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Analysis of Mathematical Critical Thinking Ability Viewed from Students' Self-Confidence Post-Covid-19 Pandemic

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Abstract

The outbreak of the covid-19 virus has dramatically affected the quality of education so that several times it has changed policies related to teaching and learning activities, one of which is learning mathematics. One of the crucial skills in learning mathematics is the ability to think critically mathematically. Critical thinking skills can be stimulated in various ways, one of which is self-confidence. This research aims to describe mathematical critical thinking skills in terms of the self-confidence of junior high school students. This study employed a qualitative descriptive methodology. The participants in this study were eighth-grade SMPN 283 Jakarta students. The research subjects consisted of 36 students sorted into three for each self-confidence criterion using a proposed sampling procedure to assess their mathematical critical thinking abilities. This study's instruments include a self-confidence questionnaire, critical thinking skills test, and an interview guide. Data analysis consists of data display, data reduction, and making conclusions. Students with high self-confidence demonstrated four signs of their critical thinking abilities: interpretation, analysis, evaluation, and inference. Analysis, assessment, and inference are three signs of critical thinking skills that students with moderate self-confidence can demonstrate. Students with low self-confidence can meet one indicator of critical thinking skills: analysis.

Keywords: *mathematical critical thinking ability, mathematics, self-confidence*

Introduction

Since the beginning of 2020, several countries have been afflicted by the COVID-19 epidemic in Indonesia, including those affected by it. This impacts numerous parts of life that have changed, especially in the education sector (Herliandry et al., 2020). Despite the presence of COVID-19, educational activities must continue. For this reason, ideal and successful mathematics instruction must still be considered to attain educational objectives (Agustina et al., 2018). So that learning continues, and there are no less covid-19 situations in distant education, PJJ may be a potential answer (Mansyur, 2020). Students experienced difficulties as a result of the implementation of PJJ, such as a limited internet quota and a less stable internet connection, so the material taught by educators was not optimally comprehended. This resulted in low student enthusiasm and activity so the material taught by educators was not optimally comprehended(Putri & Munandar, 2021). As time passes, the dissemination of Covid-19 has waned. Thus the best strategy for overcoming some of the hurdles in PJJ is to implement restricted face-to-face learning (PTMT) (Mubarok, 2022). After PTMT had been implemented and it has been determined that there has been no surge in the spread of Covid-19, the government publishes a 4 Ministerial Decree with certain criteria, including the implementation of PPKM areas level 1 and 2 full face-to-face learning in multiple schools (Fauzia, 2022).

Referring to 21st-century learning, the Ministry of Education and Culture, in collaboration with the Directorate General of Teachers and Education Personnel (Ditjen GTK), launched learning with Higher Order Thinking Skills (HOTS) to enhance the quality of learning (Ariyana et al., 2018). Based on Bloom's taxonomy categories and critical thinking indications, the HOTS components are related to critical thinking skills (Susilowati & Sumaji, 2021). To complete HOTS-based learning as well as

contemporary economic and technological advances, students need to acquire mathematical critical thinking skills so they may be more selective in their information gathering and solve complicated problems in everyday life (Silaen, 2021).

Critical thinking is a technique of thinking that combines inquiry, observation, experience, and other search activities to get rational conclusions by systematically connecting some knowledge (Andriawan et al., 2018). The ability to think critically is the finest alternative to logical problem-solving abilities for children. In addition, children must be taught critical thinking abilities to address common problems. The capacity to think mathematically critically was determined to be the higher-order cognitive function that enables pupils to make the best decisions, particularly while tackling mathematical problems (Pertiwi, 2018).

Students have varying levels of mathematical critical thinking skills and require different amounts of time to initiate critical thinking when solving a mathematical problem. As a result, teachers must play a crucial role in fostering the critical thinking skills of each student, as their thinking characteristics vary. Critical thinking must be integrated and emphasized in the mathematics curriculum so that students can develop their abilities and apply them to increase their accomplishments and critical thinking skills (Widana, 2018). Each student has a unique method for stimulating critical mathematical thinking. Each student's self-confidence is one of these factors. Self-confidence One will be able to believe that he is capable of expressing the answer to the problem adequately and following the notion of comprehension he has gained from the mathematical study (Adharini & Herman, 2020).

The students can not develop their cognitive abilities because of their lack of self-confidence in themselves. Many students prefer to abandon arithmetic issues rather than attempt to solve them because of their lack of confidence in themselves and inability to comprehend students' mathematical skills. In mathematics and daily life, self-confidence is crucial for problem-solving. A person's self-confidence might lead to the creation of their thoughts (Sheldrake, 2016). According to a meta-analysis study (Çiftçi & Yildiz, 2019), self-confidence has a strong and moderate influence on students' mathematical achievement therefore, students' mathematical achievement can be affected by their level of self-confidence.

