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Analysis of mathematical critical thinking ability of junior high school students in solving problems on two-variable linear equation system

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Abstract

Critical thinking skills are important for students in the process of learning mathematics. Critical thinking skills in the mathematics learning process can help students better understand the material. This study aims to describe students' critical thinking skills in solving problems on the Two-Variable Linear Equation System material. This type of research is descriptive qualitative. The subjects of the study were 18 students of class VIII MTS Daarun Nahdhah Bangkinang. The data collection instruments used in this study were mathematical critical thinking ability test questions and interview sheets. The test to measure students' critical thinking skills consisted of 4 descriptive questions on the Two-Variable Linear Equation System material. The test results were analyzed according to the indicators of critical thinking skills used in this study: Interpretation, Analysis, Evaluation, and Inference. The results of this study stated that the average value of mathematical critical thinking skills of class VIII students of MTS Daarun Nahdhah Bangkinang was 41.99% in the reasonably critical category. The interpreting indicator is in the low category with an average of 25.78%, the analyzing indicator is in the sufficient category with an average of 54.68%, the evaluating indicator is in the sufficient category with an average of 49.21%, and the inferring indicator is in the low category with an average of 38.28%. Based on the research results above, teachers must get used to giving students non-routine questions in learning, using contextual LKPD, and providing varied learning resources to improve students' critical thinking skills.

Keywords: analysis; mathematical critical thinking skills; two-variable linear equation system

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I. Introduction

Critical thinking skills are mental activities that contribute to formulating and solving everyday problems, as well as decision-making related to things that are believed and done (Khoirunnisa & Malasari, 2021). Critical thinking is the process of applying, analyzing, synthesizing, and evaluating information collected through observation, experience, reflection, reasoning, or communication to produce valid, strong, and resistant arguments and conclusions and be able to provide evidence

to support one's arguments (Setiana, 2018). Students need critical thinking skills to solve social, scientific, and practical problems effectively (Ongesa, 2020).

Critical thinking skills are important and must be possessed by someone because someone is often faced with problems and must make decisions that require reasoning, understanding, analysis, and evaluation of the information (Aizikovitsh-Udi & Cheng in Wasqita et al., 2022). In mathematics learning, in addition to helping students understand concepts and solve problems, critical thinking skills also help them hone logical reasoning, situation analysis, and argument evaluation (Sachdeva & Eggen, 2021). Students who can think critically can work on high-level thinking skills questions (Zulkardi & Kohar, 2018). Critical thinking skills do not onlyhave an effect when we are in school. Critical thinking skills will apply throughout life because life is inseparable from various problems that must be faced. Critical thinking skills are very much needed by someone to be able to face various kinds of problems in social or personal life (Nuryanti, Zubaidah, & Diantoro, 2018).

Critical thinking in the process of learning mathematics can help students gain a deeper understanding. Students trained to think critically can face problems, analyze problems, and solve them with the right steps (Faiziyah & Priyambodho, 2022). The reality that occurs is based on research conducted by Fitri (2023), Hidayat (2019), and Septiana (2019), which obtained results that students' critical thinking skills were in the low category.

Research conducted by Fitaloka (2022) found that students' critical thinking skills are still low, this can be seen from the results of the study, which show that students find it difficult to solve the questions given and in the learning process in the classroom, students are less actively involved. The research results by Faiziyah and Priyambodho (2022) showed that students' critical thinking skills in solving mathematical problems are still not optimal. In solving HOTS-based story problems, the level of mathematical critical thinking of most students is in the low category, this can be seen based on the results of student tests, which only meet the problem understanding stage or the first indicator (Interpretation).

According to Hidayanti et al. (in Fitri, 2023), critical thinking indicators reveal four main critical thinking skills involved in the critical thinking process: interpretation, analysis, evaluation, and inference. Interpretation is the process of understanding and expressing the meaning or significance of various situations, events, statements, or mathematical problems. Analyzing identifies the relationship between the information provided, the problems solved, and all the concepts needed in compiling a problem-solving plan. Evaluation is assessing the credibility of the statement and assessing the logical strength of the statement/problem-solving that has been done. The inference is drawing logical conclusions by providing all important and reasonable reasons. The inference stage is carried out by correctly making conclusions from a learning material being studied.

