The students' mathematical critical thinking skill ability in solving mathematical problems

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Abstract. This study aimed to describe students' mathematics critical thinking skills in solving math problems. It employed descriptive qualitative method. It was conducted at Junior High School (SMP) Negeri 2 Kebakkramat in academic year 2017/2018 by using purposive sampling technique to select the participants. Hence, the selected research subjects were 6 students. Instruments used to measure and explore mathematics critical thinking skills in the form of description tests, followed by interviews. The findings of this research showed that 10,3% of the students have high mathematics critical thinking ability, 34,6% have medium mathematics critical thinking ability and 55,1% of the students have low mathematics critical thinking ability. Mathematical thinking ability is low because students are not used to using non-physical questions in the form of contextual. Hence, students are not used to conveying ideas and students cannot answer questions that are different from the example given by the teacher.

1. Introduction
In nowadays era of technology, communication and information, the ability of critical thinking becomes urgently needed so that humans can be able to deal with changes in circumstances or challenges that are always facing them. Critical thinking in the learning process is one of the skills that introduces generalization thinking [1] which ideally means familiarizing students to have the will of knowing relevant information, flexible and fair thinking when evaluating [2].

Thinking is a process of developing naturally, but it should be developed [3], the ability of critical thinking should not be just left behind, but rather it needs to be developed by being more active for the students and the teacher as a facilitator to develop their critical thinking skills [4]. The teacher plays an important role in developing students' critical thinking skills in learning to understand the knowledge, be able to search, read, besides that, critical thinking is expected to foster intelligence, deepen understanding of processing information, concluding, considering the issues or cases faced, transferring new ideas and exploring implementation and consequences [5].

The habit of memorizing mathematical formulas in the learning process is still applied, this causes low student thinking skills supported by the results of the 2015 Program for International Student Assessment (PISA) Indonesia ranks 62 out of 72 countries [6]. Furthermore, pre-research data in Kebakkramat 2 Public Middle School in mathematics subject to the average completeness of mathematical critical thinking skills of class VII students is still relatively low, which is below 70 even
though the implementation of the standard minimum score or \textit{KKM} value is 70. [7] Mathematical critical thinking skills have lifelong benefits that are closely related to learning activities and can minimize student involvement in finding problems in the learning process.

Increasing high-level of thinking skills has become one of the priorities of the schools in delivering mathematics lessons. Critical thinking means students are able to reflect to problems in an in-depth way, do not trust information that comes from several sources and are able to solve problems systematically and make decisions with clear reasons [8]. Junior high school students must begin to be trained to use high-level thinking in accordance with their ages, this is in accordance with BSNP which states that mathematics subjects are given to all students to equip them with the ability to think logically, analytically, systematically, critically, and creatively, and improve their ability to work together. Meanwhile in reality at school, the questions tend to test more aspects of memory that lack training of higher-order thinking skills of students.

Mathematical thinking skills, especially high-level mathematical thinking (high-order mathematical thinking) are needed by students, related to the needs of students to solve the problems they face in everyday life [9]. Benefits of mathematics critical thinking are building relationships between concepts and decisions in expressing beliefs, drawing reasonable conclusions, assessing credibility and assessing the power of relevant information. Therefore, the role of students as objects and teachers as facilitators in the process of learning mathematics is important [10]. Students who take mathematics learning are expected to have mathematical thinking skills on triangular material. Researchers take triangular material because there are many mistakes made by students to solve non-routine problems and realize that triangular material requires more analysis to be able to understand the problem.

Critical thinking skills tend to be measured either by special tests in the form of descriptions to assess how students reach and explain their respective conclusions [11]. in the matter of the description form, scoring is usually done with a politomus score, where the score is graded over two categories given according to certain criteria. [12] Mathematical critical thinking skills have benefits and are important for everyday life. Moreover [13] each other student has different mathematical critical thinking skills.

