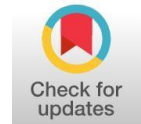


## Analysis of Students' Mathematical Critical Thinking Ability In One Variable Of Linear Equation Material



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### Abstrak

Berpikir kritis adalah salah satu kemampuan esensial bagi peserta didik yang merupakan suatu proses untuk mengevaluasi, memilih, memecakan masalah, dan membuat keputusan dengan alasan-alasan rasional yang dapat dipertanggungjawabkan. Penelitian ini tergolong jenis penelitian deskriptif eksploratif dengan pendekatan kualitatif yang bertujuan untuk menganalisis dan menggambarkan kemampuan berpikir kritis matematika siswa pada materi persamaan linear satu variabel. Indikator yang digunakan untuk mendeskripsikan kemampuan berpikir kritis matematika siswa antara lain kemampuan identifikasi masalah, kemampuan analisis, kemampuan sintesis, kemampuan inferensi, dan kemampuan evaluasi. Subjek penelitian adalah siswa kelas VII-1 SMP Negeri 2 Gorontalo Tahun Pelajaran 2021/ 2022 yang telah selesai mempelajari materi Persamaan Linear Satu Variabel. Teknik pengumpulan data terdiri dari observasi, tes tertulis, dan wawancara untuk menggali informasi mengenai kemampuan berpikir kritis matematika siswa. Adapun teknik analisis data yang digunakan dalam penelitian ini meliputi reduksi data, penyajian data, dan penarikan kesimpulan/ verifikasi. Berdasarkan hasil penelitian ditemukan bahwa kemampuan berpikir kritis matematika siswa kelas VII pada materi Persamaan Linear Satu Variabel tergolong sedang. Faktor-faktor yang mempengaruhi hal tersebut antara lain kecermatan dalam mengidentifikasi soal, penguasaan konsep persamaan linear satu variabel dan materi prasyarat (kemampuan awal), kecenderungan siswa mengandalkan hafalan, dan motivasi.

Keyword: Kemampuan Berpikir Kritis Matematika, Persamaan Linear satu variabel, analisis

### Abstract

*Critical thinking is one of the essential abilities for students which is a process to evaluate, choose, solve problems, and make decisions with rational reasons that can be accounted for. This research classified as an exploratory descriptive research with a qualitative approach that aims to analyze and describe students' mathematical critical thinking ability in one variable linear equation material. The indicators used to describe students' mathematical critical thinking ability include problem identification abilities, analysis, synthesis, inference, and evaluation. The research subjects are students of class VII-1 of SMP Negeri 2 Gorontalo in the 2021/ 2022 academic year who had finished studying the material of linear equation in one variable. Data collection techniques consisted of observation, written tests and interviews to dig up information about students' mathematical critical thinking ability. While the data analysis techniques include data reduction, display data, and conclusion / verification. Based on result of this research, students' mathematical critical thinking ability in linear equation in one variable materials was classified a moderate. It is influenced by several factors, such as accuracy in problem identifying, mastery of the linear equation in one variable concepts, and the prerequisite material (initial ability), students' tendency to rely on memorization, and motivation.*

Keyword: Mathematical critical thinking ability, Linear equation in one variable, analysis

## INTRODUCTION

Mathematics is one of the subjects that can develop someone's thinking ability, especially students because it can help themselves in dealing with various challenges and changes that occur in the development of science and technology. Students' mathematical thinking ability is related to the ability to manage information, which is connecting the problems or information obtained



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with information that has been previously owned through systematic assessment and investigation to produce a solution or problem solving idea. One of the mathematical thinking ability is critical thinking.

The benefits of critical thinking for students include being able to develop and improve students' conceptual understanding, improve problem-solving ability that do not only rely on rote memorization but can be accompanied by accountable evidence and it will be easier to solve more complex questions.

