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The Analysis of Mathematical Critical Thinking Skills of Students in Junior High School

Desi Ratna Sari
Postgraduate of Mathematics Education
Lampung University
Bandar Lampung, Indonesia
drsdesyratna@gmail.com

Caswita
Mathematics Education Department
Lampung University
Bandar Lampung, Indonesia

***Abstract*— This study aims to analyze the students' critical thinking skills in triangular and quadrilateral material. This research is a descriptive study with a qualitative approach with the sample research involved 104 students, grade VII students of state junior high school 30 Bandar Lampung. The data collection technique used is a written test consisting of two essay questions. The results of this study indicate that indicators of critical mathematical thinking skills, students' critical thinking skills of mathematics, especially in the analysis, evaluation, and indicators of mathematical inference of students in SMP Negeri 30 Bandar Lampung are still relatively low.**

Keyword: mathematical critical thinking skills

I. INTRODUCTION

In the process of education in schools, various sciences prepare students to face global challenges that are scattered in the distribution of subjects. In the learning process at the school, mathematics is one of the sciences learned. Mathematics is one of the sciences that plays an important role in the development of science and technology. Mathematics is given at every level of primary and secondary education so that the students can use mathematics as a way of reasoning (logical, analytical, systematic, critical, creative, and the ability to work together) [1]. Based on that, increasing the ability to think critically is an important and urgent matter to be developed in the present, which is full of life problems or challenges[2].

Critical thinking in mathematics is a cognitive ability and disposition to combine the knowledge, reasoning, and cognitive strategies in generalizing, proving, and evaluating mathematical situations that are not recognized by reflective means [3]. Also, critical thinking is thought to make sensible decisions about what is believed and done [4]. The ability to think critically is closely related to the aspects of the indicators. Critical thinking indicators can be seen from its characteristics so that by having the characteristics of critical thinking, a person can be said to have the ability to think critically. Indicators of critical thinking, according to Facione, are interpretation, analysis, evaluation, and inference [5].

In Indonesia, students' critical thinking skills are still low. One of them is based on the results of the Program for International Student Assessment (PISA) test conducted in 2015. Indonesia is ranked 63 out of 70 countries with an average mathematical score of 386, while the international average score is 490 [6]. It shows that the ability of Indonesian students to solve non-routine questions or questions that require higher-order thinking skills, including critical mathematical thinking, is still relatively low.

In addition to the 2015 PISA results that illustrate the low mathematical critical thinking skills of students in Indonesia in general. One of the schools in Indonesia with low mathematical critical thinking skills of students at SMP Negeri 30 Bandar Lampung. Based on the observations and interviews with teachers taught the VII grade of SMP Negeri 30 Bandar Lampung. The results of observations indicate that students find it difficult to solve mathematical problems given by the teachers, and they also still have difficulty in writing the answers systematically, especially in the triangle and quadrilateral material. The results in students not being independent because if students are given a mathematical problem that is not much different from the example problems or exercises, they will find it difficult and unable to express their opinions mathematically. Hence, their mathematical critical thinking skills are still relatively low.

This study aims to analyze the critical thinking skills of VII grade students of SMP Negeri 30 Bandar Lampung on the material of triangles and quadrilateral based on the indicators of critical thinking skills according to the Facione's opinions, namely interpretation, analysis, evaluation, and inference. With this research, it is expected to provide information to mathematics teachers about the condition of critical thinking skills in mathematics in class VII junior high school students. And the teacher can design learning activities that can encourage students to practice their critical thinking skills.

II. EXPERIMENTAL METHOD

This study was classified as a descriptive study with a qualitative approach aimed at describing the characteristics of the developed test, as well as describing the ability of mathematical critical thinking skills of VII grade students on triangular and quadrilateral material. The research subjects are VII F, VII G, and VII H class, with 104 students selected by a simple random sampling technique. In this study, the data obtained from the test results of students' mathematical critical thinking skills test consisting of 2 items essay related to the

material triangle and quadrilateral. The data is then analyzed with the four indicators of mathematical critical thinking skills. The data is obtained by assessing each student's answer based on the rubric of critical thinking skills assessment. Furthermore, it is processed by determining the percentage of fulfillment of each indicator presented in tabular form and made conclusions.

