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Description of Mathematical Critical Thinking Skills for Vocational High School Students during the COVID-19 Pandemic

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a b s t r a c t

The Pandemic period made mathematics less understood by students, especially vocational students. Because of that, describing mathematical critical thinking skills need to be done so that teachers can improve the approach or learning method. This research aims to describe the essential skills of thinking of 10th-grade vocational high school students on the content of quadratic equations and functions. This type of research is descriptive quantitative research. The subjects in this study consisted of 25 students of SMK Negeri 1 Karawang grade 10 to determine the sample using the purposive sampling technique. The test instrument collected the research data in three validated description questions. This research indicates that students' critical thinking skills implemented through web-based learning media at SMK Negeri 1 Karawang are “moderate category”. The final test results among 25 respondents consisted of three students within “high category”, seventeen students within “medium category”, and five students within “low category”. Moreover, the students’ percentage level on critical thinking skills having 55% was deemed within “moderate category”. The conclution is that the respondents' mathematical critical thinking skills are in the moderate category, so it is hoped that educators can improve the students' critical thinking skills by using learning methods, learning media, and teaching materials.

K e y w o r d s :
Critical Thinking Skills, Equations, Quadratic Functions.

INTRODUCTION

During the current COVID-19 pandemic, the Minister of Education and Culture issued a Circular Letter of 2020 number 36962/MPK.A/HK/2020, which states that learning must be done online to prevent the spread of the COVID-19 virus (Fauzy & Nurfauziah, 2021). Spearheading the lowest level of an educational institution, principals are required to make quick decisions in response to the Circular Letters from the Minister of Education and Culture that schools need to enforce learning from home (Hakim, 2021). Online learning is carried out remotely through the internet and other supporting tools such as cell phones and computers (Putria et al., 2020). The use of online learning assisted by access from modern technology based on mobile and technology has great potential and contribution in the world, especially as a transition and challenge to the use of learning using changes in the industrial revolution 4.0 in developing countries, especially in Indonesia and some part of the world and Asia (Batilantes, 2021; Roysa & Hartani, 2020; Spitzer & Musslick, 2021).

In his book, Hakim (2021) says that 'In fact, the implementation of learning from home with the use of information technology that applies suddenly not infrequently surprises students and educators, including parents and even everyone in the house. Not all students can understand lessons using a video platform or reading material and voice notes sent by teachers or lecturers. There may also be many who can understand it, but not everyone has the skills. Most of the Indonesian people who are carrying out online don't understand the explanations of the lecturers or teachers. In addition to not understanding the material provided, erratic signals are also an inhibiting factor for online learning'. It is complicated to learn during the COVID-19 pandemic, especially in mathematics effectively. Fauzy & Nurfauziah (2021) also said that online learning is less than learning in class, especially in mathematics.

The Ministry of National Education said that mathematics develops the ability to calculate and measure, which is needed in everyday life through algebra and geometry materials. Furthermore, mathematics also functions to develop the ability to communicate ideas or ideas with language through mathematical models in the form of mathematical sentences, diagrams, graphs, or tables (Agustina, 2020). In addition, mathematics familiarizes students with making decisions and conclusions based on logical, rational, critical, careful, efficient, and practical thinking. So, in general, mathematics has many uses in everyday life, especially in improving critical thinking skills (Janah et al., 2019).

Mathematics education in Indonesia, which adapted the revised 2013 curriculum, requires schools to conduct assessments on processes and outputs, hard and soft skills, and design learning environments that allow students to develop their potential in a pleasant learning environment according to their abilities. One of the hard skills required in the 2013 curriculum is thinking critically (Ridha et al., 2019). Crismasanti & Yunianta (2017) identified critical thinking abilities or skills into 12 indicators which he grouped into five primary activities. The five primary activities or indicators of knowledge or critical thinking skills are elementary clarification, basic support, inference, advanced clarification, and strategy and tactics. Critical thinking skills must be possessed and developed by everyone, including students, so that they can use them in making decisions in everyday life (Sudiarta et al., 2021). The Ministry of National Education stated that critical thinking skills focus on learning and are one of the graduation standards for middle and high school students. Middle and high school graduates must have the ability to think logically, analytically, systematically, critically, creatively, and can work together (Sulistiani & Masrukan, 2016). So, it will be awful if students' critical thinking skills are in a low position.

