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Analyzing mathematics critical thinking ability on trigonometric equation based on students' confidence

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Abstract

This study is aimed to describe the students' mathematical critical thinking skills in the material of trigonometric equations in terms of students' self-confidence. The subjects of this study were students of class XI MIPA 3 at SMA Negeri 2 Bantul, which consisted of 32 students. The instrument used in this research is a mathematical critical thinking ability test, a self-confidence questionnaire, and interviews. From the results of this study, it was found that students with high self-confidence had low mathematical critical thinking skills. Meanwhile, students with moderate self-confidence have good mathematical critical thinking skills, and students with low self-confidence have low mathematical critical thinking skills. So can be concluded that the students' self-confidence categories do not influence the students' mathematical critical thinking skills.

Keywords: mathematics critical thinking skill, self-confidence, trigonometric equation

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INTRODUCTION

One of the important parts of mathematical abilities that need to be developed is critical thinking skills. In learning mathematics, critical thinking is one of the abilities that must be mastered by students (Nurapipah, 2019). Students can use these critical thinking skills to observe the opinions of others who are the same or different and decide which opinion is correct.

One of the mathematical subjects that require mathematical skills is trigonometric equations (Endaryono & Azzahra, 2022). This makes learning mathematics not only by memorizing or simply studying the concept, but it needs to be designed so that it can develop students' thinking processes to be able to solve problems by providing appropriate solutions. Critical thinking is not only used in the scientific world but can also be used in everyday life (Amalia et al., 2020).

According to (Hidayah et al., 2017), critical thinking indicators are the ability to analyze, interpret, identify relevant and irrelevant information, evaluate, implement strategies to make the right decisions, and conclude and self-regulate. According to (Setiana & Purwoko, 2020), there are six aspects and indicators of critical thinking, namely: 1) Focus, the stage to understand the given problem by identifying the information contained in the problem. 2) Reason is the stage for compiling a reason that is in accordance with facts or evidence. 3) Inference (drawing conclusions), the stage to conclude the problem appropriately to support the conclusions that have been made. 4) Situation, the stage to use the information obtained from the given problem. 5) Clarify the stage to provide further explanation of the conclusions that have been made. 6) Overview, the stage to check or re-correct the results of problem-solving obtained. In this study, the indicators of mathematical critical thinking skills that will be used refer to the opinion above, which are presented in Table 1.

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Table 1. Critical thinking indicator

No	Indicator	Information
1	Identify	Students are able to formulate information clearly
2	Clarifying	Students are able to rediscover important questions in the problem
3	Analyze	Students are able to describe problem-solving strategies
4	Evaluate	Students are able to solve problems carefully
5	Conclude	Students can conclude the problem correctly

The importance of instilling the habit of critical thinking skills in students, it is hoped that students can solve various problems found in everyday life. To achieve mathematical critical thinking skills in mathematics learning, students need self-confidence. Self-confidence is needed by students in order to develop their abilities (Hajar & Minarti, 2019).

Confidence in learning mathematics is the confidence of students in their mathematical abilities. With this sense of confidence, students have confidence in their abilities to be used in solving problems (Pebianto et al., 2019). Research (Agryvita et al., 2019) shows that students with high self-confidence have good mathematical critical thinking skills, and vice versa. Aspects of self-confidence, according to (Amri, 2018), are belief in one's own abilities, optimism, objectivity, responsible, and rationale.

Previous research conducted by (Wicaksono & Prihatnani, 2019) entitled "Profile of Students' Mathematical Critical Thinking in Solving Trigonometry Problems Judging from the Level of Confidence" stated that the critical thinking ability of students was strongly influenced by their self-confidence. S1 students as subjects who have high self-confidence are able to solve problems correctly and fulfill all aspects of FRISCO, while S2 students as subjects who have low self-confidence are unable to solve problems correctly and only fulfill aspects of focus, reason, inference, and clarity. The update carried out in this study is a study conducted on students of Class XI at SMAN 2 Bantul on the material of trigonometric equations.