However, the facts show the opposite of what is expected. Based on the results of interviews with one of the Mathematics teachers at SMP Negeri 2 Gorontalo and observations to students by giving questions related to linear equations of one variable, information was obtained that the majority of students learned mathematics only according to what was taught by the teacher, which is more procedural and mechanistic. The ability of students is only limited to memorizing concepts and steps or procedures to solve problems without studying and reasoning how to obtain and reasons for using the formula. Students also have not been able to evaluate or re-examine the answers given in order to produce the right problem-solving strategies. This situation conduce the inability of students to solve the more problems and require a higher level of understanding and logical thinking as well. Therefore, in learning mathematics, educators must familiarize students with solving high-level questions that can develop their critical thinking skills, especially in the one-variable linear equation material.

Referring to the background, we interested to exploring the students' critical thinking ability in a research with the problem formulation, namely *"How is the VII class Students' Mathematics Critical Thinking Ability in One Variable Linear Equation Material?"*.

## METHOD

### *Approach and Subject*

This research is an exploratory descriptive study with a qualitative approach. This approach is partly adopted from Moleong (2013: 6). This study uncovers and analyzes students' mathematical critical thinking ability based on the indicators that have been formulated and then describes the results of the analysis. This study was carried out at SMP Negeri 2 Gorontalo with 32 students of class VII-1 who had studied linear equations of one variable as the subject of this study. In determining the sample for giving the test, this study refers to Arikunto (2010: 95). Meanwhile, in choosing subjects of this study for interviews, that is based on test results using purposive sampling technique, which means sampling is based on certain goals or considerations.

### *Data Collection*

The data collection techniques used in this study include:

- a. Observation
- b. Test

We prepared an essay test that consists of 5 questions regarding linear equations of one variable material that fulfill the indicators of mathematical critical thinking ability and had previously been tested for validity and reliability so that the questions were feasible to use. Student test results were analyzed using a rubric as an assessment guide, one of the example is presented in the following table:

**Table 1.** Rubric of Mathematical Critical Thinking Ability

| Number | Indicator              | Descriptor                                                                                                                                   | Level    | Score |
|--------|------------------------|----------------------------------------------------------------------------------------------------------------------------------------------|----------|-------|
| 1.     | Problem Identification | Able to write down all the elements that are known and asked in the problem, translate the sentence in the problem into a mathematical model | High     | 2     |
|        |                        | Able to write one element that is known and asked but cannot translate the sentence in the problem into a mathematical model.                | Moderate | 1     |

|  |           |                                                                                                                                                                                                                                                          |          |   |
|--|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|---|
|  |           | Unable to write the element that is known, asked, and translate the sentence in the problem into a mathematical model.                                                                                                                                   | Low      | 0 |
|  | Analisis  | Elaborate the components of linear equation in one variable problem, i.e examining ideas that can be used in problem solving, detecting arguments, and obtaining appropriate explanations.                                                               | High     | 2 |
|  |           | Elaborate the components of linear equation in one variable problem, i.e examining ideas that can be used in problem solving, detecting arguments, but mistaken in one of the elaboration,                                                               | Moderate | 1 |
|  |           | Unable to elaborate the components of the problem and mistaken in problem solving solution.                                                                                                                                                              | Low      | 0 |
|  | Sintesis  | Connecting and combine all elements of existing knowledge to produce new ideas, i.e the property of distributive multiplication, arithmetic operations on integers and algebraic, and produce one correct value so that the other value is also correct. | High     | 2 |
|  |           | Connecting and combine all elements of existing knowledge to produce new ideas, i.e the property of distributive multiplication, arithmetic operations on integers and algebraic, but produce a wrong value so that the other value is also mistaken.    | Moderate | 1 |
|  |           | Not connecting and combine all element of the existing knowledge.                                                                                                                                                                                        | Low      | 0 |
|  | Inferensi | Make conclusions based on proper work in the analysis and synthesis processes.                                                                                                                                                                           | High     | 2 |
|  |           | Make conclusions based on improper work in the analysis and synthesis processes.                                                                                                                                                                         | Moderate | 1 |
|  |           | Make conclusions that is not based on the analysis and synthesis processes.                                                                                                                                                                              | Low      | 0 |
|  | Evaluasi  | Solve the problem of linear equation in one variable with correct steps and get a right solution.                                                                                                                                                        | High     | 2 |
|  |           | Solve the problem of linear equation in one variable with correct steps but get a wrong solution.                                                                                                                                                        | Moderate | 1 |
|  |           | Solve the problem of linear equation in one variable with wrong steps and solution                                                                                                                                                                       | Low      | 0 |

