ANALYSIS OF STUDENTS' MATHEMATICAL CRITICAL THINKING SKILLS AND COLLABORATIVE COLLABORATION SKILLS

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ABSTRACT

Indonesian students' mathematical critical thinking abilities are still inadequate and one of the things that influences mathematical critical thinking abilities is students' collaboration skills. This study will provide an overview of the relationship between student collaboration and the mathematical critical thinking skills of grade VIII-F students of SMP N 1 Yogyakarta. The correlational technique is a technique used to test the relationship between the two variables. Based on the findings, there is a linear relationship between the mathematical critical thinking capacity of learners and the willingness to work together. The conclusion that can be drawn is that there is a substantial relationship between collaboration skills and mathematical critical thinking skills of grade VIII-F students of SMP N 1 Yogyakarta because of r_hitung>r_tabel (0.467>0.29). so the conclusion that can be obtained is that there is a significant relationship between the ability to think critically mathematically and the collaboration of students of VIII-F SMP N 1 Yogyakarta. In addition, the relationship between the two research variables was positive because r_hitung= 0.467. Overall, students' collaboration skills fall into the medium, high, and very high categories, while their mathematical critical thinking skills fall into the low, medium, and high categories. However, some of them have collaboration skills that fall into the medium category but have low mathematical critical thinking skills, and some students have collaboration skills that fall into the high category but have medium mathematical critical thinking skills. Low mathematical critical thinking skills make students unable to express reasons and justifications accurately. Although learners with intermediate critical thinking skills can provide reasonable justifications for such questions, the arguments they provide may not be entirely valid.

Keywords: Mathematics, Critical thinking; collaboration

Introduction

The 21st century has filled the cavities of human life, especially in the field of education. To adapt to the times, what must be possessed is life skills. Based on the Decree of the Head of BSKAP Number 8 of 2022 concerning learning outcomes on Learning Outcomes in Early Childhood, the Primary Education Level and the Secondary Education Level in the Independent Curriculum states that 21st-century skills in the field of knowledge can be developed through (1) the ability to think critically and solve problems; (2) effective communication skills; (3) the ability to think originally and innovate; and (4) collaboration skills. It is also needed in mathematics learning (Widianti, 2023).

Based on the Decree of the Head of BSKAP Number 8 of 2022 concerning learning outcomes on Learning Outcomes in Early Childhood, Primary Education Level, and

Secondary Education Level in the Independent Curriculum states that the ability to think independently, critically, analyze, logically, regularly, and creatively is an ability that is needed in learning various learning including mathematics so that students can collect, manage and use the information that has been obtained (Fitriyani & Fauzi, 2023). These abilities will make it easier for students to understand mathematical concepts so that they can be applied when solving contextual/real problems (Çakıroğlu et al., 2023).

The ability to think critically is the most needed ability at this time. The ability to think critically is the ability needed when interpreting, analyzing, evaluating, and making conclusions, or the ability to make explanations by mathematical information and concepts used as contextual considerations and as a basis for making a decision (Peter & Gittens, 2015). This is because children who can think critically cannot easily receive information without the process of filtering information and looking for causes or evidence logically and rationally before making decisions on the information (Firdaus et al., 2019). So, it can be said that learners must have the ability to think critically. This is because the ability to think critically mathematically is the ability to think reflectively, regularly, logically, and productively so that one can make good judgments and decisions on the information obtained whose processes are developed in mathematics learning (Johnson et al., 2016). Therefore, the conclusion that can be obtained is that the capacity to collect and sort information then look for evidence logically from the information obtained and make decisions based on the process is a component of mathematical critical thinking (Mogea, 2022).

Permendikbudristek No. 9 of 2022 concerning the Dimensions, Elements, and Subelements of the Pancasila Student Profile explains that it will make it easier for them to obtain and process various information, conduct reasoning analysis and evaluation, reflect on the results of thoughts and carry out thinking processes to obtain the right decisions. Therefore, the need for mathematical critical thinking skills is very large because this ability can help in solving various story problems related to real contexts (Burhanuddin, 2023). However, research conducted by (Putri et al., 2022) obtained research results stating that junior high school students still struggle with their low mathematical critical thinking skills. Therefore, these skills are still important to pay attention to.

According to (Santoso et al., 2021), one of the skills that affect students' critical thinking skills is collaboration skills. which explains that collaboration skills are a professional interaction in working together to achieve a predetermined goal. Furthermore, collaboration skills are seen as the ability to commit, be responsible, and work together as well as possible to achieve goals that have been set together, students are expected to achieve meaningful results when they experience real life in society (Hidayati, 2019). Collaboration skills can make students have a tolerant and wise attitude in solving problems. It can be concluded that collaboration skills are the ability to work together and commit to solving a problem and achieving a predetermined goal (Khoriah, 2020).

The ability to think critically and collaborate is something that needs to be considered because it is a competency needed in the future and needs to be empowered through the learning process (Rieckmann, 2018). When the collaboration skills of students increase, the ability to think also increases. The reason is that when students cooperate or collaborate in then their intellectual abilities are higher than students who do not cooperate in solving a problem (Mulyana et al., 2022).