Another Research conducted by (Yusmanto & Herman, 2016) stated that learning mathematics with the discovery learning (D-L) model could improve mathematical critical thinking skills. The mathematics self-confidence (S-C) of students in the experimental class using the discovery learning model (D-L) was higher than in the class that used direct learning. There was no relationship between mathematical critical thinking skills and self-confidence (S-C) of elementary school students. The difference between this research with the previous research is this research was conducted to describe mathematical critical thinking skills in terms of students' self-confidence. The research subject is class XI students at SMAN 2 Bantul, and the material used is trigonometric equations.

Research conducted by (Oktaviani et al., 2019) states that using the Discovery Learning (D-L) model can improve critical thinking skills and mathematics learning outcomes. The difference with the research conducted is that the research subject is class XI students at SMAN 2 Bantul on the material of trigonometric equations in terms of students' self-confidence.

RESEARCH METHOD

The research method used in this study was a qualitative descriptive method. This research was conducted in Kec. Bantul, Special Region of Yogyakarta. The subjects in this study were students of class XI MIPA 3 at SMA Negeri 2 Bantul, totaling 32 students. The material taken for this research was trigonometric equations.

In this study, the instrument used was a mathematical critical thinking ability test, a self-confidence questionnaire, and interviews to obtain supporting data. The mathematical critical thinking ability test consists of 2 description questions based on five selected critical thinking skills indicators. In comparison, the self-confidence questionnaire consists of 25 statement items based on four selected confidence indicators. The questionnaire used in this study was a closed questionnaire to determine students' confidence in learning mathematics. Student responses consist of 4 choices, namely Strongly Agree, Agree, Disagree, and Strongly Disagree. Then the researcher categorizes the research subjects based on the level of self-confidence, namely:

Table 2. Criteria for grouping students' self-confidence levels

Criteria	Score
High	$75 \leq x \leq 100$
Medium	$50 \leq x < 75$
Low	$25 \leq x < 50$

(done by the researcher)
x= self-confidence score of each student

This study uses data analysis techniques with three steps, namely scoring, data presentation, and drawing conclusions. Scoring is used to determine the number of scores. The scores given for the assessment of students' mathematical critical thinking skills are presented in Table 3.

Table 3. Scoring guidelines for students' critical thinking ability test

No	Indicator	Information	Score
1	Identify (Students can formulate information clearly)	Not writing down some information on the problem	0
		Write down all the information in the question, but something is wrong	1
		Write down all the information in the question correctly	2
2	Clarifying (Students can rediscover important questions in the problem)	Unable to determine the essence of the question	0
		Found the essence of the problem but wrong	1
		Find the essence of the problem correctly	2
3	Analyzing (Students can describe problem-solving strategies)	Does not describe how to solve the problem	0
		Describe how to solve the problem but not all correct	1
		Describe how to solve the problem correctly	2
4	Evaluating (Students can solve problems carefully)	No answer	0
		Giving answers but not all correct	1
		Give understandable and correct answers and reasons	2
5	Concluding (Students can conclude the problem correctly)	Don't conclude	0
		Summing up, but some wrong	1
		Summing up properly	2

For the calculation of students' mathematical critical thinking ability test scores using the following formula:

$$\text{Score } (S) = \frac{Total\ score\ obtained}{maximum\ score} \times 100\%$$

After determining the value of students, then grouping is carried out based on the value criteria presented in Table 4.

Table 4. Categories of students' critical thinking ability

Score	Category
$80 \leq S \leq 100$	High
$65 \leq S < 80$	Medium
< 65	Low

RESULTS AND DISCUSSION

Student Confidence

The results of this confidence analysis were carried out on 32 students of class XI MIPA 3 at SMA Negeri 2 Bantul by giving a questionnaire containing 25 statement items from 4 confidence indicators. From these data, a description of the students' scores is obtained in Table 5.

Table 5. Criteria for grouping students' self-confidence levels

Criteria	Score
High	$75 \leq x \leq 100$
Medium	$50 \leq x < 75$
Low	$25 \leq x < 50$

x= self-confidence score of each student

Based on Table 5, the results of the questionnaire recapitulation are presented in Table 6. Table 7. shows that the percentage of students' self-confidence is 67.5% in the medium confidence category. From the results of grouping the level of self-confidence of students in each group, one research subject was selected by considering the score of the self-confidence questionnaire that was answered according to the time given and also considering the willingness of students during interviews to obtain valid data. Thus, the subjects selected in this study to analyze the students' mathematical critical thinking skills were subjects with high self-confidence, namely R_{22}, subjects with moderate self-confidence, R_{16}, and subjects with low self-confidence, R_{29}.