III. RESULTS AND DISCUSSION

A. Results

1) Percentage tests of students' mathematical critical thinking skills

The percentage of data of the students' mathematical critical thinking skills tests can be seen in table 1.

TABLE I. PERCENTAGE TESTS OF STUDENTS' MATHEMATICAL CRITICAL THINKING SKILLS

Students' Score	**Scoring**	**Percentage Question No. 1**	**Percentage Question No.2**	**Total Percentage**
81 – 100	Very Good	20.19	19.23	15.39
61 – 80	Good	55.77	53.85	57.69
41 – 60	Enough	24.04	26.92	26.92
21 – 40	Less	0	0	0
0 – 20	Very Less	0	0	0
Jumlah		100	100	100

2) Percentage of the students' mathematical critical thinking skills based on the indicators

Indicators of critical thinking skills used in this study are interpretation, analysis, evaluation, and inference. The results of tests of critical thinking skills based on indicators are as follows.

TABLE II. PERCENTAGE OF THE STUDENTS' MATHEMATICAL CRITICAL THINKING SKILLS BASED ON THE INDICATORS

Indicator	**Percentage Question No. 1**	**Percentage Question No. 2**	**The Average percentage of fulfillment of indicators**	**Category**
Interpretation	87.50	72.12	79.81	Good
Analysis	56.73	43.27	50	Enough
Evaluation	53.85	30.77	42.31	Enough
Inference	40.38	18.27	29.33	Less

B. Discussion

Based on Table 2 it can be explained that the level of mathematical critical thinking skills of students on each indicator is different. The level of critical thinking skills in both categories for interpretation indicators is 79.81%. It shows that students have good critical thinking skills in understanding and giving meaning to the information from various experiences, events, situations, assessments, and certain criteria [5].

The ability to think critically in the category is sufficient for the analysis indicator to reach 50%. The test results show that the analysis aspect needs to be improved so that the students can have the ability to clarify based on the relationship between information and concepts, with the questions that are in the given problem.

The ability to think critically in the category is sufficient, also obtained by the evaluation indicators, which reach 42.31%. Then the evaluation aspect also needs to be improved, so that the students can assess the credibility of a statement based on the relationship between information and concepts, with the questions that exist in a problem.

The ability to think critically in the less category or the lowest aspect for inference indicators is 29.33%. Therefore the inference aspect must be improved so that the students can identify the parts needed to make rational conclusions by considering the relevant information on a problem that has been given [7]. These results indicate that the students' mathematical critical thinking skills are still relatively low, especially on indicators of analysis, evaluation, and inference.

Analysis of mathematical critical thinking skills can be seen in the following question number 1.

Two congruent right triangles have a base size a cm and a height measure b cm, can you find the formula for the area of the rectangle of the area of the triangle? If you already have the formula, can you find the area of the triangle and rectangle if the value of a is 4 cm, and the value of b is 8 cm?

Based on table 1. it was found that for problem number 1, who got an excellent category of 20.19% with 21 students. On the indicators of interpretation, analysis, evaluation, and inference, the students can connect all the information that is known with the right completion strategy until they can conclude well.