Mathematics learning materials that require high reasoning in the solution process include two-variable linear equation systems because in solving problems on two-variable linear equation systems, students are asked to be able to change real problems into mathematical models (Ramadani, 2019). Students tend to be less understanding of changing story problems into mathematical equations, making it difficult for them to solve problems in the form of story problems (Aqsha in Ulva, 2018). Students cannot only rely on their ability to remember (recall), but also their ability to interpret questions, which requires a high level of thinking. Students must be able to think critically, analytically, and systematically to solve two-variable linear equation problems (Ramadani, 2019).

Based on the explanation of the importance of mathematical critical thinking skills and the presentation of previous research results, the researcher sees the need for further

research to analyze the level of students' mathematical critical thinking skills. This study aims to describe the critical thinking skills of class VIII students of MTS Daarun Nahdhah Bangkinang on the material of two-variable linear equation systems. The analysis carried out on students' mathematical critical thinking skills is expected to find out what causes the low level of students' critical thinking skills in the future, andit is hoped that teachers and students can avoid the same mistakes.

II. Research Method

The research was conducted in a qualitative study using a descriptive analysis method that aims to describe students' critical thinking skills on the material of two-variable linear equation systems. The subjects in this study were 18 students of class VIII MTS Daarun Nahdhah Bangkinang.

The data in this study were descriptions of students' mathematical critical thinking skills in solving problems on the material of a two-variable linear equation system. The instruments used were written test questions to measure students' mathematical critical thinking skills and interview sheets to dig deeper into students' mathematical critical thinking skills on the material of two-variable linear equation systems.

The data collection technique used descriptive questions to determine students' mathematical critical thinking skills on the material of two-variable linear equation systems based on predetermined indicators and interview sheets in an effort to find out more deeply about students' mathematical critical thinking skills.

To obtain data on students' mathematical critical thinking skills, scoring was done on students' answers to each question. The scoring criteria for critical thinking skills used were modified rubric scores from Facione (1994) and Pertiwi (2018).

Table 1. Scoring guidelines for students' mathematical critical thinking skills

Indicator	Description	Score
Interpretation	Not writing what is known and what is asked.	0
	Writing what is known and what is asked incorrectly.	1
	Writing only what is known or what is asked correctly.	2
	Writing what is known from the question correctly but incompletely.	3
	Writing what is known and asked from the question correctly and completely.	4
Analysis	Not making a mathematical model of the given problem.	0
	Making a mathematical model of the given problem but not correctly.	1
	Making a mathematical model of the given problem correctly without explaining.	2
	A mathematical model of the given problem was made correctly, but there is an error in the explanation.	3
	Making a mathematical model of the given problem correctly and providing a correct and complete explanation.	4
Evaluation	Not using strategies to solve problems.	0
	Using inappropriate and incomplete strategies in solving problems.	1
	Using the right strategy in solving the problem, but incomplete, or using an inappropriate strategy but complete in solving the problem.	2

	Using the right strategy in solving the problem, complete but making mistakes in calculations or explanations.	3
	Using the right strategy in solving problems, complete and correct calculations and explanations.	4
Inference	Not making conclusions.	0
	Making inappropriate conclusions does not fit the context of the question.	1
	Making conclusions that are not appropriate even though they are adjusted to the context of the question.	2
	Making appropriate conclusions is appropriate to the context but incomplete.	3
	Making appropriate, appropriate conclusions to the context of the question and completing.	4

The data analysis technique is carried out by correcting students' work results and then analyzing students' critical mathematical thinking skills. Students' critical mathematical thinking score data is analyzed using the following percentage formula.

$$Final\ Score = \frac{Student\ Scores}{Maximum\ Score} \times 100\ \%$$

The percentage value of students' critical thinking ability obtained from the calculation is then categorized according to the table of mathematical critical thinking ability categories adopted from (Setiana & Purwoko, 2020) down below:

Table 2. Critical thinking ability percentage category

Final score (%)	Category
81 - 100	Very Good
61 - 80	Good
41 - 60	Fair
21 - 40	Low
0 – 20	Very Low

III. Results and Discussion

This study was conducted to describe students' critical mathematical thinking skills through solving problems on the material of two-variable linear equation systems. The assessment was carried out by looking at the suitability of students' answers with the indicators of critical mathematical thinking, namely interpreting, analyzing, evaluating, and inferring.