Table 6. Results of student confidence questionnaire recapitulation

No	Respondent	Score	Criteria
1	R_1	56	Medium
2	R_2	69	Medium
3	R_3	70	Medium
4	R_4	62	Medium
5	R_5	61	Medium
6	R_6	70	Medium
7	R_7	49	Low
8	R_8	63	Medium
9	R_9	69	Medium
10	R_{10}	72	Medium
11	R_{11}	64	Medium
12	R_{12}	71	Medium
13	R_{13}	63	Medium
14	R_{14}	75	High
15	R_{15}	65	Medium
16	R_{16}	57	Medium
17	R_{17}	74	Medium
18	R_{18}	88	High
19	R_{19}	63	Medium
20	R_{20}	48	Low
21	R_{21}	71	Medium
22	R_{22}	82	High
23	R_{23}	69	Medium
24	R_{24}	74	Medium
25	R_{25}	67	Medium
26	R_{26}	75	High
27	R_{27}	77	Tinggi
28	R_{28}	69	Medium
29	R_{29}	49	Low
30	R_{30}	71	Medium
31	R_{31}	80	High
32	R_{32}	67	Medium
Confidence Percentage Student Self		67,5%	Medium

Mathematical critical thinking ability

Based on the test results of students' mathematical critical thinking skills. The following is the acquisition of students' mathematical critical thinking ability test scores regarding the material of trigonometric equations, presented in Table 8.

Table 8. Obtaining students' critical thinking ability scores

No	Resp.	Problem 1					Score	Problem 2					Score	Total Score	Mark	Criteria
		1	2	3	4	5		1	2	3	4	5				
1	R_{22}	2	0	2	2	0	6	2	0	1	1	1	5	11	55	Low
2	R_{16}	2	2	2	2	0	8	2	0	2	0	2	6	14	70	Medium
3	R_{29}	1	1	2	2	0	6	2	0	1	0	2	5	11	55	Low
Total score per item		5	3	6	6	0		6	0	4	1	5				

From the scores of students' critical thinking skills, the percentage of critical thinking skills per indicator is presented in Table 9.

Table 9. Percentage of Students' Critical Thinking Ability per Indicator

	Critical Thinking Ability Indicator	Percentage per Indicator	Criteria	Percentage Critical Thinking Ability
1	Identify (Students can formulate information clearly)	92%	High	60%
2	Clarifying (Students can rediscover important questions in the problem)	25%	Low	
3	Analyzing (Students can describe problem-solving strategies)	83%	High	
4	Evaluating (Students can solve problems carefully)	58%	Low	
5	Concluding (Students can conclude the problem correctly)	42%	Low	
Criteria for Students' Critical Thinking Ability				Low

Based on table 9. shows that students' critical thinking skills are in the low criteria, with a classical average value of 60%. The achievement of indicators to identify or formulate information clearly is 92%, the achievement of indicators to clarify or rediscover important questions in the problem is 25%, the achievement of indicators to analyze or describe problem-solving strategies is 83%, the achievement of indicators to evaluate or solve problems carefully is 58%, the achievement of the indicator concludes the problem correctly, namely 42%.

Mathematical critical thinking ability in students with high self-confidence

Mathematical critical thinking skills in trigonometric equations that have high self-confidence are R_{22}.