### c. Interview

Interviews were conducted by direct communication by giving questions to obtain more in-depth information about students' mathematical critical thinking ability on one-variable linear equation material. In addition, through interviews it is also possible to reveal factors that influence students' critical thinking ability in mathematics in an effort to solve linear equation on one variable problems. Students who become interview respondents are determined based on the results

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of observations and the results of the mathematical critical thinking ability test. Based on the test results, students are then classified into three levels, i.e high, medium, and low abilities determined by 27% of the upper group and 27% of the lower group (Kelley in Widyantoro, 2009: 17).

Due to limited time and ability, we limited the study subjects who became respondents to be interviewed to six people consisting of two people representing the high group, two people from the medium group, and two people from the low group.

### *Data Analysis*

After collecting data, the results are then analyzed by using data analysis techniques proposed by Miles and Huberman in Sugiyono (2012: 246), i.e:

#### 1. Data reduction

- a. Check the results of students' work (answer sheet).
- b. All conversations in interview activities were recorded and compiled in the form of transcripts by playing back the recording of the interview process to obtain the required information.
- c. The data obtained from each subject of this study then selected based on the required information, which in this case was about their mathematical critical thinking ability. The irrelevant data were excluded.

#### 2. Data display

The data that will be presented in the study are in the form of data analysis results and descriptions of students' mathematical critical thinking ability in solving problems both during tests and interviews based on five critical thinking indicators which include problem identification abilities, analytical abilities, synthesis abilities, inference abilities, evaluation abilities and factors that influence it.

#### 3. Conclusion drawing/verification.

The data obtained were concluded in accordance with the research objectives, namely analyzing and categorizing the abilities of research subjects. Conclusions are credible if they are supported by findings in the field in the form of valid and consistent evidence.

## **RESULTS AND DISCUSSION (70%)**

### ***Result***

Based on the results of students' tests on one-variable linear equation material obtain a description of students' critical thinking ability in mathematics for each item that was reduced so that it was presented based on indicators of critical thinking ability as can be seen in the following data presentation.

#### a. Indicator I: Ability to identify problems

Problem identification ability is the ability to identify the elements that are known in the problem, including the ability to recognize problems, decoding meaning or translating symbols or message codes given (translating sentences in problems into mathematical sentences/ model), and explaining the meaning of symbols or codes that have been translated. The description of students' abilities for problem identification indicators on each item of questions can be seen in the following table:

**Table 2.** Students' ability to identify problem

| Predicate | Item Test   |             |             |             |             |
|-----------|-------------|-------------|-------------|-------------|-------------|
|           | 1           | 2           | 3           | 4           | 5           |
| High      | 16 Students | 14 students | 13 students | 9 students  | 8 students  |
| Moderate  | 11 students | 10 students | 13 students | 12 students | 14 students |
| Low       | 5 students  | 8 students  | 6 students  | 11 students | 10 students |

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## b. Analytical ability

It is include the ability to describe all components that exist in a problem which includes the ability to examine alternatives or ideas that can be used for problem solving, detecting opinions, and analyze opinions/arguments. A description of students' abilities for indicators of analytical skills for each item can be seen in the following table:

**Table 3.** Students' analytical ability

| Predicate | Item Test   |             |             |             |             |
|-----------|-------------|-------------|-------------|-------------|-------------|
|           | 1           | 2           | 3           | 4           | 5           |
| High      | 16 students | 10 students | 10 students | 9 students  | 7 students  |
| Moderate  | 11 students | 12 students | 15 students | 11 students | 14 students |
| Low       | 5 students  | 10 students | 7 students  | 12 students | 11 students |

## c. Synthesis Ability

Synthesis ability includes the ability to combine all their knowledge to create new ideas or knowledge. The description of students' abilities for indicators of synthesis ability on each question item can be seen in the following table:

**Table 4.** Students' synthesis ability

| Predicate | Item Test   |             |             |             |             |
|-----------|-------------|-------------|-------------|-------------|-------------|
|           | 1           | 2           | 3           | 4           | 5           |
| High      | 13 students | 9 students  | 9 students  | 7 students  | 7 students  |
| Moderate  | 13 students | 13 students | 14 students | 13 students | 13 students |
| Low       | 6 students  | 10 students | 9 students  | 12 students | 12 students |

## d. Inference Ability

Inference ability includes the ability to collect evidence, create problem solving solutions, and make conclusions based on valid evidence and reasons in the analysis and synthesis process. The description of students' abilities for indicators of inference ability on each question item can be seen in the following table:

**Table 5.** Students' inference ability

| Predicate | Nomor Soal  |             |             |             |             |
|-----------|-------------|-------------|-------------|-------------|-------------|
|           | 1           | 2           | 3           | 4           | 5           |
| High      | 13 students | 9 students  | 8 students  | 6 students  | 6 students  |
| Moderate  | 13 students | 12 students | 13 students | 13 students | 14 students |
| Low       | 6 students  | 11 students | 11 students | 13 students | 12 students |

## e. Evaluation Ability

Evaluation ability includes the ability to assess and evaluate the relevant arguments in solving problems and correcting alternatives used in problem solving. The description of students' abilities for evaluation indicators for each item can be seen in the following table:

**Table 5.** Students' evaluation ability

| Predicate | Nomor Soal  |             |             |             |             |
|-----------|-------------|-------------|-------------|-------------|-------------|
|           | 1           | 2           | 3           | 4           | 5           |
| High      | 13 students | 9 students  | 8 students  | 6 students  | 6 students  |
| Moderate  | 13 students | 12 students | 13 students | 13 students | 14 students |
| Low       | 6 students  | 11 students | 11 students | 13 students | 12 students |

**Discussion**

The From the test results above, students with high, medium, and low group classifications were then interviewed. Based on the results of the tests and interviews, the characteristics of each

group or predicate were obtained as follows:

1. Subjects with high predicates

Based on the results of written tests and interviews, information was obtained that subjects with high predicates had good problem solving abilities, marked by the subject's ability to identify and analyze the problem, synthesize, conclude, and evaluate the argument. In addition, the subject is also able to state the reasons for using a concept or formula that shows that the subject is able to understand and master what he is learning that make it easier for the subject to solve problems with more complex levels.

2. Subjects with moderate predicate

Based on the results of tests and interviews, subjects with moderate predicates have the ability to answer each question given well, such as being able to give reasons for using the alternative taken and understanding the intent in the question. However, there are several questions that have not been fulfilled by all indicators of mathematical critical thinking ability, either on indicators of identifying problems, analyzing, or synthesizing the problems given. That is because subject is not careful in examining the problem before drawing conclusions for problem solving.

3. Subjects with low predicates

Based on the results of written tests and interviews, it was found that subjects with low predicates were unable to identify and understand most of the questions given, resulting in the inability of the subject in thinking about problems alternative solutions and cannot solve problems properly. The inability of these students is caused by the low mastery of material on linear equations of one variable and other concepts which are prerequisite skills needed in solving problems of linear equations of one variable. Thus the subject has not been able to solve problems at a complex level and requires critical thinking.

The description above indicates that mathematical critical thinking ability of students in VII-1 class at SMP Negeri 2 Gorontalo is still relatively moderate. Based on the results of the analysis during written tests and interviews, the factors that influence each indicator of students' mathematical critical thinking abilities are described as follows:

- a. Problem identification ability

At this stage students are expected to be able to identify all the information and translate it into a mathematical model so that it can be used as a guide for making the next decision. However, because students do not understand the internal problems given in the questions and are not careful and thorough in reading the questions, it makes a missing supporting information and makes students wrong in determining alternative problem solving.

- b. Analytical ability

Analytical ability is influenced by factors of students who are not careful in identifying previous problems so that they are not able to describe the components that exist in the problem and respond to the problems given. In addition, this ability is influenced by the low motivation of students in conducting in-depth studies to collect supporting data or information needed for decision making. This is also influenced by the tendency of students to rely on rote memorization and work on procedural questions without a good understanding of the reasons for using the concept.

