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The Relationship Between Mathematical Resilience and Critical Thinking Ability of Student

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ABSTRACT

Critical thinking ability is one of the important abilities in mathematics learning, while mathematical resilience acts as an affective factor that encourages students to persevere in the face of difficulties. This study aims to analyze the relationship between mathematical resilience and students' critical thinking skills in the context of mathematics learning. The research method used a correlational quantitative approach involving 20 Al-Hikmah Junior High School students as samples. Data were collected through mathematical resilience questionnaire and mathematical problem-based critical thinking ability test, then analyzed using correlation test (Pearson/Spearman) and crosstab test. The results showed that there was no significant relationship ($r = 0.266 < 0.05$) between mathematical resilience and critical thinking ability. This finding indicates that other factors, such as learning motivation, teaching model, or learning environment, may have more influence on students' critical thinking ability. Nonetheless, this study contributes to the understanding of students' cognitive and affective abilities in the context of mathematics learning.

Keywords: critical thinking ability; correlation; mathematical resilience

INTRODUCTION

Global development in the 21st century is characterized by significant scientific advances in various fields, especially in the world of education. Education is one of the main pillars that determine the progress or decline of a nation's civilization. Therefore, in this digital era, education plays a crucial role in shaping the nation's generation that is able to adapt and can keep up with the pace of scientific development, one of which is mathematics (Aziz et al., 2025; Septian et al., 2025). Mathematics is a scientific dicipline that emphasizes critical, logical, imaginative and methodical thinking patterns so that it becomes an important part of education at all levels, from elementary school to college (Antara et al., 2020).

The field of mathematics develops not only in the context of mathematical theory, but also in classroom learning practices. The Ministry of Education and Culture states that learning mathematics encourages the ability to think logically, critically, analytically, systematically and innovatively (Sari & Lutfi, 2023). The development of mathematics learning is followed by various demands to improve students' abilities and skills in learning mathematics. One of the important abilities in learning mathematics is the ability to think critically (Rahmaini & Ogylva Chandra, 2024). Critical thinking ability is a high-level cognitive ability in solving a problem, which involves the thought process of analyzing and differentiating problems systematically and specifically, as well as identifying and

evaluating information to plan problem-solving strategies (Firdausi et al., 2021; Rahmi et al., 2023).

Facione in Anggraeni & Ramlah (2024) states that there are four indicators of mathematical critical thinking skills, namely (1) Interpreting, in learning, students are encouraged to better understand the problems presented by writing down the things that are known and asked, (2) Analyzing, at this stage students identify the relationship that occurs between statements, questions, and concepts contained in the problem, (3) Evaluating, students try to solve the problem by using the right strategy and supported by logical statements, and (4) Concluding (Inference), the last stage students make conclusions from the results obtained appropriately. Critical thinking skills are very important for students to have because it can help them to solve various problems both academic problems and daily problems (Ramdani et al., 2021). However, reviewing the facts in the field, shows that critical thinking skills are not in accordance with expectations. This is evidenced by research by Puspita & Dewi (2021) which shows that students' difficulties in analyzing and solving problems are the cause of students' low critical thinking skills. Another factor that contributes to low critical thinking skills is learning activities that do not actively involve students in it (Wati et al., 2024).

In addition, students' positive attitude is one of the important factors needed to support students' critical thinking skills in learning (Heryadi, 2021). This is in line with research by Rasyidah & Widiyasari (2022) which states that a positive attitude is an important quality that students must have because many of them often show fear, anxiety, and feel difficulties when learning mathematics. According to Johnston and Lee (in Betaviana et al., 2024) math learning difficulties in overcoming a problem can be overcome with a persistent, persevering and confident attitude which is then known as resilience. Mathematical resilience is one of the important concepts in education (Al Ghifari et al., 2022).

Mathematical resilience is an outlook that pleases and motivates a person to overcome nervousness and fear in facing math learning difficulties so that in the end they can find answers (Nurmala et al., 2023). Mathematical resilience is an attitude or tool to overcome anxiety and fear in facing challenges in the form of difficulties in solving math problems (Azizah & Abadi, 2022). The resilience indicators that are most often used are indicators according to Sumarmo (in Arvianti, 2023) as follows: (1) Students show interest in socializing, helping, discussing with peers and being able to adjust to the environment; (2) have an attitude of perseverance, confidence, hard work, not easily giving up in facing problems, failures and uncertainties; (3) students can generate new ideas and find creative problem solving in the face of challenges; (4) students take advantage of experiences from failure to build self-motivation; (5) students have curiosity, reflect, research, and utilize various sources; (6) able to control themselves and be aware of their feelings.