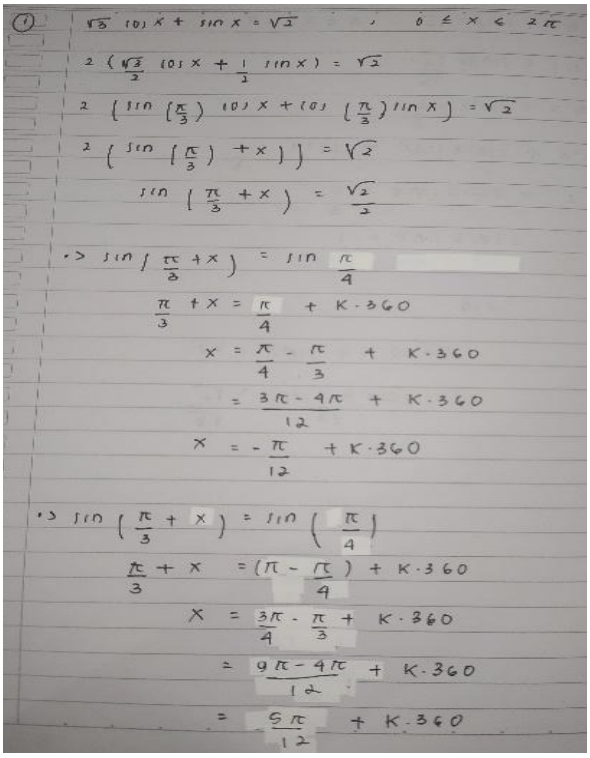

Figure 1. Answer R_{22} in question number 1

Based on Figure 1 shows that R_{22} can answer the problem correctly but is less precise in the form of the questions given. The indicators clarify or rediscover important questions in the problem and conclude that the problem is not listed.

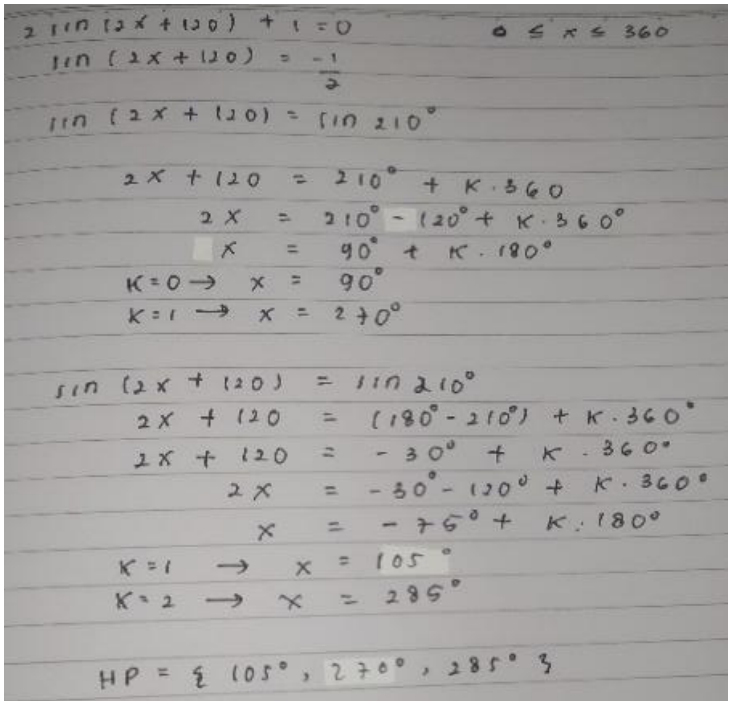

Figure 2. Answer R_{22} in question number 2

Based on Figure 2 shows that R_{22} cannot answer the problem correctly. The indicators for clarifying or rediscovering important questions are not listed. R_{22} has not met the indicators of analyzing and solving problems appropriately, so R_{22} answer to question number 2 is not quite right.

After an interview with R_{22}, it was stated that R_{22} had difficulty in solving the problems given. In solving these problems, R_{22} looked for solutions on the internet, but R_{22} answered according to his ability without the help of friends.

Based on the answers to the mathematical critical thinking ability test and the results of interviews, researchers can conclude that R_{22} has not met the indicators of analyzing and solving problems correctly, as can be seen in the answers to question number 2, and cannot rediscover important questions in the problems given, so it can be said that R_{22} has the ability low category mathematical critical thinking.

Mathematical critical thinking ability in students with medium confidence

The results of the analysis of mathematical critical thinking skills on the material of trigonometric equations that have moderate confidence are R_{16}.