- c. Synthetic ability

This ability is influenced by the mastery of concepts, especially in relation to one-variable linear equations and the prerequisite materials as well as the ability to connect or link their knowledge in solving one-variable linear equation problems with systematic and precise steps. However, this ability is also interconnected with the ability to identify and analyze problems.

- d. Inference ability

Inference ability is influenced by accuracy in identifying, analyzing, and synthesizing using appropriate steps in problem solving.

#### e. Evaluation Ability

Students' ability in conducting evaluations is influenced by the low motivation of students in checking and re-testing the conclusions that have been made. This is also influenced by the understanding and mastery of a material, both concept and application. If students are able to re-examine the conclusions that have been obtained by not rushing in making decisions and using a series of knowledge they have, then students will obtain appropriate and accountable problem solving.

Based on the description of the factors that affect each indicator of mathematical critical thinking abilities, it can be synthesized the factors that affect students' mathematical critical thinking ability in solving one-variable linear equation questions as follows:

##### 1. Accuracy in identifying questions.

Accuracy in identifying questions is related to the ability of students to identify important points from the questions given. This is implemented by the ability of students to read the questions carefully so that they can accurately know the information provided and can translate it into mathematical models, think about the relationship between things that are known in the problem and know the assumptions that are not stated in the problem.

##### 2. Mastery of the concept of linear equations of one variable and prerequisite material and implementation.

Mastery of the concept of one variable linear equation greatly affects students' critical thinking ability in mathematics. In completing the mastery of this concept, it is supported by the initial ability or mastery of the prerequisite material that has been studied previously, such as distributive properties, arithmetic operations of integers and algebraic forms. In connection with this description, this must be supported by the ability of students to apply and connect the necessary concepts through systematic and appropriate steps.

##### 3. The tendency of students to rely on memorization

Students' mathematical critical thinking ability is also influenced by the tendency to rely on memorization without an understanding of the concepts or materials they receive. Students who only rely on memorization are accustomed to solving problems based only on examples of questions that have been given by the teacher, causing an inability to develop their thinking skills in solving more complex problems.

##### 4. Motivation

One of the factors that also affects students' mathematical critical thinking ability is motivation. This is indicated by the low motivation of students in gathering various knowledge or relevant information for problem solving and testing the alternatives and conclusions that have been made. In addition, motivation is also shown by not only relying on materials and questions that have been taught by the teacher but also developing the materials and questions.

In order to develop and increase students' mathematical critical thinking abilities, especially in linear equations of one variable materials, it requires students to continuously practice in solving problems related to the material. Students' knowledge should not only be limited when receiving material during learning process, but also should be able to review and develop the concepts they have learned. In this regard, it is necessary to motivate students to be able to develop their critical thinking skills through continuous practice questions. In solving problems, students should use theories that can be accounted for through systematic and logical assessment. Critical thinking can also be developed by carefully reading the problems given to improve the ability of identify and analyze problems. Research results are presented in the form of graphs, tables, or descriptive. Analysis and interpretation of these results are required before they are discussed.

## CONCLUSION (5%)

Conclusions are general findings according to research problems, also recommendations for the next steps. Mathematical critical thinking ability of class VII-1 students at SMP Negeri 2 Gorontalo on linear equation in one variable material is classified as moderate. This is based on the description of the characteristics of critical thinking skills in mathematics in each predicate which shows that in general students have not been able to fulfill all the indicators of critical thinking or subjects are only able to fulfill some of the indicators of critical thinking. The factors that affect the mathematical critical thinking ability of students in class VII-1 at SMP Negeri 2 Gorontalo include accuracy in identifying questions, mastery of the concept of linear equations in one variable along with initial abilities or prerequisite materials and their application, students who tend to rely on memorizing material, and low motivation. While the strategies that can be taken to develop students' mathematical critical thinking skills include increasing motivation in developing concepts that have been taught by the teacher, constantly increasing problem solving exercises, and identifying and reading carefully the problems given so as to improve the ability to identify and analyze problem.

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