According to educators, the mathematical critical thinking capacity of pupils in many elementary and secondary schools with supporting applications during PJJ is still reasonably strong, although PTM is still preferable (Sudiarta et al., 2021). Moreover, when issues are provided in the form of story questions, students struggle to write their mathematical models, so most markers of critical thinking skills are not met during PJJ (Sudiarta et al., 2021). The purpose of these challenges is to still in pupils the confidence that, through critical thinking, they can solve even the most complex problems. One can encourage students' critical thinking by giving an issue and requiring pupils to write solutions with self-confidence.

Relevant to this study is the research of Reni Astari Hidayat and Sri Hastut Noer (2019), which explores the relationship between critical thinking skills and self-efficacy. Research indicates that the greater a student's self-efficacy, the greater their ability to carefully solve difficulties, whereas students with low self-efficacy are less adept at carefully addressing problems. Then, research conducted by Keni Eviliasani and Eka Senjayawati (2018) on the relationship between self-confidence and the ability to think creatively revealed that the indicator of achievement in mathematics creative thinking skills is more influential the higher the self-confidence. The conclusion that these two research studies can be drawn is that the association between mathematical critical thinking skills and self-confidence significantly impacts each indication of the connected variable. After the covid-19 outbreak, researchers wish to study the relationship between mathematical critical thinking ability and self-confidence because the mentioned research was conducted during the COVID-19 epidemic.

Method

The researcher employed a qualitative methodology and descriptive research for research. The researcher intends to examine the critical thinking skills of students based on self-confidence criteria. As many as 36 students from class VIII-E were chosen as potential candidates for researchs. The study was carried out at SMPN 283 in Jakarta, which is directly connected to schools. In this study, subjects were selected based on the fulfillment of criteria for high, medium, and low self-confidence, using a purposive sampling technique to select up to 3 subjects for each criterion. Following the selection of each criterion, mathematical critical thinking ability on high self-confidence, and the interview based on the results of the test of mathematical critical thinking skills on the flat-sided geometry material, the candidate is selected. The research instrument comprised an expert-validated self-confidence questionnaire, a mathematical critical thinking ability test, and an interview guide.

The self-confidence questionnaire instrument was adapted and compiled based on indicators containing 20 items divided into five indicators (Rizqi et al., 2016), namely: (1) being always positive in dealing with problems; (2) believing in one's abilities; (3) being courageous in expressing opinions; and (4) having a positive self-concept. Using a Likert scale, questionnaires are collected and measured with the following options: always, frequently, seldom, and never.

Classification of self-confidence assessments and criteria for evaluating positive and negative remarks (Nurafni, 2019).

Table 1. Questionnaire Group

Answer	Positive	Negative
Always	4	1
Often	3	2
Seldom	2	3
Never	1	4

The critical thinking ability test instrument consisting of three descriptive questions was adapted and compiled based on indicators from (Pertiwi, 2018), consisting four indicators, namely: (1) being able to understand the problems presented by expressing known and asked questions accurately (interpretation); (2) being able to connect between the concepts and principles presented in the problem by writing a mathematical model and stating the right reasons (analysis); and (3) being able to determine the solution to the problem by writing a mathematical model and providing (inference).

Extensive interviews then supported the test results. Interviews are used to validate the correctness of students' responses that demonstrate critical thinking skills. Interviews were conducted with study subjects who met each self-confidence requirement to obtain data relevant to the data required for research, particularly the self-confidence and mathematics critical thinking skills of junior high school students. Triangulation is a technique used to validate these research findings. The data triangulation employed in this study is time-based.

Results and Discussion

It can be categorized into each category of self-confidence based on the findings of the questionnaire analysis. High, medium, and low self-confidence are the three categories of self-confidence. The completed analysis determined that $\mu = 51.67$ and $\sigma = 7.07$ correspond to the self-confidence category, which is provided in Table 2.