The results obtained from the trial of the mathematical critical thinking test instrument can be seen in Table 3, which contains the percentage of students' critical thinking ability scores based on each indicator of mathematical critical thinking ability.

Table 3. Percentage of student scores based on indicators

Mathematical Critical Thinking Indicators	Percentage
Interpreting	25,78 %
Analyzing	54,68 %
Evaluating	49,21 %
Inferring	38,28 %

The average value of critical mathematical thinking ability of class VIII students of MTS Daarun Nahdhah Bangkinang is 41.99% in the reasonably critical category. Based on the values obtained, an analysis was conducted on students' problem-solving abilities on the SPLDV material. The following is an analysis of students' answers based on indicators of critical mathematical thinking.

Indicator 1: Interpreting is done by writing down what is known and asked from the problem correctly and completely. Table 3 shows that students' scores on the interpreting indicator are in the low category, with an average of 25.78%. This shows that class VIII students lack understanding of problems and are unable to

determine what is known and asked about the problem, as shown in Figure 1 below.

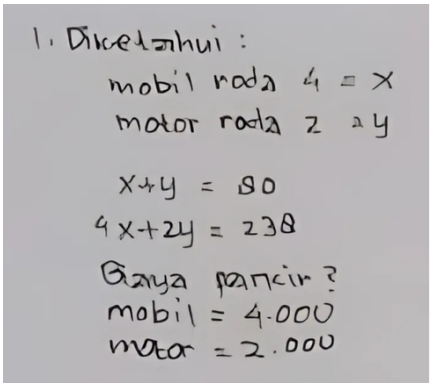

Figure 1. Interpretation mistakes

Figure 1 shows students trying to write what is known and asked from the question, but it is not accurate and complete. Only one student wrote what is known and asked the question correctly. Some students only wrote what is known or what is asked from the question, and some students did not write what was known and asked from the question but went directly to solving the question. Students do not understand the meaning of the question well and are not accurate in writing what is known and asked from the question. In line with the results of Imayanti, Syarifuddin, and Mikrayanti's (2021) research on the interpreting indicator, some students were unable to create what is known and what is askedin the question. This means that students do not understand the problem presented in the question because students do not understand the question well.

Indicator 2: Analyzing is done by correctly making a mathematical model of the given problem and providing a complete explanation. Table 3 shows that the student's scores on the analyzing indicator are in the sufficient category, averaging 54.68%. The student's scores on the analyzing indicator show that they have not been able to identify the relationship between statements, questions, and concepts given in the problem and have not been able to correctly make a mathematical model based on the information in the problem. The errors found in the analyzing indicator can be seen in Figure 2 and Figure 3 below.

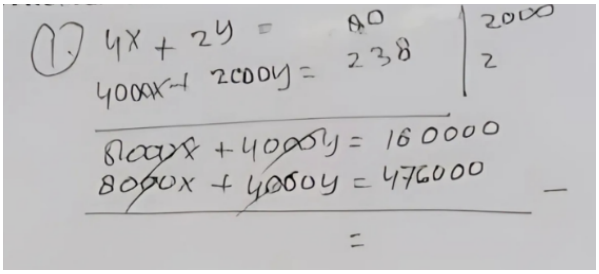

Figure 2. The first mistake in analyzing

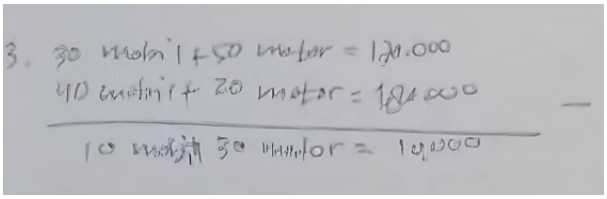

Figure 3. The second mistake in analyzing

Figures 2 and 3 show that students try to create a mathematical model based on information from the problem, but the analogy made is not yet correct. Students have difficulty correctly modeling the information in the problem into mathematical form. In line with the research of Lubis et al. (2020) on the indicator of analyzing, most students are not yet able to change the problem into the correct mathematical model and operation. The difficulty in creating a mathematical model is caused by limited experience and knowledge of mathematics. Thus, students' difficulties in creating mathematical models cause them to be unable to analyze or plan to solve problems (Zulkarnaen, 2020).

