength is indispensable for effective learning and positive emotions have an effect on both creative and flexible thinking [11]. The students’ habits in using creative ideas in problem-solving are aimed at developing their creative thinking skills.

A person’s success factors in developing thinking ability affected by internal factors and external factors. Among them are factors in a person that may affect thinking ability, namely Adversity Quotient (AQ) and learning interest [12,13]. The interest predicted students’ performance in their different ability levels [14]. These studies supported the fact that interest is indispensable in students’ engagement in academic activities. Interest is a constant tendency to pay attention to and remember some activities. Therefore, in order to be successful in any endeavor, one must cultivate an interest in what is desired. The ability to withstand the face of adversity is certainly needed by students as an important point in learning success. [15] classifies humans into three AQ categories, namely: low AQ (quitters), moderate AQ (campers), high AQ (climbers).

The aims of this study based on the background description above aims to find the increase in mathematical creative thinking ability through the CPS learning model, to find the increase in mathematical creative thinking ability through the CPS learning model viewed from learning interest, and from AQ, to determine the effect of learning interest and AQ of students toward mathematical creative thinking abilities, and to describe mathematical creative thinking skills of students viewed from learning interest through the CPS learning model.

2. Methods
This type of research is mixed methods, with a sequential explanatory design. The quantitative research design used One-Group Pretest-Posttest, with a population of all students of eighth grade in the even semester of SMPN 1 Talang in the 2019/2020 academic year including grade 8A to 8I with a total of 288 students.

The sampling technique used simple random sampling, selected grade 8G as the research class as many as 30 students. Taking research subjects using purposive sampling technique consisted of 6 students with different learning interests, namely 2 students for high learning interest, 2 students for moderate learning interest, and 2 students for low learning interest. The selection of research subjects from different levels of interest in learning is intended to obtain complete information.

Quantitative data were obtained from tests score of mathematical creative thinking abilities and the results of questionnaires on students’ learning interest and AQ, while qualitative data were obtained from the results of tests, questionnaires and interviews which were used to obtain descriptive data of students'
creative thinking abilities viewed from learning interest. Before using, the test instrument is tested validity, reliability, difficulty level, and discriminant index. Quantitative data analysis used t test, N-gain with Hake's formula, and regression analysis. While for the qualitative research used collecting data, reducing data, presenting data, and drawing conclusions.

3. Results and Discussion

3.1. Quantitative Data Analysis

Hypothesis 1 test is used to determine whether there is an increase in students' creative thinking ability from the pretest to posttest scores after using the CPS learning model. This hypothesis test uses paired sample t-test with SPSS. The statistical results show that Sig.=0.000 < 0.05. This means that there is a difference in the average value of the pretest and posttest of mathematical creative thinking abilities. With an average pretest value =61.61< the average posttest value =75.27.

Furthermore, to determine the magnitude of the increase in the pretest value of students' mathematical creative thinking abilities with the posttest, the N-Gain test was carried out. The N-Gain test was carried out using the Ms Excel program based on the gain test formula proposed by Hake (1998). The results of the N-Gain calculation for grade 8G is 0.3716. This means that there is an increase in learning outcomes in the moderate category.

The CPS learning has a positive impact on students, the impact that is felt can produce student self-confidence which in turn will increase students' interest [16]. CPS improves various skills, so the students can analyze their ideas, find solutions the problems, provide support for their abilities, become more active, creative, and participate well [17]. The CPS strategy has been proven to be more effective in increasing mathematics learning achievement and also in improving students' attitudes towards mathematics [18].

Hypothesis test 2 is used to determine whether there is an increase in students' creative thinking ability from the pretest to posttest scores after using the CPS learning model viewed from learning interest. The explanation of the results of the N-Gain test for students with each level of interest learning can be seen in Table 1.

| Interest Level | $S_{pre}$ | $S_{post}$ | N-Gain | Information |
|----------------|----------|-----------|--------|-------------|
| High           | 64.77    | 80.11     | 0.451  | Moderate    |
| Moderate       | 60.76    | 72.41     | 0.304  | Moderate    |
| Low            | 52.1     | 65        | 0.27   | Low         |

Based on the Table 1. above, the results of the N-Gain calculation, the students with a high learning interest obtained an N-gain value of 0.451, meaning that students with high learning interest there is an increase in learning results in the moderate category. Students with a moderate learning interest get an N-gain value of 0.304, meaning that students with a moderate learning interest there is an increase in learning results in the moderate category. Meanwhile, students with a low learning interest obtained an N-gain value of 0.2, meaning that students with low learning interest there is an increase in learning results in the low category.

