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Analysis of Differences in Critical Thinking Skills in Relation to Students' Mathematical Resilience in SLETV Curriculum

Nurul Nurhayati [1], Musthofiatur Rochmah[2], Sintha Sih Dewanti[3]*, Zupia Annisa[4]
[1,2,3,4]Department of Mathematics Education, Universitas Islam Negeri Sunan Kalijaga, Yogyakarta, Indonesia
*Correspondence: sintha.dewanti@uin-suka.ac.id

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Abstract

Critical thinking skills are an important yet difficult competency to develop in mathematics learning at the junior high school level. This study aims to analyze differences in students' critical thinking skills in terms of three categories of mathematical resilience: high, moderate, and low. The research design used in this study is quantitative research with a comparative approach. The sample was selected using cluster sampling, consisting of 29 eighth-grade students from Class VIII C at a junior high school in Yogyakarta. Data collection techniques included a questionnaire and a test. The questionnaire comprised 20 Likert-scale statements (1-4) to measure mathematical resilience, while the test consisted of 5 items to assess critical thinking skills, specifically regarding the topic of Systems of Linear Equations with Two Variables. The analysis technique used was parametric analysis employing a One-Way ANOVA test. The results indicated no significant difference in critical thinking ability between categories of mathematical resilience, with an F- value of 2.572 and a significance level of 0.096 ($p > 0.05$). This finding indicates that the two constructs operate relatively independently; therefore, the development of critical thinking skills requires learning strategies that directly train analytical and evaluative abilities.

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Introduction

One phenomenon that frequently arises in mathematics learning at the secondary school level is students' difficulty in explaining the reasoning behind the solution steps they write. Many students can follow procedures, but when asked to justify their choice of method or verify the correctness of their answers, they lack sufficient mastery. This phenomenon is not merely a matter of conceptual understanding. It also indicates a weakness in students' critical thinking skills. Initial observations of eighth-grade students in Class VIII C at MTs Kotagede, Yogyakarta, revealed a similar pattern. Based on field analysis, it was found that students typically only memorize procedures without thinking deeply enough. Ennis states that critical thinking involves rational and reflective thought, and emphasizes decision-making regarding what to believe or do. According to Ennis (as cited in Nuridha & Hardianti, 2022), the indicators of critical thinking ability include *elementary clarification, basis for decision, inference, advanced clarification*, and *supposition and integration.*

Students' weaknesses in critical thinking are also reflected in international data. The 2022 PISA survey ranked Indonesia 70th out of 81 countries in mathematics. Indonesia's average score was only 366, far below the OECD average of 472 (OECD, 2023). This low level of critical thinking achievement stems from students' insufficient ability to analyze problems, evaluate strategies, and draw logical conclusions. Sachdeva & Eggen (2021) revealed that students generally struggle to think critically about their own mathematics learning processes and are also reluctant to offer meaningful alternative suggestions. This indicates that critical thinking skills in mathematics have not developed effectively. Furthermore, Dewanti (2018) indicates that the critical thinking profiles of PGMI students when solving basic mathematical problems remain diverse and tend to be suboptimal. These findings suggest that weaknesses in critical thinking in mathematics do not only appear at the secondary level but persist into higher education. Dores et al. (2020) state that critical thinking skills are influenced by many factors. Internal factors include motivation and self-directed learning. External factors include the teaching strategies employed by teachers. This highlights that mathematical resilience is an internal factor believed to be closely related to critical thinking skills.

Mathematical resilience refers to a student's ability to persevere, bounce back, and strive with a positive attitude when facing difficulties in learning mathematics. Lee and Johnston-Wilder (2017) define mathematical resilience as a student's positive attitude toward mathematics, wherein this positive attitude enables the student to continue learning despite facing obstacles and challenges. Rachman et al. (2023) categorized mathematical resilience into five indicators: (1) diligence, self-confidence, hard work, and perseverance; (2) social spirit; (3) creative ideas; (4) self-motivation; (5) curiosity. These five indicators demonstrate that mathematical resilience is not merely passive endurance but an active attitude that encourages students to keep thinking and seeking solutions. Nuraeni & Kusuma (2022) found that students with high self-efficacy typically master all indicators of mathematical resilience, whereas students with low self-efficacy have not yet fully mastered all these indicators. Theoretically, the attitudes within mathematical resilience should support critical thinking skills. Both require perseverance, intellectual courage, and a willingness to analyze deeply.