Asmarawati's (2018) junior high school level results showed that students' creative and critical thinking skills were still low, this can be seen from the ability of students who

haven't been able to interpret problems into mathematical form and haven't been systematic in solving problems on the questions, so that resulting incorrect answers. According to Nuryanti et al. (2016), the critical thinking ability of junior high school students is still relatively low. Similarly, Zakaria et al. (2021) stated that students' critical thinking skills carried out through online learning at Widyakrama State Junior High School were in the medium category. These assertions were the classification of critical thinking skills of 23 respondents. There are only five (5) students in the high category, 14 in the medium category, and four (4) in the low category. So, the conclusion based on these research there are still many students whose critical thinking skills are still in a low position.

Most researchers don't describe the level of students' critical thinking skills at the high school or vocational level, so it needs to be described to know the extent of students' critical thinking skills so that teachers can improve their learning approaches, learning methods, and teaching materials. Putri et al. (2019) also said there are still many vocational high school students who are not ready to work because the skills of vocational high school graduates are still lacking, both soft skills and hard skills. Therefore, students need to have critical thinking skills to become who always thinks actively and positively. Where students first understand the ins and outs of the real problem, are not easily influenced by the opinions of others, solve problems nicely and neatly, and can conclude whether the information is right or wrong (Maya et al., 2019).

Moreover, based on observations at the school where the research will be conducted, teachers feel that online learning reduces students' critical thinking skills when learning is carried out. Widyastuti et al. (2020) also states that online learning affects students' thinking habits.

In this regard, the research problem should focus on describing the mathematical critical thinking abilities of SMK students during the COVID-19 pandemic. Thus, it can provide input to SMK teachers to improve learning methods and teaching materials based on indicators of students' mathematical critical thinking abilities if they remain in the medium or low category.

METHODS

The researcher used the descriptive quantitative research design, therefore this research is concerned with elaboration with statistical figures. The researcher described the critical thinking skills of vocational high school students on the material of quadratic equations and functions. This research consisted of 25 students of SMK Negeri 1 Karawang class 10, which were determined using the purposive sampling technique. According to Etikan (2016), purposive sampling was a non-random technique that doesn't need an underlying theory, or the choice is made intentionally because of the qualities possessed by the participants. The instrument used in this research was three descriptive questions validated based on three indicators of critical thinking skills adapted from Robert Ennis in Crismasanti & Yunianta (2017), which provided basic clarification, basic support, and inference.

Researchers conducted this research online through E-Learning SMKN 1 Karawang. E-learning SMKN 1 Karawang was a virtual classroom used to implement online learning at SMKN 1 Karawang. This research stages started with students taking online tests, researchers correcting the answers to students' work, and researchers giving assessments. The assessment provided based on the reference guideline for assessing mathematical critical thinking skills based on a modified rubric score by Oktaria (2019), which is in line with the Robbert Ennis mathematical critical thinking ability indicator as presented in the table 1.

Table 1
Critical Thinking Ability Scoring Guidelines

Question Number 1		
Indicators	Criteria	Score
Basic support	Finding the result of the sum and product of the roots of a new quadratic equation, but there is still an error.	1
	Finding the result of the sum and product of the roots of the new quadratic equation exactly	2
	Finding the result of the sum and product of the new quadratic equation's roots correctly, but there are still errors in compiling the quadratic equation.	3
	Finding the result of the sum and product of the new quadratic equation's roots and constructing the quadratic equation correctly.	4
Basic clarification	Make a mathematical model of the problem, but there are still errors.	1
	Make a mathematical model of the problem correctly.	2
	Make a mathematical model of the problem correctly, but there are still errors in finding the size of the box.	3
	Make a mathematical model and find the exact size of the box.	4
Inference	Make steps to draw a graph, but there are still errors.	1
	Make steps to draw a graph correctly.	2
	Make steps to draw a graph correctly, but there are still errors in drawing graphs and making conclusions.	3
	Make steps and draw graphs and draw conclusions correctly.	4

Then the data obtained were analyzed using percentage analysis. To find out the percentage of learning outcomes, the researchers used the following formula (Zakaria et al., 2021):

$$\text{Acquisition Value} = \frac{\text{Total Score}}{\text{Maximum Score}} \times 100\%$$

By categorizing the percentage of critical thinking ability according to table 2.