[19] stated that teachers as motivators have a crucial role in influencing student interest in mathematics learning achievement. To cultivate student interest, teachers must make students happy to learn, because pleasure is important in learning. Through this CPS learning model, it shows that students are dominant at a high level of interest, which means that it has a positive impact on their interest in learning.

Hypothesis test 3 is used to determine whether there is an increase in students' creative thinking ability from the pretest to posttest scores after using the CPS learning model viewed from the AQ level of students. The explanation of the results of the N-Gain test for students with each student's AQ level can be seen in Table 2. below.
Table 2. Student N-Gain test results for each student's AQ level.

| AQ level | $S_{pre}$ | $S_{post}$ | N-Gain | Information |
|----------|-----------|------------|--------|-------------|
| Climber  | 69.52     | 84.28      | 0.501  | Moderate    |
| Camper   | 60.22     | 73.87      | 0.346  | Moderate    |
| Quitter  | 58.3      | 70.83      | 0.305  | Moderate    |

The result of the three levels of AQ namely climber, camper, and quitter increased mathematical creative thinking ability each in the moderate category, all of which belong to the moderate increasing category. Judging from the table, the AQ climber has a far range of scores from the AQ camper and quitter types. It is in accordance with the research of [20] which show that the adversity quotient through the CPS model affects students' creative thinking abilities. [21] said that students with AQ climber show better intelligence than students with AQ camper and quitter with have an open attitude, not easily give up, enthusiastic in learning also their can manage the emotions and morals well.

Hypothesis test 4 is used to show whether there is a positive influence on students’ learning interest and adversity quotient through the CPS learning model toward creative thinking ability. The regression equation from statistical results is

$$\hat{Y} = -13,850 + 0.482X_1 + 0.302X_2$$

is linear and the coefficient of regression direction is significant. Where $X_1$ is the level of students’ learning interest, $X_2$ is the level of AQ students and $\hat{Y}$ is the student's mathematical creative thinking ability. The results of the SPSS output show that there is a relationship between students’ learning interest and AQ on mathematical creative thinking abilities. After the calculation is done, the coefficient of determination $r^2 = 0.686 = 68.6\%$. This shows that the average mathematical creative thinking ability of students is 68.6% influenced by students’ learning interest and AQ, while the remaining 31.4% is influenced by other factors.

The existence of a positive influence on students’ learning interest and AQ to learning outcomes is achieved through the process of applying the CPS learning model. In CPS learning, interest will encourage students to keep trying to find strategies by doing everything they can to produce creative ideas based on the knowledge they have until they find solutions [22]. So that students who have high interest tend to have high creative thinking ability.

[15] states that people who are successful in learning are people who have high AQ. The dominant factor forming AQ is an unyielding attitude. Someone who has a high AQ has an optimistic nature, so if you want the ability to think creatively to be improved, it is necessary to increase the adversity quotient because it has a positive relationship.

3.2. Qualitative Data Analysis

The questionnaire analysis results of learning interest level from 30 students grade 8G of junior high school 1 Talang showed that there were 14 students with high interest, 12 students with moderate interest, and 4 students with low interest. The selection of research subjects was chosen by two students in each level of interest in learning with the dominant level of creative thinking at each level of learning interest. The selection of these subjects was based on the consideration of the level of learning interest, pretest score, and posttest score. Selected subjects were then interviewed. The interview held on Saturday, March 28, 2020.

The analysis results of the questionnaire on the level of student learning interest obtained six research subjects which can be seen in Table 3.

3.2.1. Description of Mathematical Creative Thinking Ability Viewed from Learning Interest

This section will show students' mathematical creative thinking ability. The analysis was carried out based on data from the posttest and interview data from each research subject, by paying attention to three indicators, namely fluency, flexibility, and novelty.

Students with a high level of learning interest tend to be at Level 4 of Mathematical Creative Thinking (LMCT) which means very creative. In indicator fluency, students with a high level of learning interest the answers to the problems tend to be able to write fluently, or smoothly. Each work process is
written completely and accurately. As for the results of the interviews, the subject of S-1 and S-2 confidently explained the ideas or answers during the test smoothly and correctly. In indicator flexibility, students with high learning interest tend to be able to provide closure in different ways and diverse. Every step of the completion is written accurately and completely. As for the results of the interviews, the S-1 and S-2 subjects tend to be able to explain the ideas that have been obtained properly and precisely. In indicator novelty, students with high learning interest tend to be able to solve problems in their own way of thinking that is different from the others. Even with the idea itself, the solution is done correctly with the correct answer. Based on the results of the interviews, the S-1 and S-2 subjects can explain the ideas they got properly and precisely.