However, some empirical studies have yielded findings that cast doubt on the existence of such a relationship. Faradillah & Humaira (2021) reported that students with high mathematical resilience do not automatically possess high critical thinking skills. They found that other factors also play a role. Meanwhile, Rohaeti & Koswara (2018) noted that instructional interventions designed to enhance critical thinking skills do not always significantly alter mathematical resilience. Achadiyah (2023) found that mathematical resilience accounts for only 28.51% of the variation in critical thinking skills, while 71.49% is influenced by other factors such as metacognition, conceptual knowledge, and the learning environment. This is supported by the findings of Ghifari et al. (2022), who reported that some studies found no significant effect of mathematical resilience on higher-order critical thinking skills. Similar findings were reported by Wijayanti et al. (2020) in their study on the authentic assessment of middle school students' mathematical critical thinking skills, which found that students' critical thinking skills remain very limited and require interventions that go beyond mere affective reinforcement. These findings indicate that the relationship between mathematical resilience and critical thinking is not always linear and requires further validation, particularly at the junior high school level with specific subject matter.

More specifically, the initial observations in Class VIII C at MTs Kotagede, Yogyakarta, showed that students experienced difficulties when solving story-based problems involving Systems of Linear Equations in Two Variables (SLETV). Most students were able to perform calculations using elimination or substitution methods, however they struggled to identify relevant information, translate the problem into mathematical equations, explain the rationale behind their chosen method, verify the correctness of their answers, and formulate conclusions consistent with the problem context. These difficulties indicate that students' understanding of SLETV was still predominantly procedural. Students tended to memorize the steps for solving problems without fully understanding the meaning and rationale underlying each procedure. This condition highlights the need to investigate students' critical-thinking abilities in solving SLETV problems in relation to their levels of mathematical resilience.

Based on empirical findings, the researchers designed this study to directly test whether critical thinking abilities differ significantly among students with high, moderate, and low levels of mathematical resilience. Previous research used a correlational approach. This study employs a comparative approach. The relevant topic is Systems of Linear Equations in Two Variables (SLETV), as this topic requires students to apply modeling, analysis, and inference skills, as well as critical thinking skills, making it particularly challenging for eighth-grade MTs students.

Methods

This study employs a quantitative research design with a comparative approach. The objective of this study is to analyze differences in students' critical thinking skills as viewed through the lens of mathematical resilience categories in the Systems of Linear Equations in Two Variables (SLETV) material. The study was conducted during the second semester of the 2025/2026 academic year at an MTs in Kotagede, Yogyakarta. The sample in this study was eighth-grade class C, consisting of 29 students. *Cluster sampling* was used because the sample was selected based on the formed class groups.

The research instruments consisted of a critical thinking test and a mathematical resilience questionnaire. According to Ennis, as cited in Nuridha & Hardianti (2022), the critical thinking ability test is structured based on five indicators: *elementary* clarification, *basic decision- making*, inference, *advanced* clarification, and *supposition and clarification*. Based on these indicators, the test instrument consists of five open-ended questions, each representing one indicator of critical thinking ability in the SLETV material. The mathematical resilience questionnaire uses a 1–4 Likert scale (Strongly Agree, Agree, Disagree, Strongly Disagree) based on mathematical resilience indicators. The indicators in this study were developed according to Rachman et al. (2023), namely: (1) diligence, self-confidence, hard work, and perseverance; (2) social spirit; (3) creative ideas; (4) self-motivation; (5) curiosity. The questionnaire consists of 20 statements covering both positive and negative statements.

Before being used in the study, the critical thinking ability test instrument and the mathematical resilience questionnaire were first subjected to validity and reliability tests. Item validity was assessed using Corrected Item-Total Correlation analysis, while reliability was assessed using Cronbach's Alpha coefficient. According to Raharjanti & Ramadianto (2016), an instrument item is considered valid if it has a Corrected Item-Total Correlation value greater than 0.30. Furthermore, the instrument is considered reliable if the Cronbach's Alpha value is greater than 0.60 (Raharjanti & Ramadianto, 2016). The instrument's reliability level follows Arikunto 's (2019) criteria: values of 0.80 – 1.00 fall into the very high category, 0.60 – 0.79 high, 0.40 – 0.59 adequate, 0.20 – 0.39 low, and 0.00 – 0.19 very low.

Data were collected through the administration of a critical thinking test and the distribution of a mathematical resilience questionnaire to students. The study was conducted with due regard for research ethics, specifically by maintaining the confidentiality of respondents' identities and using the data solely for academic purposes. The resulting mathematical resilience scores were then categorized into high, moderate, and low categories based on *the mean* and standard deviation (SD). The criteria for grouping mathematical resilience categories are presented in Table 1.

