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Analysis of Mathematically Creative Thinking Ability in View of Students' Curiosity in E-module Assisted Creative Problem-Solving Learning

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Abstract

This study aims to describe the level of mathematical creative thinking ability in terms of students' curiosity. The research method used is a mixed method method with a sequential explanatory design. Quantitative data was obtained through pre-test and post-test, while qualitative data was obtained through questionnaires and interviews. The population in this study were all students of class VII SMP N 1 Sayung with a sample of two classes, namely, the control class and the experimental class taken by purposive sampling. The results showed that Creative Problem-Solving learning assisted by e-module was effective on students' mathematical creative thinking abilities. There is a significant influence of students' curiosity variables on the ability to think creatively mathematically. In the analysis of mathematical creative thinking ability, students with high curiosity master the four indicators of creative thinking ability, namely fluency, flexibility, originality, and elaboration. Students with curiosity are mastering the three indicators, namely fluency, flexibility, and originality. While students with low curiosity master two indicators, namely fluency and flexibility.

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INTRODUCTION

In the current era of globalization, science and technology are advancing and developing along with the times. One of them is that quality education will create superior and useful human resources in advancing a nation.

Mathematics is an educational science that has an important role in everyday life (Tan et al., 2020). Therefore mathematics is taught in formal and non-formal schools (Martalyna et al., 2018) from elementary to higher education, even from an early age children have been taught about calculations and introduced to numbers. Mathematics plays an important role in the learning process at school because through mathematics students are trained to think critically, creatively, logically, analytically and systematically. The ability to think creatively for students is very important in the era of global competition (Widiansah et al., 2019; Tubb et al., 2020; Gunawan et al., 2018). Creativity plays an important role in mathematics (Regier & Savic, 2020 ; Schoevers et al., 2020 ; Isnani et al., 2020 ; Maskur et al., 2020 ; Bicer, 2021). Creative thinking provides benefits to one's life such as adding new knowledge and creating solutions to solve problems, as stated by Ramadhani & Caswita (2017) the benefits of creative thinking are very broad, so as to be able to find completely new things or ideas/renewable concepts. Creative thinking can build ideas in dealing with problems (Leasa et al., 2021; Ernawati et al., 2019). Someone who always thinks creatively will have an impact on the person in planning and deciding an action and a creative person is usually more organized in action, so by thinking creatively, a plan can be executed properly and carefully from the planning stage to implementation. The ability to think creatively is needed by students because currently science and technology are developing rapidly so that anyone can obtain information quickly and easily from various sources. This is in accordance with the opinion of Latifah & Widjajanti (2017), the rapid development of science and technology has a positive role in human life and one of the sciences in charge is mathematics.

Mathematics is a scientific discipline that consists of several topics. Mathematics topics given to students from elementary to secondary education include numbers and their operations, algebra, geometry, measurement and data analysis and measurement (National Council of Teachers of Mathematics, 2000). In mathematics, the questions presented also vary, starting from questions in the form of numbers, pictures, diagrams, and story questions, according to the level of education. However, many students cannot understand the forms of these questions. Understanding a problem is written by knowing what is known and what is asked. Meanwhile, planning for problem solving is written by collecting existing data, information and formulas creatively by using certain ways to find possible solutions to problems. According to Krulik, Stephen & Rudnick (1995) argues that in understanding or planning problem solving an adequate student creative thinking ability is needed, because this ability is a high-level thinking (reasoning) ability after basic and critical thinking.

Based on the TIMSS report in 2011, the average score for geometry material was 377 (Vebrian & Hartono, 2016). Indonesia is in the lowest three rankings of the other TIMSS participating countries and this shows that students' ability to work on geometry questions is still low. According to Utami & Kuneni (2016) most students only rely on memorization without understanding geometric concepts so they often make mistakes in solving problems. Meanwhile Silalahi (2021) stated that geometry is an important field of mathematics which has an important effect on the development of students' creative thinking skills in learning mathematics.