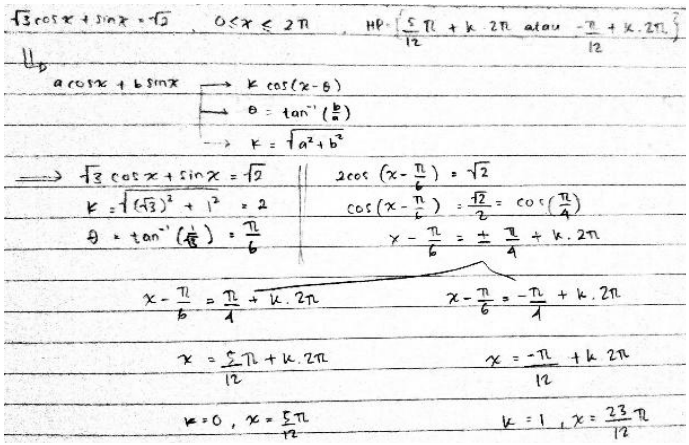

Figure 3. Answer R_{16} in question number 1

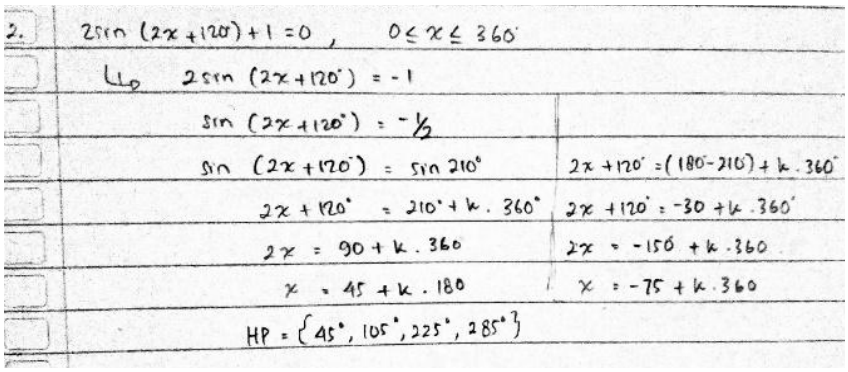

Figure 4. Answer R16 in question number 2

Based on Figure 3 shows that R_{16} can identify the given problem so that R_{16} can answer the question correctly. However, it still does not meet the indicators of analyzing or describing problem-solving strategies. R_{16} is not complete in describing problem-solving. It can be seen when determining the value of x. The indicator concludes that the problem is not listed.

Based on Figure 4, R_{16} can identify the given problem and write down the set of solutions correctly. However, R_{16} is less careful in solving the problem. It can be seen that R_{16} immediately writes down the set of solutions without describing the solution steps.

After the interview with R_{16}, it was conveyed that R_{16} could understand the given problem on the condition that he reread the material related to the problem. For question number 1 R_{16}, they still do not understand to describe problem-solving. It was also stated that R_{16} could not solve the problem given carefully. In solving the problem, R_{16} looked for ways in books and the internet but did not copy a friend's work.

Based on the answers to the R_{16} mathematical critical thinking ability test and the results of the interviews, researchers can conclude that R_{16} is quite good in indicators of identifying and concluding the problems given. However, it still does not meet the indicators of solving the problem carefully. It can be seen that R_{16} immediately concludes the problem without writing down the steps to solve it.

Mathematical critical thinking skills in students with low self confidence

The results of the analysis of mathematical critical thinking skills on the material of trigonometric equations that have low self-confidence are R_{29}.