Table 1. Mathematical Resilience Category Thresholds

High	$X > (\text{Mean} + SD)$
Moderate	$(\text{Mean} - SD) \leq X \leq (\text{Mean} + SD)$
Low	$X < (\text{Mean} - SD)$

Source: (Alvira et al., 2022)

The mathematical resilience questionnaire assessment is divided into two parts: assessment of positive statements and assessment of negative statements. The questionnaire scoring guidelines are presented in Table 2.

Table 2. Student response scoring guidelines

Response	Positive	Negative
Strongly Agree	1	4
Agree	2	3
Disagree	3	2
Strongly Disagree	4	1

Source: (Nurhayati & Ni'mah, 2023)

The research data obtained consisted of measurement scores and involved comparisons of more than two independent groups; therefore, the data analysis was conducted using the parametric statistical method known as One-Way ANOVA. Before testing the hypotheses, prerequisite tests were conducted, including a normality test and a homogeneity test. The normality test was performed using the Shapiro-Wilk test because the sample size was less than 30 students, while the homogeneity test was performed using Levene's Test to determine the equality of variances across groups. The data met the assumptions of normality and homogeneity, so the analysis proceeded using the One-Way ANOVA test. The data analysis was conducted using IBM SPSS Statistics Version 27. Data analysis was performed using descriptive statistics to determine the general characteristics of the data, including the minimum, maximum, mean, and standard deviation. The mathematical resilience data was then categorized into three categories high, moderate, and low based on the mean and standard deviation. A One-Way ANOVA was used to determine differences in students' critical thinking abilities based on their mathematical resilience categories.

Result and Discussion

Result

Validity and Reliabilty Test of the Mathematical Resilience Instrument

Table 3. Results of the Validity Test of the Mathematical Resilience Instrument

Item	Corrected Item-Total Correlation (CITC)	Validity Level
S1	0,884	Valid
S2	0,812	Valid
S3	0,793	Valid
S4	0,874	Valid
S5	0,876	Valid
S6	0,860	Valid
S7	0,596	Valid
S8	0,543	Valid
S9	0,885	Valid
S10	0,638	Valid
S11	0,609	Valid
S12	0,872	Valid
S13	0,736	Valid
S14	0,785	Valid
S15	0,829	Valid
S16	0,797	Valid
S17	0,845	Valid
S18	0,475	Valid
S19	0,684	Valid
S20	0,664	Valid

Based on Table 3., the results of the mathematical resilience instrument validity test show that all items have a Corrected Item-Total Correlation (CITC) of more than 0.30, ranging from 0.475 to

0.885. Thus, all 20 items are declared valid and suitable for use in measuring students' mathematical resilience.

Table 4. Results of the Mathematical Resilience Instrument Reliability Test

Cronbach's Alpha	0.965

Based on Table 4., the results of the reliability test of the mathematical resilience instrument show a Cronbach's Alpha value of 0.965. This value is greater than 0.60, so the mathematical resilience instrument falls into the highly reliable category. Thus, the instrument has a very high level of consistency and is suitable for use in research.

Validity and Reliability Test of the Critical Thinking Skills Instrument

Table 5. Results of the Validity Test of the Critical Thinking Skills Instrument

Item	Corrected Item-Total Correlation (CITC)	Validity Level
S1	0.421	Valid
S2	0.434	Valid
S3	0.633	Valid
S4	0.493	Valid
S5	0.302	Valid

Based on Table 5., the results of the validity test of the critical thinking ability instrument show that all items have a Corrected Item-Total Correlation (CITC) value greater than 0.30, ranging from 0.302 to 0.633. Therefore, all items are declared valid and can be used to measure students' mathematical critical thinking ability.

Table 6. Results of the Reliability Test for the Critical Thinking Skills Instrument

Cronbach's Alpha	0.965

Based on Table 6., the results of the reliability test of the critical thinking skills instrument show a Cronbach's Alpha value of 0.699. This value is greater than 0.60 and falls into the high reliability category, indicating that the instrument has sufficient consistency for use in research.