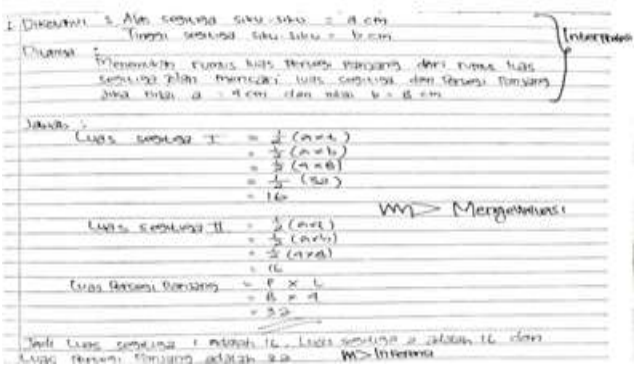


Fig. 1. One of the results of the students' work in either category

Figure 1. Demonstrates that the interpretation indicator, the students can interpret very well because they can write down all the information that is known and can describe a condition in the problem given correctly. They can also write what is asked correctly. These results indicate that the ability of the students in the aspects of student interpretation is good because 87.50% of them can interpret well.

In the analysis indicator, students cannot connect the known information with the solution to the strategy. Because in problem number 1, they are directed to be able to find a rectangular formula from the formula area of a right triangle.

But because the students already know the triangle area formula from previous experience, so they are no longer looking for a rectangular area formula from the triangle area formula students immediately apply it to the rectangular area formula they know. From these results, it was identified that the students' ability in the aspect of student analysis was still quite sufficient because only 56.73% of students could analyze it well

In the evaluation indicators, the students can use the strategy correctly in completing the complete and correct questions in doing calculations, but some students do not write the unit area. From the results of evaluating the ability of students on aspects of student, evaluation is still quite sufficient because only 53.85% of students can evaluate well.

In the inference indicator, some students can make the conclusions correctly according to the context of the problem but are incomplete, because they only write the inferences from the results of the rectangular area only, the students do not explain that the formula for rectangular area can be obtained from adding two pieces of the triangle area formula. From these results, it was identified that the ability of students in the aspect of inference was lacking because only 40.38% of students were able to infer properly.

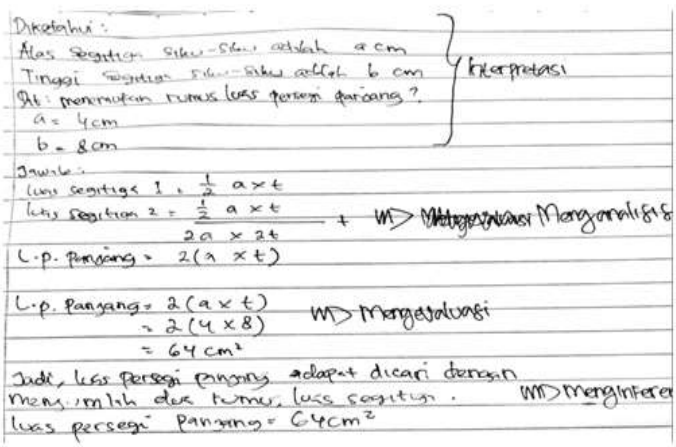


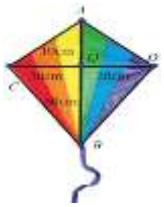
Fig. 2. One of the results of the students' work in a sufficient category

Figure 2. Shows that on the indicator of interpretation, students cannot interpret correctly. Because they can only write down all the information that is known, but they do not write down what is asked. In the analysis indicator, the students can make a mathematical model of the problem given. Still, it is not right, because students can write the formula area of the triangle I and II correctly which is $\frac{1}{2}(axt)$. However, they are not careful in understanding the information that is known that the base of the right triangle is *a* and the height of a right triangle is *b*, and in the area of the rectangle, the student is wrong in the calculation.

In the evaluation indicators, the students use the right strategy, but at the analysis stage, they have made mistakes. Then at the evaluation stage, the calculations made by students are wrong. In the inference indicator, some students can make the conclusions exactly according to the context of the problem but are incomplete, because they only write the conclusions from the results of the area of the rectangle with the wrong result.

Analysis of other critical thinking skills can be seen in the question number 2 below.

Andre plans to make his favorite kite. He has made the kite design, as shown on the side. To make this kite, Andre has a bamboo length 125 cm long and rectangular paper size 75 cm long and 42 cm wide. Help Andre to find out the rest of the bamboo and the rest of the paper he has used.



