



The Influence of Learning Discipline, Anxiety, and Self-Efficacy through Critical Thinking Ability on the Mathematical Reasoning Ability of Eighth-Grade Students at UPTD SMPN 2 Barru

Asri Ainun Amaliah*), Ahmad Talib, Rosidah
Makassar State University, Makassar, Indonesia

Abstract

Mathematical reasoning skills are essential in understanding mathematical concepts and solving problems. This study aims to examine the influence of learning discipline, mathematical anxiety, and self-efficacy on students' mathematical reasoning ability through critical thinking skills. The study utilized an ex-post facto research design with a sample of 100 eighth-grade students from UPTD SMPN 2 Barru. Data were collected through questionnaires on learning discipline, mathematical anxiety, and self-efficacy, as well as critical thinking and mathematical reasoning tests. The findings indicate that learning discipline, mathematical anxiety, and self-efficacy significantly influence mathematical reasoning ability both directly and indirectly through critical thinking skills. Moreover, students with high discipline tend to have better reasoning skills, while those with high mathematical anxiety demonstrate lower reasoning ability. The study suggests that improving students' learning discipline and self-efficacy while reducing mathematical anxiety can enhance their mathematical reasoning ability.

Keywords: Learning discipline, math anxiety, self-efficacy, critical thinking, and mathematical reasoning

(*) Corresponding Author: ainunasri34@gmail.com

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INTRODUCTION

Education is a fundamental element in the development of high-quality human resources. Law of the Republic of Indonesia No. 20 of 2003 concerning the National Education System states that education aims to develop students' potential to become individuals who are faithful, pious, morally upright, knowledgeable, creative, and responsible members of society. One of the key elements in education is the learning process, which encompasses various disciplines, including mathematics.

Mathematics is a fundamental science that plays an essential role in daily life and serves as the foundation for various other disciplines. According to Abdurrahman (2010), mathematics functions as a clear means of communication, supports decision-making, and fosters logical thinking and problem-solving skills. However, in reality, many students struggle to understand mathematical concepts, which leads to low academic achievement. These difficulties are generally associated with students' low mathematical reasoning ability.

Mathematical reasoning ability is a crucial cognitive aspect in mathematics learning. Students with strong mathematical reasoning skills tend to understand abstract concepts better and apply them in problem-solving. However, various factors can influence

students' mathematical reasoning ability, including learning discipline, math anxiety, and self-efficacy.

Learning discipline is a key factor that influences the effectiveness of the learning process. Students with a high level of discipline tend to manage their time well, stay focused on understanding the material, and take greater responsibility for their learning (Simbolon, 2020). A study conducted by Rusma & Setyaningrum (2024) found that students with higher levels of discipline tend to have better mathematical reasoning abilities compared to those who are less disciplined.

On the other hand, math anxiety also affects students' mathematical reasoning ability. This anxiety can lead to fear and a lack of self-confidence when dealing with math problems, which in turn impacts their academic performance (Napitupulu & Mevianti, 2023). The higher the level of anxiety students experience toward mathematics, the lower their ability to reason mathematically.

Self-efficacy is another psychological factor that plays a role in mathematics learning. Bandura (as cited in Nurussalamah & Marlina, 2022) defines self-efficacy as an individual's belief in their ability to complete specific tasks. Students with high self-efficacy tend to be more confident in solving math problems, enabling them to develop more effective problem-solving strategies. Conversely, students with low self-efficacy are more likely to give up easily and struggle to understand mathematical concepts.

In addition to the factors mentioned above, critical thinking ability also plays a significant role in enhancing students' mathematical reasoning. Critical thinking involves the ability to analyze, evaluate, and make decisions based on available information (Werdiningsih, 2022). Students with strong critical thinking skills are better able to understand the relationships between mathematical concepts and apply them in problem-solving.

Based on the explanation above, it can be concluded that learning discipline, math anxiety, and self-efficacy are factors that can influence students' mathematical reasoning ability. In addition, critical thinking ability also plays a role in improving the quality of students' mathematical reasoning. Therefore, this study aims to analyze the influence of learning discipline, math anxiety, and self-efficacy on students' mathematical reasoning ability through critical thinking skills. This research is expected to provide insights for educators in designing more effective learning strategies to enhance the quality of mathematics education in schools.

METHODS

This type of research is an ex post facto study. Ex post facto research is designed to explain the causal relationships between variables. In this study, the researcher explores the existence of causal relationships and tests hypotheses that were formulated beforehand.

This research was conducted in the second semester of the 2024/2025 academic year at UPTD SMPN 2 Barru. The study population consists of all eighth-grade students, with a sample size of 100 students. The method used for sampling is probability sampling, specifically systematic proportional random sampling, which is a sampling technique where the sample is determined based on a random systematic approach. Data were collected using tests and questionnaires. The instruments used include questionnaires on learning discipline, math anxiety, self-efficacy, critical thinking ability tests, and mathematical reasoning ability tests.