Descriptive Statistics

Table 7. Descriptive Statistics of Mathematical Resilience and Critical Thinking Skills

Variable	N	Minimum	Maximum	Mean	Standard Deviation
Mathematical Resilience	29	30.97	64.03	50.936	7.868
Critical_Thinking_Skills	29	10.00	85.00	43,103	18.68

Based on Table 7., it was found that the mathematical resilience variable had a minimum value of 30.97, a maximum value of 64.03, a mean of 50.936, and a standard deviation of 7.868. Meanwhile, for the critical thinking ability variable, the minimum value is 10.00, the maximum value is 85.00, the mean is 43.103, and the standard deviation is 18.68. This indicates that the variation in students' critical thinking ability is greater than that of mathematical resilience, meaning that critical thinking ability varies more widely among students.

Variable Distribution

Based on the mean and standard deviation values, the distribution of tendencies for each variable was obtained, where each variable was categorized into high, medium, and low levels.

Table 8. Distribution of Mathematical Resilience Variables

Score Interval	F	Percentage	Category
$X \geq 58.805$	4	13.79%	High
$43{,}068 \leq X < 58{,}805$	21	72.42%	Medium
X < 43,068	4	13.79%	Low
Total	29	100	

Table 8. shows that the majority of students fall into the moderate mathematical resilience category, with 21 out of 29 students, or approximately 72.42%. Meanwhile, the low and high categories each have the same frequency, namely 4 students or 13.79% of the total number of students. This indicates that the majority of students already possess fairly good mathematical resilience, although there are still some who have not yet reached the optimal level.

Table 9. Frequency Distribution of the Critical Thinking Ability Variable

Score Interval	F	Percentage	Category
$X \geq 61.7837$	4	13.79%	High
$24.4232 \leq X < 61.7837$	21	72.42%	Medium
X < 24.4232	4	13.79%	Low
Total	29	100	

Based on Table 9., the frequency distribution is the same as that of the mathematical resilience variable, where the critical thinking ability variable is also dominated by students in the moderate category, namely 21 students or about 72.42%, while the low and high categories each comprise 4 students or 13.79%. This indicates that students' critical thinking skills also tend to be at a fairly good level, although they are not yet evenly distributed among all students.

Normality Test

Table 10. Results of the Normality Test by Mathematical Resilience Category

		Shapiro-Wilk		
	Mathematical_Resilience_Category	Statistic	df	Sig.
Critical_Thinking_Skills	Low	.831	4	.171
	Medium	.947	21	.294
	High	.863	4	.272

Based on Table 10., the results of the Shapiro-Wilk normality test show that the Sig. values obtained were 0.171 for the low category, 0.294 for the medium category, and 0.272 for the high category. The criteria for the normality test are that if the Sig. value is ≥ 0.05, the data is normally distributed (Ho is not rejected), whereas if the Sig. value is < 0.05, the data is not normally distributed (Ho is rejected). Since all Sig. values in each category are greater than 0.05, H0 cannot be rejected; therefore, it can be concluded that the data are normally distributed across all categories of mathematical resilience.

Homogeneity Test

Table 11. Homogeneity Test Results

Critical_Thinking_Skill	Levene Statistic	df1	df2	Sig.
Based on Mean	1.716	2	26	.199

Based on Table 11., the results of the Levene's Test for homogeneity show that a Sig. value of 0.199 was obtained for Based on Mean. The criteria for the homogeneity test are that if the Sig. value is ≥ 0.05, the data is homogeneous (Ho is not rejected), whereas if the Sig. value is < 0.05, the data is not homogeneous (Ho is rejected). Since 0.199 > 0.05, Ho is not rejected, so it can be concluded that the variance between groups is homogeneous. Thus, the requirements for proceeding to the One-Way ANOVA test have been met.

One-Way ANOVA Test

Table 12. Results of the One-Way ANOVA Test

	df	F	Sig.	Partial Eta-Squared
Mathematical_Resilience_Category	2	2.572	.096	0.165
Error	28			
Total	29			

Based on Table 12., the results of the One-Way ANOVA test show that the calculated F value is 2.572 with a Sig. of 0.096. The testing criterion for the One-Way ANOVA test is that if the Sig. value is ≥ 0.05, then H0 is not rejected, meaning there is no significant difference among all groups; whereas if the Sig. value is < 0.05, then H0 is rejected, meaning there is a significant difference among all groups. Since the Sig. value (0.096) > 0.05, H_0 is not rejected; thus, there is no significant difference among all groups or in students' critical thinking abilities across the low, moderate, and high mathematical resilience categories. In other words, statistically, mathematical resilience does not show an effect on differences in critical thinking ability.