Category	Interval	Interval Score
High	$X \geq (\mu + SD)$	$X \geq 58{,}74$
Medium	$(\mu - SD) \leq X < (\mu + SD)$	$44{,}59 \leq X < 58{,}74$
Low	$X < (\mu + SD)$	$X < 44{,}59$

Table 2. Category of Self Confidence
Source : (Ulfa et al., 2019)

Based on the data in Table 2, It is determined that there are four students with strong self-confidence, 29 students with moderate self-confidence, and three students with low self-confidence. Subjects were grouped according to their level of self-confidence. Then, perform a three-question test of critical thinking using flat-sided geometry. In the subsequent analysis, a purposive sampling strategy was utilized to select one student from the three previously investigated self-confidence groups. Three students selected in total can be categorized in Table 3. In this study, the subject code is classified as follows:

Table 3. Subject subject code

Student Code	**Category**
P1	High
R1	Medium
S1	Low

After choosing the subject of the students, the test results of their answers about the ability to think critically and mathematically on the problem of constructing a flat side space will be analyzed. Students who have completed a self-confidence questionnaire will also be interviewed. The following describes the distribution of each test and interview analysis result:

Question No. 3
The length of a pencil case is (p - 4) cm, and its width is p cm. Given that the pencil case's height is 4 cm and its capacity is 240 cm3, determine the area of each side of the pencil case!

Mathematical Critical Thinking Ability on High Self Confidence
The answers to exams and interviews of learners with the code P1 who have strong self-confidence will be examined as depicted in the accompanying graph.

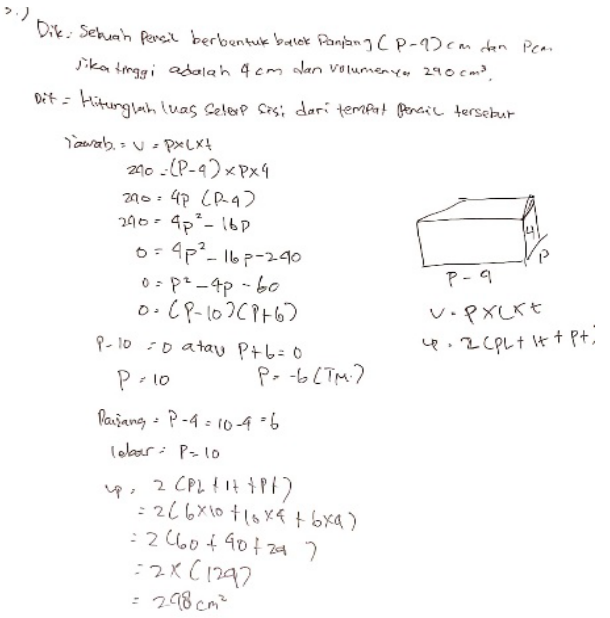

Figure 1. Example of working with great self-confidence on subject P1

In Figure 1. Subject P1 can write what components are included in the problem and what to search for in the problem, illustrate pictures of the problems, decide on detailed and appropriate techniques, and draw good and accurate conclusions. The following are the outcomes of the researcher's interview with subject P1:

Researcher :		**Do you find the question challenging?**
P1	**:**	Not terrible because the volume is known.
Research :		Then, in addition to this, what are the issues with the questions you encounter?
P1	**:**	Find the surface area when the length and width are unknown due to the presence of variables.
Researcher:		Are you able to describe your writing?
P1	**:**	So, I first determined what was known and asked Sis to make the problem easier to read. I also drew a picture of the pencil case in the form of a block to visualize it better. Next, I determined the length and width of the pencil case using the volume formula because the volume of the pencil case is known.
Researcher :		Are you sure about your solution?
P1	**:**	Yes, because I have double-checked

According to the interview results, subject P1 took great care to comprehend the supplied problems, as evidenced by the fact that P1 wrote down what was learned and requested assistance in solving the problem, thereby meeting the interpretation indications. P1 satisfies the analytical criteria because it employs a mathematical model to illustrate the applicable problem to make the solution formula easier to comprehend. Then, P1 utilizes the correct technique, which is first to determine the length and width using the volume formula, then, after determining the length and width, calculate the surface area; hence, P1 has met the evaluation criteria. Then, subject P1 correctly concluded the results and double-checked the computations to obtain the correct outcome, thereby completing the inference indicator. This is consistent with a study by Agung Setiawan and Rochmad (2021), which indicates that highly self-confident pupils will have superior mathematical critical thinking abilities.

Mathematical Critical Thinking Ability on Medium Self-Confidence

Subjects with the code R1 for moderate self-confidence will have their responses to the tests and interviews assessed.

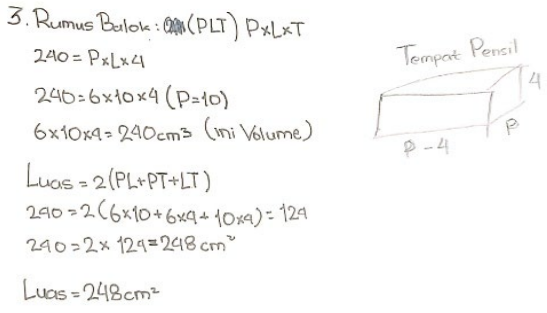

Figure 2. Example of working with medium self-confidence on an R1 subject

In Figure 2. Subject R1 can construct a mathematical model in a pencil case in the shape of a cube. Subject R1 can also employ the appropriate method to solve problems and provide precise and correct conclusions and outcomes. However, R1 cannot specify which components are present in the problem and what to check for. The following are the outcomes of the interview conducted by the researcher with R1:

Researcher :	Do you find the question challenging?