Table 2
Percentage of Critical Thinking Ability

Percentage (%)	Category
69-100	High
45-68	Medium
0-44	Low

Meanwhile, the formula used to interpret student learning outcomes is listed in table 3.

Table 3
Interpretation of Critical Thinking Ability Level

Criteria	Category
High	Value $\geq \bar{x}$ + SD
Medium	$\bar{x}$ – SD $\leq$ Value < $\bar{x}$ + SD
Low	Value < $\bar{x}$ - SD

RESULT AND DISCUSSION

The results of research that has been conducted on 10 students of SMKN 1 Karawang based on indicators of critical thinking skills are shown in table 4 below.

Table 4
Test Results of Critical Thinking Ability Test

Category	Subject	Indicator			Total Score
		Elementary clarification	Basic support	Inference	
High	3	12	10	12	34
Medium	17	61	19	37	117
Low	5	5	5	4	14
Total	25	78	34	53	165
Percentage		78%	34%	53%	55%

Based on the data in Table 4, we can obtain two pieces of information, the level of students' critical thinking skills based on interpretation and the percentage of achievements based on indicators of critical thinking skills.

The level of students' critical thinking skills based on interpretation

Students' critical thinking ability is divided into high, medium, and low categories. Based on the scores obtained from 25 students, there are three (3) students in the high category, 17 students in the medium category, and five (5) students in the low category.

The total score obtained from students in the high category scored 34 out of 36, consisting of indicators giving basic clarification worth 12, building basic support skills worth 10, and the inference was worth 12. The total score for students in the medium category got a score of 117 out of 204, which consisted of indicators giving basic clarification is worth 61, building basic support skills is worth 19, and inference is worth 37. And the total score obtained from students in the low category gets a value of 14 out

of 60, consisting of indicators providing basic clarification worth five (5), building basic support skills worth five (5), and inference worth four (4).

Percentage of achievement based on critical thinking ability indicators

Researchers use three (3) indicators of mathematical critical thinking ability, namely providing basic clarification, basic support, and inference. Based on the scores obtained from 25 students, the indicator providing basic clarification gets a score of 78 out of 100 with a percentage achievement of 78%, building basic support receives a score of 34 out of 100 with a percentage achievement of 34%, and inference getting a score of 53 out of 100 with a percentage achievement by 53%. Meanwhile, the student's critical thinking ability level scored 165 out of 300 with a percentage achievement of 55%. Based on Table 2, 55% is in the medium category.

Based on the description above with adjustment on Table 2, the results of the respondent's test show that the mathematical critical thinking ability on the material of quadratic equations and functions is in the medium category. The following explanation is based on the mathematical critical thinking ability level category.

1. **High Category**
   Based on the research results, three (3) students are in the high category. It means that if these three (3) students are taken on average, they are by the criteria in the indicators of critical thinking ability. The explanations were in Figures 1, 2, and 3.

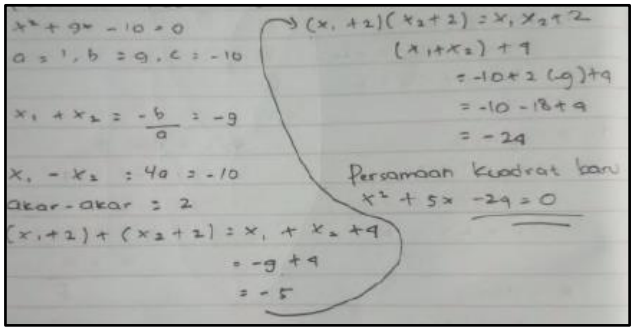

Figure 1. High Category's Answer in Question 1.

It can be seen in Figure 1, with indicators of building basic skills, students can find the result of the sum and product of the roots of the new quadratic equation correctly and arrange the new quadratic equation correctly.