Geometry is a part of mathematical material that has a close relationship with other parts of mathematics (Sholihah & Afriansyah, 2017). Geometry is used by everyone in everyday life. In real life geometry is useful in engineering, geography and other fields. This is in accordance with the opinion of San & Lwin (2020) which states that scientists, architects, artists, engineers, and housing developers are a few examples of professions that use geometry regularly. In everyday life, geometry is used to design houses, gardens or decorations. According to Suhartini & Martyanti (2017) the purpose of learning geometry is for students to gain confidence about their mathematical abilities, become good problem solvers, be able to communicate mathematically, and

be able to reason mathematically. The geometry studied at school includes basic geometry, analytic geometry and transformations. Each stage is studied starting from elementary school to high school, starting from studying pure geometry, then analytic geometry then transforming geometry. Basically, geometry has a greater chance to be understood by students compared to other branches of mathematics. This is because students already know geometric ideas before they enter school, such as lines, planes, and space. Nonetheless, evidence in the field shows that junior high school students' geometry problem solving is still low. The average level of ability to solve geometric problems is still low, namely in the material of quadrilaterals (Sholihah & Afriansyah, 2017) and triangles (Fitria et al., 2018). Timutius et al. (2018) found junior high school students' mistakes in solving geometry problems in circle material. The results of the students' creative thinking ability test at Sayung 1 Public Middle School showed a lack of mathematical creative thinking ability.

The 2013 curriculum prioritizes learning that encourages students' physical and mental activities optimally. Such learning practices support the growth of active learning (active learning). This learning moves all physical and mental activities of students so that students have a lot of learning experiences through empowering their own activities. This learning also trains students to be able to think critically, creatively, and communicatively needed in 21st century life. Even though creativity has become the focus of learning mathematics, the implementation of classroom learning that leads to student creativity is still far from what is expected (Nurisalfah et al., 2018).

Given that the ability to think creatively mathematically is important to be developed by students, researchers seek to facilitate students in developing these abilities, namely with the Creative Problem Solving learning model. CPS is a learning model with a problem-solving process using systematic techniques so that it is able to solve problems by gathering creative ideas from the problems it faces (Hsm et al., 2021). The Creative problem solving syntax is Objective Finding, Fact Finding, Problem Finding, Idea Finding, Solution Finding, and Acceptance Finding (Kapoor et al., 2020); (Roswanti et al., 2020). The CPS syntax supports indicators of the ability to think creatively mathematically, including objective finding related to aspects of fluency (Hsm et al., 2021), fact finding related to aspects of fluency, problem finding related to aspects of flexibility (Hsm et al., 2021); (Hooijdonk et al, 2016), Idea Finding is related to aspects of flexibility, Solution Finding is related to aspects of elaboration (Hsm et al., 2021); (Hooijdonk et al, 2016), and Acceptance Finding is related to the elaboration aspect (Hsm et al., 2021). Research by Malisa & Bakti (2018) shows that the CPS learning model can improve the creative thinking skills of class XI IPA 2 SMA PGRI 6 Banjarmasin. Strengthened by Faturohman (2020) states that students are more able to play an active role in the learning process and can develop their thinking skills because students are required to come up with problem solving ideas both individually and in groups in the learning process so that students' mathematical creative thinking abilities increase. Another point of view, there is an influence of the Creative Problem Solving learning model assisted by ICT-based media on the ability to think creatively in solving students' mathematical problems (Yuliastuti et al., 2019). In this study, researchers will describe the low barriers to mathematical creative thinking ability and the level of mathematical creative thinking ability in terms of students' curiosity and test the effectiveness of e-module-assisted Creative Problem Solving learning to improve students' mathematical creative thinking abilities.

METHOD

The method used by researchers is a mixed method with a sequential explanatory design. This research was conducted at SMPN 1 Sayung with a population of all class VII students. The sample in this study was class VII C as the experimental class. The instrument used in this study was a mathematical creative thinking ability test in the form of a written test consisting of an initial test (pre-test) and a final test (posttest). The form of the test is a description test which consists of 4 questions with 1 indicator of creative thinking ability for each question. These questions had previously been addressed to classes with a higher level where the class had studied triangle and quadrilateral material before, after testing, the data was processed by measuring validity, reliability, discriminating power, and level of difficulty. This is used as a benchmark for the quality of the items to be given.

RESULTS AND DISCUSSIONS

The effectiveness of creative problem solving learning on mathematical creative thinking ability

To find out how the achievement of students' mathematical creative thinking abilities using the CPS model and those using the usual learning model. This achievement data analysis was carried out using percentage analysis from the test, namely looking at the results of the percentage of student post-tests and compared with the KKM score.

Table 1. Results of Analysis of Achievement of Students' Mathematical Creative Thinking Ability

Kelompok	KKM	Jml siswa	Banyak siswa mencapai KKM	Persentase	Kategori
Eksperimen	75	32	24	75%	Tinggi
Kontrol	75	34	16	47%	Cukup

Based on the results of the achievement of the ability to think creatively mathematically using the CPS learning model in the experimental group it showed that only 75% of 32 students achieved the KKM score so that it was included in the high category. Meanwhile, the achievement of students' mathematical creative thinking skills using the usual learning model in the control group showed that only 47% of 34 students achieved the KKM score, so that they were included in the sufficient category. So it can be concluded that the achievement of students' mathematical creative thinking abilities using the CPS learning model is high and the achievements of students' mathematical creative thinking abilities using conventional learning models are sufficient.