Although the ANOVA test results indicate no statistically significant differences, the Partial Eta Squared value of 0.165 indicates a large effect size. This suggests that approximately 16.5% of the variance in critical thinking ability is influenced by students' resilience levels, while the remaining 84.5% is influenced by other factors. The error value with 28 degrees of freedom (df) indicates a high degree of variation in critical thinking ability within each resilience category. This value may explain why the large effect size was not accompanied by statistical significance (p > 0.05), as it was influenced by the relatively small sample size (N = 29).

Discussion

Based on the analysis results, it was found that there were no significant differences in critical thinking skills based on students' categories of mathematical resilience. The results of the one-way ANOVA test showed a significance value of 0.096 ($p > 0.05$), indicating that the categories of low, moderate, and high mathematical resilience did not result in significant differences in students' critical thinking skills. This means that there is no significant relationship between mathematical resilience and critical thinking skills. This aligns with the study by Faradillah & Humaira (2021), which stated that there is no significant relationship between critical thinking and mathematical resilience. The study found that students with high mathematical resilience exhibited low critical thinking skills, students with moderate mathematical resilience exhibited high critical thinking skills, and students with low mathematical resilience exhibited moderate critical thinking skills. This indicates that the level of mathematical resilience does not always correlate with the level of critical thinking skills. In this regard, the research findings are presented in Table 13. below.

Table 13. Research Analysis Results

Mathematical Resilience Categories	Critical Thinking Skills Low	Critical Thinking Skills Moderate	Critical Thinking Skills High	Total
Low	0	4	0	4
Medium	2	15	4	21
Tall	2	2	0	4
Total Students	4	21	4	29

Based on Table 13., it can be seen that the groups of students in each category of mathematical resilience and critical thinking ability consist of different subjects. Although each category of the variables has the same number, this does not apply to the same subjects. This phenomenon is clearly seen in the low critical thinking ability group, which consists of 4 students. This frequency matches the total in the low mathematical resilience category, which also consists of 4 students. However, the low critical thinking ability group comprises students from the moderate (2) and low (2) mathematical resilience categories; none come from the low mathematical resilience category. Similarly, in the group with moderate critical thinking ability comprising 21 students this result was derived from students across all three mathematical resilience categories: low (4), moderate (15), and high (2). Although this frequency matches that of students in the moderate resilience category, the students do not all come from that category alone but also from other categories. Furthermore, in the high critical thinking ability category, all students come from the moderate mathematical resilience category (4); not a single student comes from the high category. Conversely, students in the high mathematical resilience category (4) are not found in the high critical thinking ability category; all are in the low (2) and moderate (2) categories. Thus, it can be said that although the frequency counts for the two variables are the same, the students contributing to them are not necessarily the same individuals. The distribution of contributions from these different subjects can be seen in Figure 1 below.

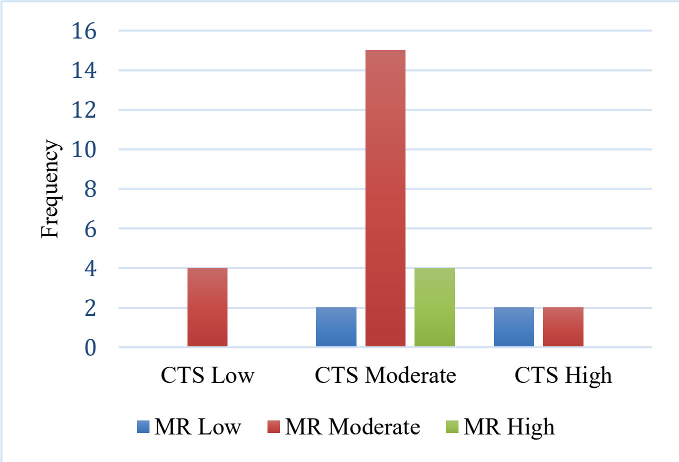

Figure 1. Distribution of Mathematical Resilience (MR) and Critical Thinking Skills (CTS)

Figure 1 shows the distribution of Mathematical Resilience (MR) and Critical Thinking Skills (CTS) categories among students, which is nearly identical to that in the study by Faradillah & Humaira (2021). In this study, the category dominated by both variables is the moderate category. This distribution implies that not every student with high mathematical resilience necessarily has high critical thinking skills, and vice versa. The data in each category do not show a perfectly linear trend between the variables. In the low CTS category, there are still 4 students with moderate MR. However, there are no students with low MR or high MR in this low CTS category. Furthermore, in the moderate CTS category, there were 2 students with low MR, 15 students with moderate MR, and 4 students with high MR. Meanwhile, in the high CTS category, there are 2 students with low and moderate RM but no high RM. This indicates that students with low RM are capable of reaching moderate to high CTS levels, students with moderate RM exhibit a full range of CTS levels (low, moderate, and high), while students with high RM only reach the moderate CTS level.