Indicator 3: Evaluating can be seen through using the right strategy in solving problems, completing and correcting calculations, and explaining. Table 3 shows that the student's score on the evaluating indicator is in the sufficient category, averaging 49.21%. This shows that students have not used the right and complete strategy in the problem-solving process. Mistakes also occur in the calculation process, which causes students to get incorrect answers. Student errors on the evaluating indicator can be seen in Figure 4 below.

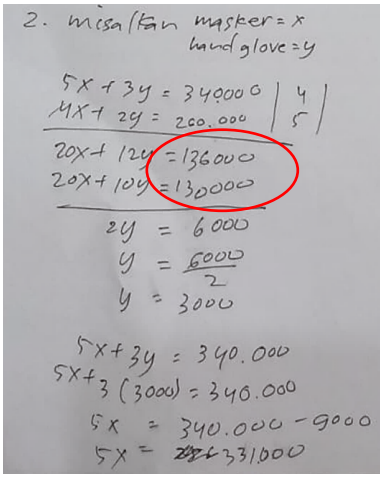

Figure 4. Evaluation mistake

Figure 4 shows the process in the evaluation indicator; errors in the calculation process result in the resulting answer being less precise. Similar to the results of Putri et al.'s study (2022), in the evaluation indicator, some students make mistakes in the calculation process because they are not careful when working on the questions. Students who make mistakes in the analysis indicator also make mistakes in the evaluation indicator, so the answers obtained are not correct.

Indicator 4: The inferring process is making conclusions correctly and completely, according to the questions' context. Table 3 shows that the student's score on the inference indicator is in the low category, with an average of 38.28%. The score on the inference indicator shows that students do not write conclusions correctly and clearly and are adjusted to the context of the question. Only two students wrote conclusions correctly and completely, and according to the context of the question, most students only worked on the questions up to the evaluation stage. In line with the results of Lestari and Roesdiana's study (2021), some students could answer correctly, but students did not rewrite the answers as conclusions; students only went straight to the core of the problem and were less precise in concluding.

Based on the results of interviews with students related to SPLDV material, students find it difficult to solve story problems; students are used to solving routine problems in the form of numbers, which results in students having difficulty in modeling the information contained in the problem into mathematical form. Similar to the results of Fitri's research (2023), students are not used to working on non-routine problems, so they need to be accustomed to working on non-routine problems to train their critical thinking skills. Critical thinking skills can be developed and improved by frequently providing exercises with gradual levels of difficulty (Syafruddin & Pujiastuti, 2020).

IV. Conclusion

The critical thinking ability of grade VIII students of MTS Daarun Nahdhah Bangkinang is in the reasonably critical category, averaging 41.99%. The interpreting indicator is included in the low category with an average of 25.78%, the analyzing indicator is included in the sufficient category with an average of 54.68%, the evaluating indicator is included in the sufficient category with an average of 49.21%, and the inferring indicator is included in the low category with an average of 38.28%.

The mistakes experienced by students are not understanding the meaning of the question well so that they cannot write down what is known and asked from the question correctly, not practicing solving story problems so that they have difficulty in modeling the information contained in the question into mathematical form correctly, being less careful when working on questions so that they make mistakes in the calculation process, and not making accurate and complete conclusions according to the context of the questions given.

Based on these results, it show that students are less trained in working on story problems. Critical mathematical thinking skills can be developed by increasing practice in solving story-based questions. Teachers can also take a role by implementing learning models that involve students in developing their mathematical critical thinking skills and providing non-routine practice questions to students so that students' mathematical critical thinking skills are trained.

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