Mathematical resilience is important to develop in students so that students are accustomed to seeing challenges as an opportunity to learn. If mathematical resilience in mathematics learning is ignored and not made the main focus, then when students are faced with a problem, students will easily give up so that they are unable to find solutions to the problems they face (Yuniar et al., 2022). Based on several statements above, mathematical

resilience is closely related to critical thinking skills. However, based on research conducted by Rohaeti & Koswara (2018) mentioned that in several other studies showed no significant relationship between critical thinking skills and mathematical resilience when compared through different teaching approaches, this indicates that the relationship may not be universally applicable and depends on the teaching model and method as well as the student's context.

In a follow-up study, it was found that there is a relationship between critical thinking skills and resilience but not in a positive sense, which in this case is characterized by low critical thinking skills correlated with low mathematical resilience (Fatimah & Lubis, 2021). Students who lack critical thinking skills often feel frustrated and give up easily when facing a complex math problem. Meanwhile, students who are able to think critically tend to be more able to identify solutions and overcome difficulties in learning effectively (Rahmadani et al., 2023). This is in line with research by Achadiyah (2023) which states that the higher the mathematical resilience of students, the higher their critical thinking skills.

Then in a recent study conducted by Fatimah et al (2024) showed that there is a significant positive relationship between critical thinking skills and students' mathematical resilience. The relationship between mathematical resilience and critical thinking skills is very important for students, as has been proven by several previous studies. Mathematical resilience, which is defined as the ability to persevere in the face of mathematical challenges, can positively affect students' critical thinking skills. In addition, the relationship between mathematical resilience and critical thinking skills has not been studied in depth, especially in mathematics learning.

Therefore, this study aims to analyze the relationship between mathematical resilience and students' critical thinking skills, as well as the extent to which resilience can influence the development of critical thinking skills in mathematics. By understanding this relationship, educators can design learning strategies and approaches that not only improve conceptual understanding of mathematics, but also build students' mental resilience in facing challenges especially in academics. The implications of this research can provide recommendations for the development of learning methods that support both resilience and critical thinking skills, so that students can become more independent and adaptive learners in the future.

RESEARCH METHODS

The research method used in this study is a correlational quantitative approach. The research design that will be used is a cross-sectional design. In this study, data were collected at one time (one-shot study). The research was conducted at Al-Hikmah Junior High School which is located at Kp. Nagrak, Ds. Jati, Kec. Tarogong Kaler, Garut Regency. The research was conducted on Thursday, May 22, 2025 at 08.40-09.20 WIB. The population in this study were all 8th grade students of Al-Hikmah Junior High School and the research sample was 8C students of Al-Hikmah Junior High School with a total of 20 students. The variables that will be examined in this study are mathematical resilience as the independent variable (X) and critical thinking ability as the dependent variable (Y).

The data collection techniques used were tests, questionnaires, and documentation. The instruments used in the research are: (a) instrument in the form of a written test containing HOTS (High Order Thinking Skills) based math questions used to measure critical thinking skills, and (b) questionnaire instrument to measure mathematical resilience using a Likert scale. Data analysis used in this research is normality test, Pearson rank test for normally distributed data, Spearman rank test for non-normally distributed data, and crosstab test.

RESULTS AND DISCUSSION

This study is a correlational quantitative study with the aim of knowing whether there is a relationship between mathematical resilience and critical thinking skills in students. The results of the normality test in this study show that for mathematical resilience data is normally distributed because the sig value > α (0.05) while for critical thinking ability data is not normally distributed because the sig value < α (0.05). The results of the data analysis using the normality test are as follows:

Table 1. Normality Test Result

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Mathematical Resilience	0.106	20	0.200*	0.954	20	0.435
Critical Thinking Ability	0.222	20	0.011	0.810	20	0.001

Furthermore, this study used the Spearman Rho data analysis technique because there was an abnormality in the relationship between the two variables in the study, so it did not meet the requirements for using parametric statistical tests. This test aims to measure how much strength and direction of the monotonic relationship between the variables of mathematical resilience and critical thinking skills. The hypothesis proposed in this study is that there is a positive relationship between mathematical resilience and critical thinking skills in students. The results of the data analysis using the Spearman Rho correlation test are as follows:

Table 2. Spearman Rho Test Result

			Mathematical Resilience	Critical Thinking Ability
Spearman's rho	Mathematical Resilience	Correlation Coefficient	1.000	0.266
		Sig. (2-tailed)	0.000	0.257
		N	20	20
	Critical Thinking Ability	Correlation Coefficient	0.266	1.000
		Sig. (2-tailed)	0.257	0.000
		N	20	20

Based on the results of data analysis using Spearman Rho between mathematical resilience and critical thinking skills, the correlation score is 0.266 with a significance of 0.257 ($p > 0.05$). This means that the results show a weak positive relationship between mathematical resilience and critical thinking skills. However, the relationship is not

statistically significant. Although numerically there is a positive correlation, this result is not statistically meaningful so that the research hypothesis is rejected.