Based on some explanations from the previous paragraph, it can be said that critical thinking skills and collaboration skills are two important things. However, research on the relationship between mathematical critical thinking skills and collaboration skills in the field of mathematics is still limited, so this study aims to reveal information on collaborative and mathematical critical thinking skills of grade VIII-F students of SMP N 1 Yogyakarta.

Research Method

This kind of research uses correlational quantitative methods that aim to provide an overview of the relationship between the variables studied. As for what is meant by quantitative research with correlational techniques, it aims to find evidence of a relationship between students' mathematical critical thinking skills (X) and their collaboration skills (Y).

The population in this study was all grade VIII students of SMP N 1 Yogyakarta. *Purposing sampling* is the sampling method used. Therefore, class VIII-F of 32 people was selected as a research sample based on input from class VIII mathematics teachers.

Collaboration questionnaires and critical thinking skills tests were used as data collection methods. The questions used are description questions that reflect critical thinking skills in each indicator and these are listed in Table 1.

Table 1. Indicators of critical thinking ability

No.	Aspects of critical thinking skills	Indicators
1	*Interpretation*	Present information and questions asked about the problems presented
2	*Analyzing*	Make and prove the correctness of arguments made based on information on the question
3	*Evaluation*	Assess statements and evaluate the results obtained
4	*Inference*	Making conclusions based on the information that has been considered
5	*Explanation*	Interpret the answer to the problem presented

Source: Facione & Peter 2015 Mods

The collaboration questionnaire consists of 20 statements describing 5 indicators of collaboration. The following standards apply to learners' ability to collaborate and think critically.

Table 2. Critical thinking skills assessment criteria

Value Interval	Criterion
$90 \leq X \leq 100$	Very high
$80 \leq X < 89$	Tall
$70 \leq X < 79$	Keep
$60 \leq X < 69$	Low
$X < 60$	Very low

Formula:

$$x = \frac{skor\ yang\ diperoleh}{skor\ maksimum} \times 100$$

Information:

X= value earned by students

Table 3. Collaboration assessment criteria

Score Interval	Criterion
$X > 135$	Very high
$105 < X \leq 135$	Tall
$75 < X \leq 105$	Keep
$45 < X \leq 75$	Low
$X \leq 45$	Very low

Information:

X= *total* score

Correlation testing is a method of data analysis used. Between -1 and 1, the correlation coefficient ranges. The relationship between the two variables is stronger when the results obtained are close to 1, and vice versa. The first step is to analyze the learners' collaboration proficiency scores. The second step is to analyze the results of the learners' critical thinking ability test. The last step is to conduct a correlation test to determine the relationship between students' mathematical critical thinking skills and their collaboration skills

Result and Discussion

Based on the score from the collaboration questionnaire, the results obtained were 9.4% of grade VIII-F students had collaboration skills in the medium category, 78% of grade VIII-F students had collaboration skills in the 'high' category and 12.6% of grade VIII-F students had 'very high' collaboration skills. The results of the analysis of student collaboration skills are shown in Table 5.

Table 5. Collaboration prowess analysis

$\bar{x}$	$Skor_{max}$	$Skor_{min}$	s

120,8	137	75	17,9

The score on the critical thinking ability test was that 15.6% of students scored in the "low" category on the critical thinking ability test, followed by 21.9% in the "medium" category, 50% in the "high" category, and 12.5% in the "very high" category. The results of the analysis of student collaboration skills are shown in Table 6.

Table 6. Analysis of mathematical critical thinking skills

$\overline{x}$	$Skor_{max}$	$Skor_{min}$	s
81,6	93,75	62,5	7,8

The following are the results of the data analysis reviewed from each indicator on mathematical critical thinking skills.

Table 7. Analysis of learners' critical thinking skills based on each indicator

Indicators	Average	Percentage
Interpretation	0,81	81%
Analyzing	0,91	91%
Evaluation	0,71	71%
Inference	0,89	89%
Explanation	0,73	73%
Average	0,81	81%

Based on Table 7 it can be seen that 81% of students can write down the meaning or information and things asked on the problem presented, 91% can make and prove the truth of arguments made based on information on the question 71% can assess statements and evaluate the results obtained, 89% can make conclusions based on information that has been considered and 73% can make interpretations Answers to the problems presented

The next step is to analyze how the two abilities are related. The *Pearson product-moment* correlation test is used if the data obtained are normally and linearly distributed, but if one of these conditions is not met, the *Spearman test is used*.

Make sure the data has been checked for normality before performing a correlation test. The table contains the data normality test findings.

Table 8. Normal distribution test results

Variable	Kolmogorov-Smirnov		
	Statistics	Df	Sig.
Critical thinking	.145	32	.085

Collaboration	.000	32	.000

The significance value of critical thinking ability is 0.85 as determined in Table 8. Critical thinking data is normally distributed because the significance value is greater than the error rate (0.85>0.05). Collaboration proficiency data is not normally distributed because its significance is less than the error threshold (0.00>0.05).