Based on table 1. it was found that for problem number 2, getting a very good category of 19.23% with a total of 20 students. On the indicators of interpretation, analysis, evaluation, and inference, the students can connect all the information that is known with the right completion strategy until students can draw a conclusion well.

Fig. 3. One of the results of the students' work in either category

Figure 3. Shows that the interpretation indicator, students can interpret very well because they can write all the information that is known and can describe a condition in a given problem. They can also write what is asked correctly. These results indicate that the ability of the students in aspects of student interpretation is good because 72.12% of students can interpret well.

In the analysis indicator, the students cannot connect the information that is known with the solution to the strategy, because in problem number 2, the students make mistakes in understanding the kite images contained in the problem, so the calculations produced by students are not right. From these results, it was identified that the students' ability in the aspect of student analysis was still quite sufficient because only 43.27% of students could analyze it well.

In the evaluation indicators, students can use the strategy correctly in solving problems, but at the analysis, stage

students have made mistakes so that it has an impact on the evaluation stage. From the results of evaluating the ability of students on aspects of student, evaluation is still lacking because only 30.77% of students can evaluate well.

In the indicator of inference, some students can make conclusions because the analysis and evaluation stages are not yet right, so the students make inaccurate conclusions. From these results, it was identified that the ability of students in the aspect of inference was very poor because only 18.27% of students were able to infer properly.

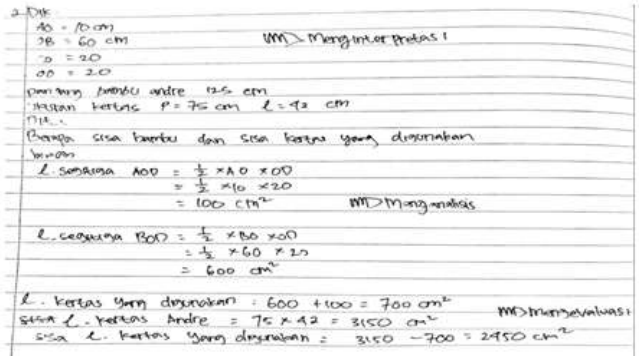


Fig. 4. One of the results of the students' work in enough category

Figure 4. Shows that on the indicator of interpretation, the students can interpret very well because they can write down all the information that is known and can describe a condition in a given problem, and they can also write what is asked correctly.

In the analysis indicator, the students cannot connect information that is known with the solution to the strategy because in problem number 2, the students make mistakes in understanding the kite images contained in the problem. Students are not looking for the total area of a triangle on a kite.

In the evaluation indicators, students cannot use the strategy correctly in solving problems. Still, in the analysis phase, they have made mistakes so that it has an impact on the evaluation stage.

In the indicator of inference, some students cannot make conclusions correctly because, in the analysis and evaluation stages, students have made mistakes.

IV. CONCLUSION

Based on the results of the analysis and discussion that has been obtained, it can be concluded that the mathematical critical thinking skills of 104 students are still relatively low. That is because the students who meet each aspect or indicator of the students' mathematical critical thinking skills are still below 50%, namely the indicators of analyzing, evaluating, and inferencing.

Based on the results of the analysis and discussion that has been obtained, it can be concluded that the constraints of students in working on students' mathematical critical thinking problems are as follows:

- Some students are only able to solve problems at the interpretation stage by writing down what is known and asked.
- Students are too rushed to draw conclusions without analyzing the questions given.
- Some students have not been able to deduce the results correctly, and there are still many students who do not write the unit area in the problem.
- Students are not accustomed to working on math problems that require students to be able to do analysis and evaluation.

The results of this study provide information to teachers about the condition of critical thinking skills of VII grade of junior high school students. It is expected that by knowing these conditions, teachers can design learning that facilitates students to be able to practice critical thinking. Thus students will get used to critical thinking.

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