Based on the description stated above, this study aims to describe the ability to think critically in solving mathematical problems. The description is based on three levels of students' critical thinking abilities, namely low, medium and high.

2. Method
This research is classified as descriptive qualitative research, which aims to describe the characteristics of developed tests, as well as estimating and describing the ability to think critically in solving mathematical problems of students at three levels of students' critical thinking abilities, namely low, medium and high. Mathematical critical thinking skills are classified based on student answers in which students can achieve indicators and based on the results of student interviews. Levels of critical thinking ability mathematics is divided into 3 levels based on the achievement of indicators in the answer sheet and student interviews. Indicator of mathematical critical thinking ability of students is said to be Low level if students are only able to reach indicators 1 and 2, critical thinking ability is mathematically Medium level if students are only able to reach indicators 1 to 5, while High level critical thinking skills are high when students meet indicators 1 through 7.

This study was conducted from March 7, 2018 until April 3, 2018. Subjects in this study were six students of class VII of Junior High School Negeri 2 Kebakkramat who were selected using purposive sampling. The instrument used to explore the ability to critical thinking in solving mathematical problem is a written test in the form of a description followed by an interview. Interviews were conducted in the form of semi-structured interviews, where questions were developed through the interview process. This interview was conducted to explore information that the researcher could not know based on the test results. The validity of the data used in this study was triangulation technique. Triangulation used in this research is triangulation method and data triangulation, that was done by checking the test results data with the interview data.
3. Result And Discussion

The initial stages in this study were compiling tests of critical thinking skills in mathematical problem solving which consist of three levels of students’ critical thinking abilities, namely low, medium and high. The test is described in terms of the level of critical thinking skills. [14] stated that the level of critical thinking based on student achievement indicators based on the scores that have been made is a percentage of students’ answers, after which they were included in the scale of the students' critical thinking skills level. [15] had 5 indicators of critical thinking ability and [2] had 12 indicators of critical thinking skills. Based on [15] and [2] provide indicators based on the steps of the ability of critical thinking in solving mathematical problems, so that the researcher developed three levels of critical thinking skills as shown in Table 1 below.

| No | Indicator                                      |
|----|-----------------------------------------------|
| 1  | Recognize the problem,                        |
| 2  | Collect and compile information needed to solve problems, |
| 3  | Recognize unstated assumptions and values, and use the right and clear language, |
| 4  | Evaluate data and value facts and statements, |
| 5  | Test the similarities and conclusions that one takes, |
| 6  | Re-arrange one's belief patterns based on broad experience, |
| 7  | Draw conclusions or opinions about the issue or issue being discussed. |

After conducting tests of critical thinking skills in solving mathematical problems, the test results showed that most students were able to solve problems of low critical thinking levels. Only a small number of them were able to solve problems of high level of critical thinking skills. Students’ ability of critical thinking skills levels in solving mathematical problems can be seen in Figure 1 below.

![Figure 1. The percentage of the ability of critical thinking skills levels in solving mathematical problems](image)