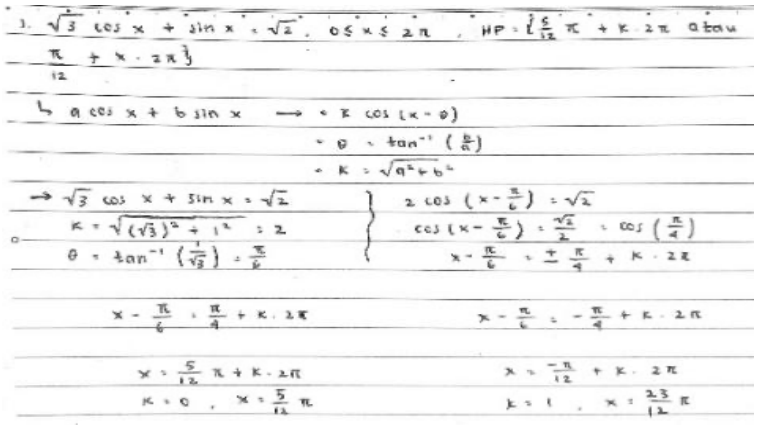

Figure 5. Answer R_{29} in question number 1

Based on Figure 5 shows that R_{29} can identify the given problem. However, it still does not meet the indicators of analyzing or describing problem-solving strategies. R_{29} is not complete in describing problem-solving. The indicators for concluding the problem are also not listed.

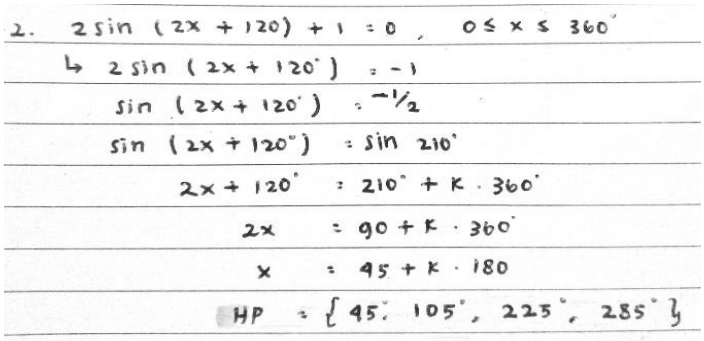

Figure 6. Answer R_{29} in question number 2

Based on Figure 6 shows that R_{29} writes the solution set correctly. However, on the indicators of analyzing or describing problem-solving strategies, R_{29} is incomplete in describing problem-solving. It is also seen that R_{29} is less accurate in indicators of solving problems. Of the two equations that should be determined, it can be seen that R_{29} only wrote one of them. After conducting an interview with R_{29}, it was stated that R_{29} had difficulty understanding the meaning of the questions given. It was also stated that R_{29} worked on the questions given by himself without the help of friends because the material given had already been taught.

Based on the answers to the R_{29} mathematical critical thinking ability test and the results of the interview, the researcher can conclude that R_{29} is only able to fulfill one indicator, namely identifying the given problem. R_{29} had difficulty in analyzing and solving the problems given, even though the material in the questions given had already been studied. Therefore, it can be said that R_{29} has a low mathematical critical thinking ability.

Based on the description above shows that respondents with high self-confidence have low mathematical critical thinking skills. While respondents who have moderate self-confidence have good mathematical critical thinking skills, respondents who have low self-confidence have low mathematical critical thinking skills. So it can be concluded that students' self-confidence does not affect students' mathematical critical thinking skills. This condition is in accordance with the results of research conducted by Pebianto et al. (2019), which revealed that students' confidence in completing the mathematical critical thinking ability test had no effect on the results of the mathematical critical thinking ability test. Students' self-confidence had an effect of 14% on the ability to think mathematically. Critical thinking and the other 86% are influenced by other factors outside the students' self-confidence (Pebianto et al., 2019).

This is also reinforced by the results of Hajar and Minarti's research (2019), which shows that students' self-confidence has no influence on mathematical critical thinking skills, other factors that can affect students' critical thinking skills are willingness to learn to solve math problems, motivation learning and self efficacy (Hajar & Minarti, 2019).

CONCLUSION

Based on the results of research and discussion, it was found that there was no significant effect between students' self-confidence on mathematical critical thinking skills. This can be seen in students with high self-confidence who are not able to solve the problems given. The results of the analysis of students' mathematical critical thinking skills are in a low category, with a classical average of 60%. The achievement of indicators to identify or formulate information clearly is 92%, the achievement of indicators to clarify or rediscover important questions in the problem is 25%, the achievement of indicators to analyze or describe problem-solving strategies is 83%, the achievement of indicators to evaluate or solve problems carefully is 58%, the achievement of the indicator concludes the problem correctly, namely 42%.

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