R1	**:**	It's hard.
Researcher :		Then, in addition to this, what challenges do you encounter in the questions?
R1	**:**	The issue in this scenario involves the surface area of the block, correct? In addition, its length and width are unclear, as it is still in the form of a p.
Researcher :		Can you describe your writing?
R1	**:**	I initially crossed off the block image, but because the length is still p-shaped, I attempted the operation that yielded 240 cm3, then estimated the surface area.
Researcher:		Are you sure about your solution?
R1	**:**	Inshallah, I'm sure

According to the results of the interview analysis, subject R1 immediately applied the problem solving to the formula without writing it down and being asked, indicating that R1 did not meet the interpretation indicator. However, subject R1 described an illustration of a pencil case to elicit memories related to the formula to be used, thus meeting the analysis indicators. Subject R1 can solve the problem using the correct approach while searching for length and width using trial and error, meeting the evaluation indicators. Subject R1 can draw the correct conclusion at the conclusion stage, thereby meeting the inference indication. This is consistent with research by Ummi Athifah and Hikmatul Husna (2022), which revealed that the outcomes of mathematics critical thinking skills on self-confidence met three indicators for females but only two for males.

Mathematical Critical Thinking Ability on Low Self-Confidence

Students with the code S1 have poor self-confidence, and their test responses will be examined as depicted in the figure below.

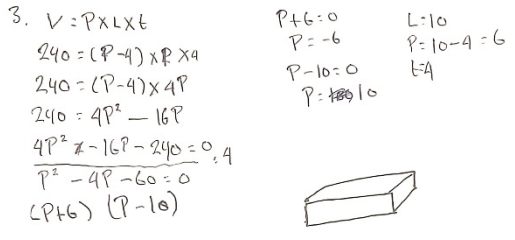

Figure 3: Illustration of working with S1 patients that lack confidence

In Figure 3. Subject S1 can only describe the mathematical model when it has been completed. In addition, the topic of S1 is inappropriate and incomplete at the completion strategy stage. The following are the outcomes of the researcher's interview with subject S1:

Researcher:		Do you find the question challenging?
S1	**:**	It isn't easy!
Researcher :		Then, in addition to this, what challenges do you encounter in the questions?
S1	**:**	Calculate the surface area
Researcher:		Can you describe your writing?
S1	**:**	What I recall to find the length is interchangeable, but I also lost the formula for calculating the surface area, Sis, which is why I did not complete the task.
Researcher :		Okay, That's good!

The S1 subject admitted that he was directly at the completion stage, beginning with drawing an illustration of a pencil case followed by a problem-solving strategy, but at the stage of solving the problem, he was not finished because he did not know the formula for the surface area. This indicates that the S1 subject interpretation indicator did not meet because it does not specify what to look for in problems. And on the analysis indicators, subject S1 is satisfied because it illustrates the existing picture of the problem. However, subject S1 does not satisfy the evaluation indicators because there are errors in the completion stage, and it is incomplete at the conclusion. The inference indicator does not satisfy because there are no conclusions in the results in the answer. This is consistent with a study by Bagus Dwi Wicaksono and Erlina Prihatnani (2019), indicating that individuals with low self-confidence in their mathematical critical thinking skills are only able to meet one indicator in mathematical critical thinking skills

The results of this study are consistent with those of Khoirunnisa (2021), who found that highly self-confident subjects have good critical thinking skills because they meet four markers or elements of critical thinking abilities that enable them to solve problems carefully and precisely. While subjects with low self-confidence are not considered good since they attain only one indicator or stage in critical thinking

abilities and cannot answer problems correctly and comprehensively, this does not negate their poor self-confidence.

Conclusion

From the conclusion of the above explanation, we can deduce that self-confidence positively correlates with critical thinking ability, and vice versa, that self-confidence negatively correlates with critical thinking ability. Therefore, in this post-covid-19 pandemic, self-confidence is still deeply ingrained and impairs critical mathematical thinking. This research is still limited because research on mathematical critical thinking skills in terms of self-confidence is more prevalent before and during the pandemic. It is hoped that after the end of the COVID-19 pandemic, additional researchers will develop and examine its mathematical critical thinking skills in terms of self-confidence.

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