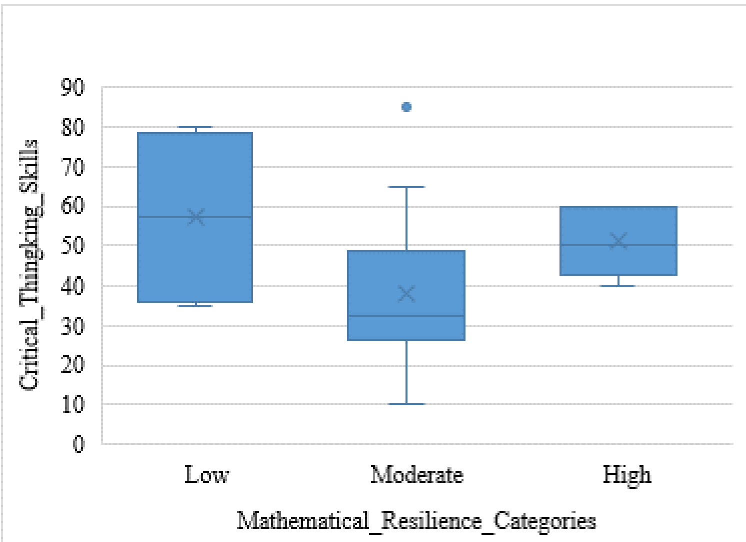

Figure 2. Boxplot of Mathematical Resilience and Critical Thinking Ability Categories

These results are further supported by Figure 2, which presents a boxplot of the categories of mathematical resilience and critical thinking skills. Based on Figure 2, the low resilience category has a median critical thinking ability of approximately 58 – 60. The interquartile range is quite wide, with the lower quartile (Q1) around 38 and the upper quartile (Q3) around 79. This indicates that students with low mathematical resilience exhibit a high variation in critical thinking ability. In the moderate resilience category, the median critical thinking score is around 30 – 32. The lower quartile (Q1) is around 28 and the upper quartile (Q3) is around 49, with the lower whisker around 10 and the upper whisker reaching around 66. Additionally, there is one *outlier* around 85. This indicates that students with moderate mathematical resilience exhibit a wide range of critical thinking abilities. On the other hand, the high mathematical resilience category has a critical thinking ability around 50. The lower quartile (Q1) is around 42 and the upper quartile (Q3) is around 60. The data range in this category is narrower than in the other categories. This suggests that students with high mathematical resilience possess relatively homogeneous critical thinking skills. Overall, the low mathematical resilience category has the highest median critical thinking ability, while the moderate category has the lowest median. These findings indicate that increased mathematical resilience does not always lead to consistent critical thinking ability. These findings are further reinforced by Figure 3 below.

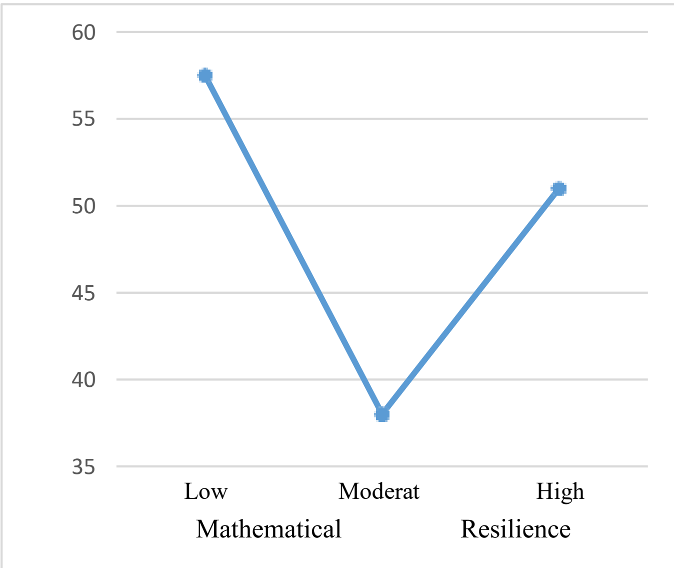

Figure 3. Mathematical Resilience Categories and Average Critical Thinking Skills

Figure 3 shows a nonlinear relationship between the categories of mathematical resilience and average critical thinking ability, with the low resilience category having the highest average critical thinking ability, at 57.5. Meanwhile, the moderate resilience category experiences a drastic drop to the lowest point of 38 and then rises again to 51 in the high resilience category; however, this figure remains lower than that of the low resilience group. This graph indicates that high critical thinking ability is not always accompanied by high resilience in facing mathematical challenges, and vice versa. Nevertheless, there is still a positive trend from the moderate to high categories, confirming that strengthening mathematical resilience can help optimize students' critical thinking skills. To understand how these critical thinking skills manifest in the learning process, an in-depth analysis of each aspect is necessary. The achievement of each critical thinking skill indicator is presented in Table 14. below.