The categorization of research subjects based on the total score of each research variable is formulated as follows:

Table 3. Research Result Data Category Formula

Category	Formula
Low	$X < Mean - 1SD$
Medium	$Mean - 1SD < X < Mean + 1SD$
High	$X > Mean + 1SD$

The results of descriptive analysis of research data based on variable measurements obtained in the field.

Table 4. Subject Categorization Based on Total Score Acquisition of Mathematical Resilience

Category	Interval	Frequency	Percentage	Mean	Standard Deviation
Low	$X < 68.29$	2	10%	74.05	5.76
Medium	$68.29 < X < 79.81$	13	65%		
High	$X > 79.81$	5	25%		
	N	20	100%		

The calculation results explain that the low category is in the score range of less than 68.29, the medium category is in the score range of 68.29-79.81, and the high category is in the score range of more than 79.81. Based on these calculations, it is known that there are 5 students in the high category with a percentage of 25%, there are 13 participants in the medium category or as much as 65% and the remaining 2 students in the low category with a percentage of 10%.

Table 5. Subject Categorization Based on Total Score Acquisition of Critical Thinking Ability

Category	Interval	Frequency	Percentage	Mean	Standard Deviation
Low	$X < 62.44$			75.94	13.49
Medium	$62.44 < X < 89.43$	18	90%		
High	$X > 89.43$	2	10%		
	N	20	100%		

The calculation results explain that the low category is in the score range of less than 62.44, the medium category is in the score range of 62.44-89.43, and the high category is in the score range of more than 89.43. Based on these calculations, it is known that there are no students in the high category, but there are 18 participants in the moderate category or as much as 90% and the remaining 2 students in the low category with a percentage of 10%.

To see how the mathematical resilience category (low, medium, high) is distributed against the critical thinking ability category (low, medium, high), a crosstab test was conducted. This test facilitates understanding of how strong the influence of one category is on another. In addition, it is also to identify patterns or trends, for example students with high resilience are more in the high critical thinking category or vice versa. The results of the crosstab test in this study are as follows:

Table 6. Crosstab Test Result

			Critical Thinking Ability		Total
			Low	Medium	
Mathematical Resilience	Low	Count	1	1	2
		% of Total	5.0%	5.0%	10.0%
	Medium	Count	1	12	13
		% of Total	5.0%	60.0%	65.0%
	High	Count	0	5	5
		% of Total	0.0%	25.0%	25.0%
Total		Count	2	18	20
		% of Total	10.0%	90.0%	100.0%

From the Table 6, it is known that there is 1 student who is in the low resilience category and low critical thinking ability with a percentage of 5%, there is 1 student in the low resilience category and moderate critical thinking ability with a percentage of 5%, and there is 1 student who is in the moderate resilience category and low critical thinking ability with a percentage of 5%. Furthermore, in the moderate resilience category and moderate critical thinking skills there are 12 students with a percentage of 60%, in the high resilience category and low critical thinking skills there are no students so that the percentage is 0%. And finally there are 5 students who are in the high resilience category and moderate critical thinking skills with a percentage of 25%.

From the results of the correlation and significance of the study, researchers found a weak and insignificant positive correlation in the variables tested. It can be said that the results of the study numerically there is a weak positive trend (the higher the mathematical resilience, the higher the critical thinking ability but the effect is small and inconsistent), but this result is not strong enough to conclude that there is a real relationship, so in other words the null hypothesis (H0) is accepted which indicates that there is no significant relationship between mathematical resilience and critical thinking ability in students. This finding is in line with research by (Rohaeti & Koswara, 2018) which states that there is no significant relationship between mathematical resilience and critical thinking skills when compared through different teaching approaches, this suggests that the relationship may not be universally applicable and depends on teaching methods and student context.

With the results of the study, it can be seen that teaching methods are one of the factors that can affect mathematical resilience and critical thinking skills. If the learning process is not designed with the aim of linking mathematical resilience with critical thinking activities (such as problem solving or critical discussion), students may not be able to develop both skills simultaneously. Therefore, a learning model that can significantly influence mathematical resilience and critical thinking skills is needed. Various learning models have shown effective results in fostering these skills, such as problem-based learning models that have been studied in various research studies (Susanti et al., 2024). Additionally, research by Faradillah & Humaira (2021) supports these findings, stating that mathematical resilience does not influence critical thinking skills, as evidenced by students with high mathematical resilience demonstrating moderate or low critical thinking skills, students with moderate resilience showing moderate or high critical thinking skills, and students with low resilience exhibiting moderate or low critical thinking skills.