The percentage of students who were able to solve problems at each level based on indicators of critical thinking skills in problem solving are 55.1% low, 34.6% medium and 10.3% high. These results indicate that students’ critical thinking skills are low at the stages of recognizing problems and collecting and compiling information needed to solve problems. This can be seen in the example of work on the questions by students as the following.
In the answers of S1 (student 1) and S2 (student 2), they could write down what is known and asked about the problem, they were able to formulate, but they could not apply and interpret what is obtained from the problem. Students must express problems that must be resolved. They are also still confused and have not understood the next step. This is consistent with the student's statement S2 "I can only know what is known in the problem and then I am confused about the next step/settlement" next S2 "I can find out what is known and asked but to solve it I use a comparison of what is known then I forget how to multiply it. The ability to think critically in solving students' low mathematical problems is fulfilling the stages of identifying problems and collecting and compiling information needed to solve problems. Students were able to use strategies to solve problems, but the strategies used were not appropriate in the execution of questions. So that the answers from S3 (students 3) and S4 (students 4) tended to be wrong. The results of answers and interviews of S3 and S4 tended to be the same, the only difference lies in the writing of mathematical forms.
On the answers of the S3 shown above, he could write down what is known but was not able to state what is asked about the problem, recognized unstated assumptions and values, evaluate data and test the similarities that one takes. While in the answers of S4, he could write down what is known and asked about the problem, but he could not recognize unstated assumptions and values, evaluate data and test the similarities that someone takes. Students were able to write conclusions from the answers to the questions even though they were wrong. But they have not been able to use the strategy and use illustrations to complete the work on the question. So the answers from S3 and S4 tended to be wrong so that their ability of thinking critically in solving mathematical problems is considered as medium. This is supported by S3 students' statements based on interviews which say "I am confused which one should be compared and I know what is being asked but forget to write" next S4 "I am still confused using the comparative and the width of the river is smaller than those known to be questioned." Even though students can use that information, he can write down what is known and asked about the problem.

(a) Answers of S5  

(b) Answers of S6

Figure 5. Answers of S5 and Answers of S6

In S5 answers (students 5), he could write down what is known and asked about the problem, but he used assumptions that were not in the problem. The student answered based on what was asked in the question. This is based on student interviews which say "I memorize the way to write like that to make it easier for the next steps and I make sure the results of the comparison are multiplied immediately." In S6 answer (student 6), the student did not write down what is known and asked about the problem but he understood what is known at the time of the interview. The students wrote answers based on what was asked in the question. This is in accordance with the student's statement which says "I am used to writing whatever is known in the problem and observing what is taken on the question." From S5 and S6 tended to be wrong so that their ability of thinking critically in solving mathematical problems is considered as high.

This study revealed that students were not able to process the evaluation of data and value facts and statements. Most of them were only able to fulfill the stages of recognizing problems and collecting, compiling information needed to solve problems and recognizing unstated assumptions and values, and using appropriate, clear language. In addition, the interesting thing to discuss is the percentage of students’ who answered correctly at the three levels of critical thinking skills in solving students’ mathematical problems namely low, medium and high. The results reinforce those found by [11] each other student has different mathematical critical thinking skills. This research is more focused on who compared the achievement of mathematical thinking abilities of junior high school students based on the level observed, the highest level achieved by students, was namely the ability to test the similarities and conclusions that someone takes, rearrange one's belief patterns based on extensive experience and draw conclusions or opinions about the issue being discussed. Meanwhile the medium level achieved by students was the ability to recognize unstated assumptions and values and use the right and clear language, evaluate data and assess facts and statements. Conversely, the low level achieved by students was namely the ability to meet the stages of identifying problems and collecting and compiling
information needed to solve problems. The findings showed students 'inability to provide answers for the problem of critical thinking skills in solving low students' mathematical problems.

4. Conclusion
Based on the findings of the research and data analysis obtained from this study, it can be summed up that. The analysis showed that students' critical thinking skills were as the following, 10.3% of students have high mathematical critical thinking skills, 34.6% of them have medium mathematical critical thinking skills and 55.1% have low mathematical critical thinking skills. Students were not able to deal with the stages of testing the similarities and conclusions that someone takes, rearranging one's belief patterns based on extensive experience and drawing conclusions or opinions about the issue being discussed in critical thinking skills in solving high mathematical problems based on the interviews, students are able to solve problems with the steps they deem appropriate. At the stage of medium critical thinking skills, students have not been able to fulfill all critical thinking skills in mathematical problem solving consisting of recognizing unstated assumptions and values, and using appropriate, clear language, evaluating data and assessing facts and statements students are accustomed to not answering questions but just writing the numbers. Most students only have low critical thinking skills, namely fulfilling the stages of identifying problems and gathering and compiling information needed to solve problems then based on the interviews, students also still have difficulty determining the problem.

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