Table 14. Achievement of Student Critical Thinking Ability Indicators

Indicator	Mean	Percentage
elementary clarification	2.34	58.62%
basic for decision	2.27	56.90%
inference	1.62	40.54%
advanced clarification	2.03	50.86%
assumption and clarification	0.34	8.62

Based on the analysis results in Table 14., student achievement on each critical thinking indicator has a nearly identical percentage, particularly for the first, second, and fourth indicators. The maximum score for each indicator is 4, to facilitate the calculation of the final critical thinking score. The highest percentage was obtained for the *elementary clarification* indicator, with the highest average of 2.34, or approximately 58.62%. Meanwhile, the *basic for decision* indicator had an average of 2.27 (56.90%), differing by only about 1.72% from the first indicator. For the *"inference"* indicator, there was a significant drop, from an average of 2.27 to just 1.62 (56.90% to 40.54%). However, for the *"advanced clarification"* indicator, there was an increase, reaching an average of 2.03 (50.86%). And for the *supposition and clarification* indicator, there was a very drastic decline, reaching only an average of 0.34 (8.62%). This figure of 8.62% indicates that nearly all students have not yet been able to develop proficiency in this indicator. This suggests that students are quite capable of providing brief explanations (*elementary clarification*) and determining the basis for decision-making (*basic for decision*). However, there was a drastic decline in the "*inference*" indicator and the lowest score was recorded in the "*supposition and clarification*" indicator. Thus, it can be concluded that there is a sharp discrepancy between advanced clarification skills and the ability to synthesize and reason at the level of inference and final clarification.

Theoretically, mathematical resilience is indeed related to perseverance, the ability to bounce back from difficulties, and the willingness to face challenges in solving mathematical problems. However, critical thinking requires more complex cognitive processes, including the ability to analyze, evaluate evidence, and draw logical conclusions; thus, the conceptual relationship between the two does not always emerge as a significant difference in group analysis. A study by Ghifari et al. (2022), which reviewed 25 articles, showed that 20% of the literature reviews found no effect of mathematical resilience on higher-order mathematical thinking skills, particularly critical thinking. This empirically demonstrates that the relationship between the two is not always significant. Furthermore, the study by Rohaeti & Koswara (2018) showed that there was no significant relationship between mathematical resilience and critical thinking skills. The results indicated that there were no differences in mathematical resilience across different teaching methods, with resilience falling into the moderate category and students' critical thinking skills remaining at a low level. This indicates that these two construct variables react independently to pedagogical interventions. Critical thinking can be enhanced through specific approaches, while resilience remains stable, confirming that even though students demonstrate a high perception of the scientific approach, improvement in one construct does not automatically lead to improvement in the other.

Additionally, students' mathematical resilience is influenced by various factors, both internal and external. Specifically, research Achadiyah (2023) indicates that 28.51% of mathematical resilience is determined by students' mathematical critical thinking skills, while the remaining 71.49% is influenced by other factors such as metacognition, conceptual knowledge, and the learning environment. Another crucial factor influencing mathematical resilience is *self- efficacy.* Research Nuraeni & Kusuma (2022) indicates that students with high *self-efficacy* demonstrate proficiency in all indicators of mathematical resilience, whereas those with low *self- efficacy* have not yet mastered all such indicators. This indicates that students' belief in their own abilities plays a crucial role in building resilience when facing difficulties in mathematics learning. In addition to influencing mathematical resilience, there are also several factors that affect critical thinking skills. Internal factors influencing critical thinking skills include intellectual development, learning motivation, anxiety, physical condition, self-directed learning, self-confidence, and interest in learning (Dores et al., 2020; Diatmika & Sudirman, 2024; Fridayani et al., 2022). Meanwhile, external factors that influence these abilities include experience, teaching methods, the environment, and teacher-student interactions (Anggraeni et al., 2023; Fadilah et al., 2025; Dores et al., 2020; Rahmawati, 2017).