Students' critical thinking ability and mathematical resilience scores were on average in the moderate category. These moderate category scores indicate that students have basic critical thinking and mathematical resilience skills, but not optimal. Students with moderate mathematical resilience are quite capable of persevering in the face of mathematical difficulties, do not easily give up when faced with difficult mathematical problems, have self-confidence and strive to work hard, and have a desire to adapt and discuss with friends. However, they still struggle with emotional control, and their perseverance and creativity require further development. They are also not accustomed to trying alternative strategies if they fail to solve a problem (Sirri et al., 2024). According to Sari & Untarti (2021) students who have a tendency to approach math problems with one method are included in the low resilience category.

Students with mathematical resilience who are in the moderate category, are quite able to survive in the face of mathematical difficulties, but are still easily frustrated when facing challenging problems, have not been able to control emotions when facing problems, and are not accustomed to trying alternative strategies if they fail to solve problems. Students with critical thinking skills in the medium category are able to understand, analyze, and solve problems, but still have difficulty in solving problems in the form of contextual problem applications. The factors that cause the average student score to be in the moderate category may be due to the lack of HOTS problem practice, accustomed to being given problems with standard difficulties so that students are not accustomed to facing problems that trigger resilience and the influence of motivation and self-confidence. Students who are accustomed to solving problems with HOTS skills will make students accustomed to thinking critically in solving problems to find the expected solution (Ichsan et al., 2019).

In addition, a small proportion of students had low resilience and critical thinking scores. This low category score indicates that students do not have critical thinking skills and mathematical resilience. Students with low resilience tend to feel anxious easily, give up quickly when facing difficult math problems or problems. This is in line with the results of research which states that students with low resilience are unable to answer and analyze problems, give up easily when facing difficulties and fill in with strategies that they think are suitable for the problem but do not think about the right strategy (Ansori, 2020). Students with low mathematical resilience will experience anxiety and experience disappointment when facing math problems and cannot solve the problems given (Rohmah et al., 2020). According to (Salsabila & Hadi, 2023), students with low resilience tend to lack motivation and fighting spirit in learning mathematics, resulting in difficulties in facing challenges and becoming easily frustrated when experiencing failure in the learning process. Meanwhile, students with low critical thinking skills have difficulty understanding mathematical concepts and are only able to solve routine problems. Students with low critical thinking skills generally have difficulty identifying and formulating problems accurately, causing them to lose focus on the core of the problem at hand and provide answers that are irrelevant to the questions in the test, as well as being unable to draw clear and logical conclusions. This is characterized by drawing conclusions that are inconsistent and not supported by strong reasoning (Siburian et al., 2023). In general, low critical thinking skills can be caused by factors such as a lack of critical thinking practice in learning, a lack of interest in the

material, and a lack of encouragement from teachers to participate actively and argue (Wibowo et al., 2022).

CONCLUSION

Based on the data analysis and discussion that has been conducted, this study concludes several important things, namely that there is no significant relationship between mathematical resilience and critical thinking skills in students, as shown by the results of the study with a weak positive correlation ($\rho = 0.266$) which is not statistically significant ($p = 0.257 > 0.05$). This finding accepts the null hypothesis (H0) and is in line with previous research which shows that the relationship between these two variables is not universal. The moderate ability category dominates in both variables, indicating that most students have a basic but not optimal ability, there are still weaknesses in dealing with complex mathematical problems and challenges and need improvement in emotional management and exploration of alternative strategies.

Factors influencing the results of the study include the lack of HOTS problem practice in learning, problems with student motivation and self-confidence, a small group of low-ability students who need special attention. Methodological limitations that need to be recognized are the small sample size which reduces statistical power, narrow coverage of test materials (only circles), possible bias in variable measurement. This study contributes to the understanding of the relationship between mathematical resilience and critical thinking skills, while also highlighting the need for a more comprehensive and student-centered learning approach. The findings can serve as a basis for further research with a more robust design and broader scope.

Suggestions for future research are to expand the sample size to increase statistical power and validity of the results, conduct a replication study with a wider range of materials to test the consistency of the findings, add variables such as teaching methods that can support mathematical resilience and critical thinking skills, and can combine the interview/observation approach to understand the context behind moderate/low scores. The findings of this study emphasize the importance of a holistic learning approach to effectively develop mathematical resilience and critical thinking skills. Implementation of the above findings can help to strengthen the methodological basis for further research, improve the quality of mathematics learning in the classroom and provide targeted support for low-ability students.

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