Next, perform a test to see the linearity of the data and perform a correlation test. Linearity test using ANOVA. The results of the linearity test are presented in Table 9.

Table 9. Linearity Test

			ANOVA			
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4156,581	1	4156,581	20,551	.000[b]
	Residual	6067.638	30	202,255		
	Total	10224,219	31			

Based on the results in Table 9, the significance value is less than the error level (0.00>0.05) so there is a linear relationship between the two variables studied.

Next, enter the correlation test stage. Because there is data that is not normally distributed but the data is linear, the correlation test used is *Spearman's rank*. The results of the correlation test are presented in Table 10.

Table 10. Spearman's rank correlation test results

			Berpikir_Kritis	Collaboration
		Correlation		
	Berpikir_Kritis	Correlation Coefficient	1.000	.467**
		Sig. (2-tailed	.	.007
Spearman's rho		N	32	
		Correlation Coefficient	.467**	.007
	Collaboration	Sig. (2-tailed)	.007	.
		N	32	32

Furthermore, a hypothesis test was carried out to see if there was a significant relationship between the collaboration skills of grade VIII-F students of SMP N 1 Yogyakarta with their mathematical critical thinking skills. This test can be seen by comparing with withwithw$r_{hitung}r_{tabel}$. so, there is a significant rrelationshipbetweenttheheher$_{hitung}$ to think critically mathematically and the collaboration skills of grade VIII-F students of SMP Negeri 1 Yogyakarta.

The results obtained $r_{hitung} > r_{tabel}$ are (0.467>0.29), so the conclusion that can be obtained is that there is a significant relationship between collaboration skills and

mathematical critical thinking of students in grade VIII-F SMP N 1 Yogyakarta. In addition, because = r_{hitung} 0.467 (positive value) the research variables have a positive relationship. Therefore, it can be concluded that students' collaboration skills can positively affect students' mathematical critical thinking skills, so when students have 'high' collaboration skills, students will also have 'high' mathematical critical thinking skills as well (Santoso et al., 2021).

Collaboration skills and mathematical critical thinking skills are interrelated, but some students have a 'medium' level of cooperation but a 'low' level of mathematical critical thinking. Some students have 'very good' cooperation skills, but their critical thinking skills are only at the intermediate level. Therefore, not all learners who show a "high" level of cooperation also show a "high" level of mathematical critical thinking. These results contradict Gokhale (1995) which states that when students' collaboration skills are 'high', students' critical thinking skills will also be 'high'. The following is an overview of the answers of students with collaboration skills in the medium category but who have collaboration skills in the low category.

Figure 1. Answers of students with moderate collaboration skills but low critical thinking skills

Figure 1 shows that learners have 'moderate' collaboration skills but have critical thinking skills in the 'low' category. Based on the results of the analysis of the answers made by students, it can give the idea that students with poor critical thinking skills cannot determine information appropriately but students cannot give opinions appropriately. Based on these answers, students also cannot make precise reasons where there is confusion when simplifying the shape of known lines even though the concepts applied to prove whether the opinions given by students are correct or not. Therefore, it

is concluded that those with low critical thinking skills cannot provide arguments and make explanations to prove that the arguments they give are correct (Chatfield, 2022).

Furthermore, here is a description of students with collaboration skills in the 'high' category but their mathematical critical thinking skills are in the 'medium' category.

Figure 2. Answer students with collaboration skills in categories high but have moderate critical thinking skills

Figure 2 shows that students with critical thinking skills in the 'medium' category can identify important information on the problem, and can provide the right argument but the reasons given are not entirely appropriate because the process of solving the right problem only reaches the stage of simplifying the line equation. While students with mathematical critical thinking skills in the 'high' category can give arguments and the right reasons.

Conclusion

Based on the results and discussion, students' collaboration skills are in the 'medium', 'high', and 'very high' categories. Overall, students of grade VIII-F SMP N 1 Yogyakarta can interact and build cooperation to achieve a goal. The mathematical critical thinking skills possessed by students are in the categories of 'less', 'medium', 'high', and 'very high'. Overall, students of grade VIII-F SMP N 1 Yogyakarta can solve story problems that require mathematical critical thinking skills with the 'medium' category. However, some students have collaboration skills in the medium category but have critical thinking skills in the low category. Students with critical thinking skills in the moderate category are unable to provide arguments and reasons appropriately. Some students have collaboration skills in the high category but moderate critical thinking skills. Students who have critical thinking skills in the moderate category can provide the right argument for the question on the question but the reasons given are not entirely appropriate.

Based on statistical tests, it is known that collaboration skills and mathematical critical thinking skills are significantly correlated or related. The correlation is in the medium category and has a positive value.

The next research suggestion is to conduct a more in-depth analysis of other factors that can influence collaboration skills and mathematical critical thinking skills. Next, determine the solution for improving these two things.

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