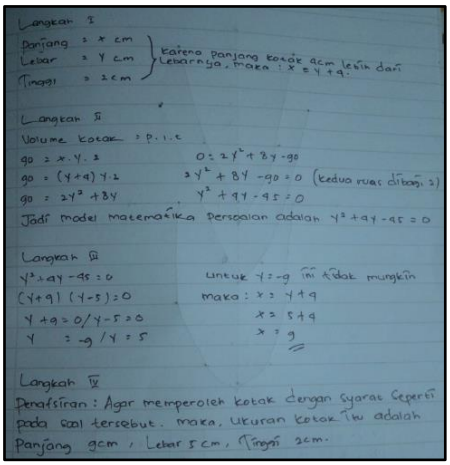

Figure 2. High Category's Answer in Question 2.

In Figure 2, with indicators providing a basic explanation, students made mathematical models and found the right size of the box.

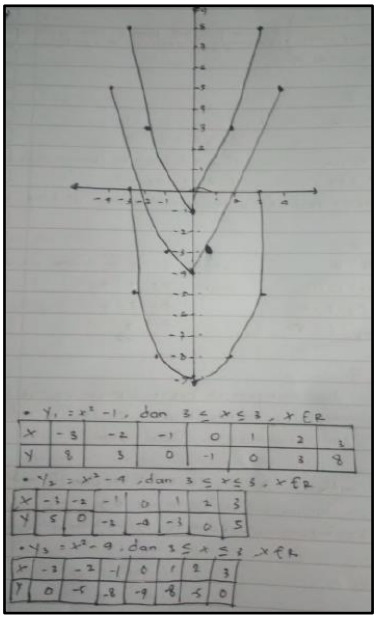

Figure 3. High Category's Answer in Question 3

In Figure 3, with the concluding indicator, students can take steps and draw graphs correctly according to their understanding, but students still forget the commands in making conclusions. So overall, students with high critical thinking ability category have been able to answer the question clearly and correctly.

2. Medium Category

Based on the research results, 17 students are in the medium category. It means that from these 17 students if the average is taken, it is close to the criteria in the critical thinking ability indicator. The explanation is in Figures 4, 5, and 6.

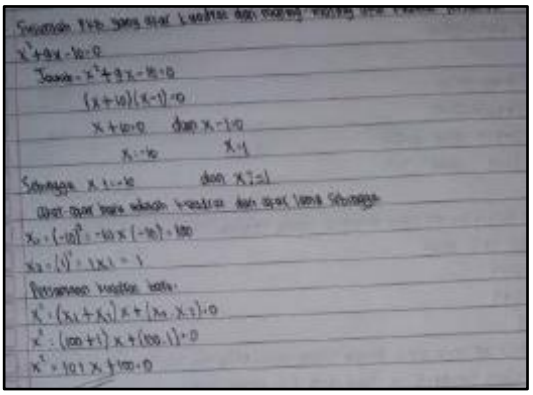

Figure 4. Medium Category's Answer in Question 1.

It can see from Figure 4 with the indicators of building basic skills students still have errors in finding the result of the sum and product of the roots of a new quadratic equation. The first step will be less precise if students make mistakes, so the answer is incorrect.

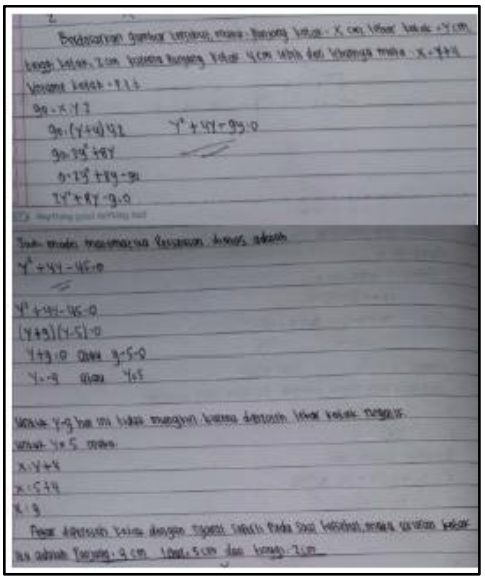

Figure 5. Medium Category's Answer in Question 2.

In Figure 5, with indicators providing simple explanations, students can make mathematical models and find the right size of the box.