Based on the research that has been done, the results of data on students' mathematical creative thinking abilities are obtained. The data obtained are pretest and posttest data. The first step is to analyze the initial mathematical creative thinking ability of students from both groups. And the statistical test results obtained that the initial ability of students' mathematical creative thinking is the same. To see an increase in students' mathematical creative thinking skills, it can be seen from the magnitude of the gain index (N-Gain).

Table 2. Results of Gain Index Descriptive Analysis

Kelompok	N	Mean	Std. Deviasi	Skor Minimum	Skor Maksimum
Eksperimen	32	24.56	2.57	0.00	50.00
Kontrol	34	10.57	3.13	-16.67	66.67

Testing students' mathematical creative thinking abilities whose learning using the CPS model is better than the usual learning model using the two-difference test of independent average gain index data. Before carrying out the difference test of the two independent averages of the gain index data, the normality and homogeneity tests of the two groups were first tested. The normality test uses Kolmogorov Smirnov because this test can be used for very small data without having to combine the data to be tested first, so the results obtained are more accurate, the results obtained are that the two groups come from normally distributed populations with the same significance of 0.200 .Then a homogeneity test of variance was carried out from the gain index data. The results of the homogeneity test showed that the two groups had a homogeneous sample population variance with a significant value of 0.257.

Table 3. Gain Index Data Difference Test Results

Class	Sig.
Eksperimen	0.162
Kontrol	0.003

From the results of the two difference test on the average gain index data contained in table 3, the results are sig. experimental class is 0.162 > 0.05 so that it can be said to be normally distributed, while sig. control class is 0.003 < 0.05 so it can be said not normally distributed. Thus it can be concluded that the average increase in students' mathematical creative thinking skills using the CPS model in learning mathematics is better than students who use the usual learning model. Providing treatment (treatment) in learning using the CPS learning model to the experimental group which can help students understand lessons more quickly and be able to develop students' mathematical creative thinking abilities. One that influences this is the steps of finding objects, finding facts, finding problems, finding ideas, finding solutions and finding acceptance so that students are creative in solving problems, and students can solve the questions given more easily. This is in accordance with the research of Malisa & Bakti (2018) which shows that the CPS learning model can improve the creative thinking skills of class XI IPA 2 SMA PGRI 6 Banjarmasin. Strengthened by Faturohman (2020) states that students are more able to play an active role in the learning process and can develop their thinking skills because students are required to come up with problem solving ideas both individually and in groups in the learning process so that students' mathematical creative thinking abilities increase. Another point of view, there is an influence of the Creative Problem Solving learning model assisted by ICT-based media on the ability to think creatively in solving students' mathematical problems (Yuliastuti et al., 2019).

Creative Problem Solving is something that is a bit new at the school and in class VII C. However, students in this class have no difficulty adjusting themselves in learning so that learning runs smoothly. In the core activity, students are divided into several heterogeneous groups consisting of four to five people in one group. Students sit in the order of their groups and each group is given a LKS. The learning media in the form of LKS is made so that students can solve problems with the hope that the solutions obtained will have many ways of dealing with SPL material. This is given in accordance with the problem clarification stage which includes the process of understanding the problem, where students explore the immediate problems given and it is hoped that with the understanding stage of this problem they will be able to find the facts that underlie the problem.

When filling out the LKS, each group is allowed to express ideas of various kinds of problem solving strategies. This is the stage where students find new ways that they find from the results of their group discussions regarding the problems given.

At the implementation stage one of the group representatives presented their findings in front of the class. At this stage each group interacts directly, where groups that do not present the results of their discussions can respond to the results of other groups' discussions. At the evaluation stage, namely the training stage and followed by assignments, students are given practice questions to solve individually. This stage aims to measure the level of student creativity in the learning process that has been done before.

Examine the effect of curiosity on mathematical creative thinking ability.

The effect of curiosity on the ability to think creatively mathematically was tested using a regression test. Based on the results of data analysis with SPSS 18.0, sig = 0.000 was obtained, so sig = 0.000 <0.05. Then H0 is rejected. this means that there is a significant influence between curiosity on students' mathematical creative thinking abilities. The magnitude of the influence of curiosity on the ability to think creatively can be seen in the R square value. Based on the results of data analysis with SPSS 18.0, the value of R square = 0.364 is obtained, which means that the curiosity variable affects the ability to think creatively mathematically by 36,4% and the remaining 63,6% is influenced by other factors. Based on the output coefficients table, it can be concluded that the regression equation is Y = 0,030 + 0,353 X. This means that each addition of the curiosity variable (X) of one unit will increase the value of the mathematical creative thinking ability test (Y) of 0,353.