In this study, the researchers identified four specific factors strongly suspected of hindering students' achievement of mathematical resilience and critical thinking skills. The first factor is physical environmental disturbances, where loud noises from outside areas penetrated into the classroom during data collection. This condition directly disrupted students' concentration and focus while working on the assigned problems (Dalimunthe & Sari, 2020). The second factor stemmed from time constraints, with only 60 minutes allotted to complete both the test and the questionnaire. This time pressure forces students to work hurriedly, causing them to tend toward quick but superficial heuristic thinking. The third factor is gender homogeneity in the classroom. This is closely related to the characteristics of MTs institutions that implement gender-segregation policies based on religious values, though not all do so. This gender homogeneity is suspected to result in flat classroom dynamics due to a lack of perspective variation between genders; however, on the other hand, it may minimize social distractions (Tajrin & Haryanto, 2026). The fourth factor stems from the lack of parental involvement as the primary motivator. This is because students attend *a boarding school,* resulting in limited interaction with parents both physically and in terms of time. This limitation is suspected to trigger a decline in students' motivation to learn mathematics, given that family emotional support serves as a crucial foundation for fostering students' mathematical resilience in overcoming challenges (Sibala & Amsidi, 2026).

The results of this study indicate that the relationship between mathematical resilience and critical thinking ability cannot be viewed as a linear relationship. Although the results of the One-Way ANOVA test showed statistical non-significance ($p = 0.096$), an in-depth analysis of the Partial Eka Squared value of 0.165 revealed an effect size in the large category. This indicates that the mathematical resilience category contributes 16.5% to the variation in students' critical thinking skills, with the remainder influenced by other factors. The lack of statistical significance is likely due to the limited sample size ($N = 29$), which increases the risk of a Type II error, where a true difference in the population goes undetected statistically. However, practically speaking, the magnitude of this effect size still confirms that interventions targeting mathematical resilience are a crucial factor to consider for improving critical thinking skills, even though in this study its influence was unable to exceed the significance threshold of 0.05 due to the limited number of subjects. Thus, it can be concluded that students with high mathematical resilience are not necessarily capable of thinking critically well; conversely, students with low resilience may still possess fairly good critical thinking skills.

Mathematical resilience and critical thinking skills are two interrelated constructs but are developed through distinct processes. Therefore, mathematics instruction alone is insufficient to strengthen students' resilience in facing challenges; it must be designed to deeply cultivate students' analytical, evaluative, and reasoning skills so that the development of resilience and critical thinking proceeds in a balanced and mutually supportive manner. The small sample size in this study limits the generalizability and statistical power of the results, the lack of comprehensive sample representation, limitations in the validity and reliability of the instruments used, and the potential failure to capture the complex dimensions of both constructs, as well as potential response bias in the questionnaire, tend to result in low statistical power and make it difficult to achieve statistical significance ($p < 0.05$). Therefore, for future research, it is recommended to increase the sample size, use more holistic instruments, and examine moderator/mediator factors that may explain differences in the relationship between mathematical resilience and critical thinking.

Conclusion

Based on the research results and data analysis, it can be concluded that there is no significant difference in students' critical thinking abilities when examined by mathematical resilience categories in the Systems of Linear Equations in Two Variables (SLETV) material. The results of the One-Way ANOVA test showed that the significance value was $0.096 > 0.05$, indicating that students' critical thinking abilities across the low, moderate, and high categories of mathematical resilience did not show statistically significant differences. The research results also indicate that the majority of students fall into the moderate category for both the mathematical resilience variable and critical thinking ability. Furthermore, students with high mathematical resilience did not necessarily demonstrate high critical thinking skills, and vice versa. Therefore, mathematical resilience category was not associated with significant differences in critical thinking skills in this study. Thus, developing critical thinking skills in mathematics learning is not sufficient through the improvement of mathematical resilience alone, but must also be supported by learning strategies capable of training students' analytical, evaluative, and reasoning skills more deeply.

Recommendation

Based on the research findings, it is recommended that teachers not only focus on developing students' mathematical resilience but also implement instruction that fosters critical thinking skills more deeply through activities involving analysis, problem-solving, and mathematical reasoning. For future researchers, this study can be expanded by using a larger sample size, different learning materials, and considering other variables suspected of influencing critical thinking skills, such as self-efficacy, learning motivation, metacognition, and learning models. Additionally, future research may also employ qualitative or *mixed-method* approaches to gain a deeper understanding of the relationship between mathematical resilience and students' critical thinking skills.

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