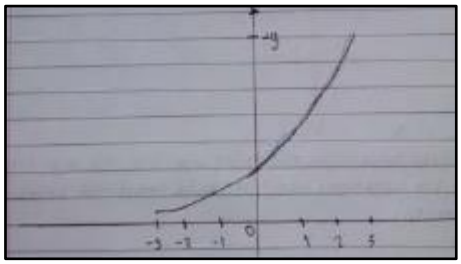

Figure 6. Medium Category's Answer in Question 3.

In Figure 6 with the conclusion indicator, students didn't include the steps in drawing a graph, and the graph was still wrong. Based on this, it can see that

students can't translate and conclude the question. So as overall, students with moderate critical thinking skills can still not answer questions clearly and correctly.

3. Low Category

Based on the research results, 5 students are in the medium category. From these 5 students, it means that the average taken is still far from being by the criteria in the indicators of critical thinking ability. The explanation is in Figures 7, 8, and 9.

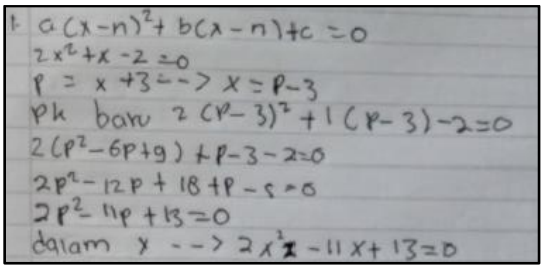

Figure 7. Low Category's Answer in Question 1.

It can see from Figure 7, with indicators of building basic skills, students still have errors in finding the result of the sum and product of the roots of a new quadratic equation. Even the concept of finding its roots is still incorrect. In this case, the basic skills of students are still meager.

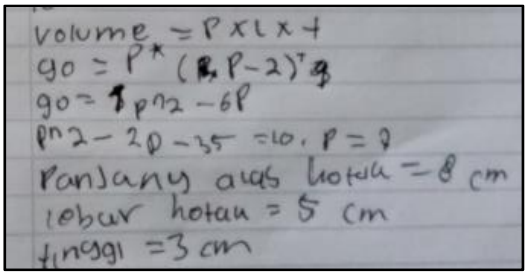

Figure 8. Low Category's Answer in Question 2.

In Figure 8, with the indicator providing a simple explanation, students haven't been able to make mathematical models and find the correct size of the box because students are still incorrect in translating the question.

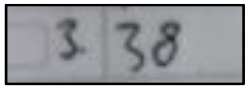

Figure 9. Low Category's Answer in Question 3.

In Figure 9, students don't include answers to the function graph material with the conclusion indicator. Students don't understand the questions given. So as overall, students with low critical thinking ability category are still very far from answering the question correctly.

Based on the categories described, the questions that answered by students correctly and approach correctly are questions with indicators to build basic skills and provide a basic explanation. The three categories haven't come to a conclusion indicator. Based on the results of data analysis and descriptive descriptions, it can say that the critical thinking

ability of respondents at the time of sampling at SMK Negeri 1 Karawang is still in the medium category. It's in line with Kharisma (2018) research that the mathematical critical thinking skills of SMK students haven't yet reached the high category.

Judging from the results of student tests, student errors in answering questions lack understanding of the questions given. It can happen because students don't understand the learning material presented or give practice questions with a high difficulty level. Therefore, it is necessary to improve learning methods and provide questions that can hone students' critical thinking skills so that students' mathematical critical thinking skills can be in the high category.

CONCLUSION AND IMPLICATION

Based on the results of research and discussion on the mathematical critical thinking skills of respondents at SMK Negeri 1 Karawang on the material of equations and quadratic functions, the critical thinking skills of the respondents is conclude still classified as moderate. From the number of students in the medium category, we can see more significance than the other categories. In achieving the percentage of indicators, indicators that provide basic clarification are superior to other indicators. Followed by indicator inference, and indicators build basic support. Although the rate of indicators concluded is more significant than building basic skills, in reality, the results of student answers, students have been able to answer all the steps correctly and correctly. Still, they have not yet reached the conclusion stage.

I hope that with this research, teachers can improve students' mathematical critical thinking skills by improving the approaches and learning methods that have been used, especially for SMK Negeri 1 Karawang.

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