Mathematical creative thinking ability

Creative thinking ability is one of the high order thingking skill. In this study, there are four indicators of the ability to think creatively mathematically, namely fluency, flexibility, originality, and elaboration. Students in the upper group were able to master the four indicators of creative thinking ability, namely: being able to solve

mathematical problems correctly (fluency), being able to use a variety of strategies in solving mathematical problems (flexibility), being able to solve mathematical problems using their own language (originality/originality) and being able to broaden the answers to problems, broaden the ideas they have (detail/elaboration).

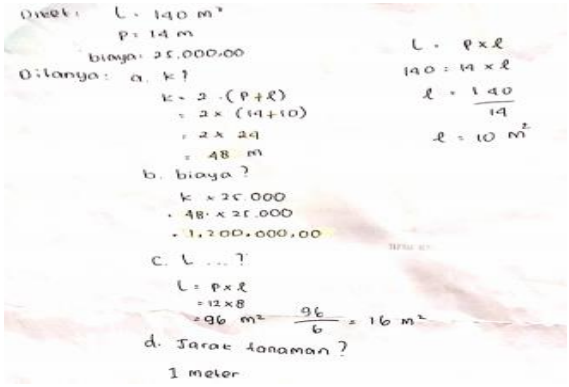

Figure 1. High curiosity test results on elaboration indicators

Based on the answers he had written, CT1 was able to write down the answers in detail, namely to write down what was asked and to do it in a coherent manner starting from calculating the circumference, cost, area, and distance between the plants and the guardrail. CT1 has not been able to write down the answer completely, CT1 writes it is known until the completion is correct. Based on the test results, CT1 fulfills the elaboration indicator. At the time of the interview CT1 was able to explain in detail the answers he wrote. CT1 is able to explain what steps must be taken in solving the problem and CT1 is able to explain the formulas used in solving the problem. Based on the results of the tests and interviews, CT1 can be said to have met the elaboration indicators.

Curiosity students are being able to master the three indicators of mathematical creative thinking ability, Curiosity students are being able to solve mathematical problems correctly (fluency), are able to use various strategies in solving mathematical problems (flexibility), are able to solve math problems using their own language (originality) /originality). However, they have not mastered the detailed indicators (elaboration).

Students in the lower group are able to master two indicators, namely being able to solve mathematical problems correctly (fluency) and using various strategies in solving mathematical problems (flexibility). In general, the achievement of indicators for the ability to think creatively mathematically for each group can be seen in Table 4.

Subject	**Indikator berpikir kreatif matematis**			
	Fluency	Flexibility	Originality	Elaboration
CT1	√	√	√	√
CT2	√	√	-	√
CS1	√	√	-	√
CS2	√	√	√	-
CR1	√	√	-	-
CR2	√	√	-	-

Based on the results of tests and interviews, it was found that students who have high curiosity also have a high level of mathematical creative thinking as well. This is in accordance with the opinion (Liberna, 2022) if a person's level of curiosity is high, it will have an impact on increasing the ability to think creatively in mathematics. According to (Solehuzain & Dwidayati, 2017) on the analysis of mathematical creative thinking skills, upper group students master the four indicators. According to (Arifin et al., 2020) male students with various categories of creative epistemic curiosity, while women are very creative. Meanwhile, according to (Shoit & Masrukan, 2021) students with high curiosity fulfill the indicators of fluency, flexibility, and novelty, occupying level 4 (very creative). In accordance with the opinion (Solehuzain & Dwidayati, 2017), that is, there is a significant influence of the student's curiosity variable on the ability to think creatively mathematically.

CONCLUSION

The Creative Problem Solving learning model effectively improves mathematical creative thinking skills. This can be seen in the results of the students' pre-test and post-test.

Creative Problem Solving learning assisted by e-module was effective on students' mathematical creative thinking abilities. There is a significant influence of students' curiosity variables on the ability to think creatively mathematically. In the analysis of mathematical creative thinking ability, students with high curiosity master the four indicators of creative thinking ability, namely fluency, flexibility, originality, and elaboration. Students with curiosity are mastering the three indicators, namely fluency, flexibility and originality. While students with low curiosity master two indicators, namely fluency and flexibility.

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