Table 3. List of research subjects.

| No. | Subject | Code | Category           |
|-----|---------|------|--------------------|
| 1   | S-1     | C-07 | High learning interest |
| 2   | S-2     | C-06 | High learning interest |
| 3   | S-3     | C-27 | Moderate learning interest |
| 4   | S-4     | C-20 | Moderate learning interest |
| 5   | S-5     | C-13 | Low learning interest |
| 6   | S-6     | C-15 | Low learning interest |

The analysis results above found that students with a high level of interest in learning tended to be able to meet 3 indicators of creative thinking abilities, namely fluency, flexibility and novelty. This is supported by research [18] states that students who have a high interest in learning will tend to be persistent, resilient, never give up and are happy to face challenges. So that in his research it was found that the mathematical creative thinking abilities of students who have high interest are higher than students who have low interest in learning.

Students with moderate learning interest levels tend to be at Level 3 of LMCT which means creative. In indicator fluency, students with moderate level of learning interest tend to be able to write answers to problems with fluently or smoothly. Each process is written completely and accurately. Even though the S-4 subject had a little difficulty in providing illustration images correctly, the problem-solving steps were smooth. As for the results of the interviews, the S-3 and S-4 subjects confidently explain the ideas or answers during the test smoothly and correctly. In indicator flexibility, students with moderate learning interest tend to be able to provide a solution in a different way and varied. Every step of the completion is written accurately and completely. As for the results of the interviews, the S-3 and S-4 subjects are able to explain the ideas that have been obtained properly and accurately. In indicator novelty, students with moderate learning interest tend not able to solve problems in their own way of thinking that is different from the others. S-3 and S-4 tend to solve problems in the usual way that they often encounter. As for the results of the interview, the S-3 and S-4 subjects can explain the ideas they get in the usual way that they encounter properly and precisely, but when asked in other ways, students cannot explain them well. The results of the analysis above found that students with a moderate level of learning interest were only able to two indicators of creative thinking, namely fluency and flexibility.

Students with a low level of learning interest tend to be at Level 1 of LMCT which means less creative. In indicator fluency, students with a low level of learning interest tend to be able to write answers to problems with fluently or smoothly. Each process is written in full. However, S-5 can provide the steps correctly, but there are mistakes in the calculation process so that the final result is not correct. As for the results of the interview, the subject of S-5 and S-6 confidently explains the ideas or answers during the test smoothly and correctly. In indicator flexibility, students with low learning interest tend not able to provide a solution in a different way and varied. Students only write one completion step, and the S-6 subject cannot write an answer with the right result. As for the results of interviews, the S-5 and S-6 subjects tend to be unable to explain the ideas that have been obtained properly and accurately. In indicator novelty, students with low learning interest tend to be able to solve
problems in their own way of thinking that is different from the others. S-5 and S-6 tend to solve problems in the usual way that they often encounter. The S-6 subject provides solving steps that are not relevant to the given problem. As for the results of the interviews, the S-5 and S-6 subjects could not explain the ideas they got properly and precisely.

The analysis results above found that students with a low level of learning interest were only able to one indicator of mathematical creative thinking abilities, namely fluency. In line with the research of [21] show that students with lower learning interest tend to have more difficulty understanding given math problems. This greatly impacts on the mistakes made both in modeling the questions and in determining the solution strategy.

4. Conclusion
Based on description of results and discussion, the following conclusions were obtained: (1) There is an increase in students' mathematical creative thinking skills through the CPS learning model with an N-gain value of 0.3716 which is in the moderate category; (2) students with high interest increased moderate creative thinking ability, students with moderate interest increased moderate creative thinking ability, students with low interest increased low creative thinking ability; (3) students with AQ climber increased in moderate creative thinking ability, students with AQ camper increased in moderate creative thinking ability, students with AQ quitters increased in moderate creative thinking ability (4) There is a significant influence between students’ learning interest and AQ towards mathematical creative thinking ability through the CPS learning model. (4) The description of mathematical creative thinking ability viewed from students' learning interest through the CPS learning model is as follows. Students with high learning interest tend to be in the very creative category. Students with moderate learning interest tend to be in a creative category. Students with low learning interest tend to be less creative.

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