This study uses three types of variables, with learning discipline, math anxiety, and self-efficacy as independent variables. The dependent variable is mathematical reasoning ability, and critical thinking ability serves as the intervening variable. The collected data

were processed using two types of statistical analyses: descriptive statistics and inferential statistics. Descriptive statistics were used to describe the tests and questionnaires, while inferential statistics were employed to test the research hypotheses.

RESULTS & DISCUSSION

Results

The results of data analysis are presented in the form of descriptive and inferential statistics. Descriptive data provide an overview of the respondents' conditions, which can serve as additional information to understand the research findings better. Descriptive analysis is used to identify, understand, and present data in a meaningful way.

Table 1. Descriptive Statistics Results

No	Research Variables	Mean	Median	Standard Deviation	Variance	Minimum	Maximum
1	Learning Discipline	62,93	63,00	4,98	24,89	52,00	73,00
2	Mathematics Anxiety	57,42	56,63	4,66	21,73	48,00	70,00
3	Self-Efficacy	49,62	50,50	6,67	44,54	40,00	62,00
4	Critical Thinking Ability	63,30	67,00	7,09	50,33	50,00	75,00
5	Mathematical Reasoning Ability	66,41	67,00	6,73	45,35	53,00	87,00

Based on Table 1 and after categorizing each variable, it can be concluded that learning discipline falls into the moderate category, mathematics anxiety is in the moderate category, self-efficacy is in the low category, critical thinking ability is in the moderate category, and mathematical reasoning ability is also in the moderate category.

Inferential statistics were used to test the research hypotheses. In this study, hypothesis testing was conducted using path analysis. The results of the path analysis are shown in Table 2.

Based on Table 2, the obtained path coefficients and probability values indicate significant effects between variables, where the significance values are 0.177 for learning discipline, -0.278 for math anxiety, 0.289 for self-efficacy, and 0.500 for critical thinking ability. All variables have significance values less than 0.05, which means that learning discipline, self-efficacy, and critical thinking ability have a significant positive direct effect on mathematical reasoning ability. In contrast, math anxiety has a significant negative direct effect.

Table 2 also shows that the indirect effects are significant, as indicated by the path coefficients. The path coefficients of X_1, X_2, X_3 affecting Y through X_4 are respectively $X_1 \rightarrow X_4 \rightarrow Y = 0,116$, $X_2 \rightarrow X_4 \rightarrow Y = -0,104$, and $X_3 \rightarrow X_4 \rightarrow Y = 0,110$. This indicates that learning discipline and self-efficacy have a significant positive indirect effect on mathematical reasoning ability through critical thinking ability. In contrast, math anxiety has a significant negative indirect effect on students' mathematical reasoning ability through their critical thinking ability.

Table 2. Summary of Direct and Indirect Effects of Independent Variables on the Dependent Variable through the Mediating Variable

Variable	Direct Effect	P-value	Indirect Effect	P-value	Total Effect
Learning Discipline	0,177	0,011	0,116	0,022	0,293
Mathematics Anxiety	-0,278	0,000	-0,104	0,038	-0,383
Self-Efficacy	0,289	0,000	0,110	0,027	0,399
Critical Thinking Ability	0,500	0,000			0,500

Discussion

The Direct Effect of Learning Discipline on Students' Mathematical Reasoning Ability

In the first hypothesis, based on the results of the hypothesis testing, it was found that there is an effect of learning discipline on the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru. This is indicated by a path coefficient of 0.177 and a $p - value = 0,011 < 0,05$ Which means that learning discipline has a positive and significant effect on students' mathematical reasoning ability. This finding aligns with Werdiningsih's (2022) research, which revealed that there is an effect of learning discipline on students' mathematical reasoning ability. This is further supported by a study conducted by Rusma & Setyaningrum (2024), which found that students with higher levels of discipline tend to have better mathematical reasoning abilities compared to those with lower levels of discipline.

The Direct Effect of Mathematics Anxiety on Students' Mathematical Reasoning Ability

In the second hypothesis, based on the results of the hypothesis testing, it was found that mathematics anxiety has an effect on the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru. This is indicated by a path correlation coefficient of $-0,278$ and a $p - value = 0,011 < 0,05$ which means that mathematics anxiety has a negative and significant effect on students' mathematical reasoning ability.

This is in line with the research conducted by Muhsana & Diana (2022), which found a negative relationship between mathematics anxiety and students' mathematical reasoning ability, with a correlation coefficient of -0.178 . However, this study also stated that mathematics anxiety had no significant effect on students' mathematical reasoning ability when solving PISA-based math problems. This finding is supported by the study of Artama et al. (2021), which discovered that mathematics anxiety has a significant negative effect on mathematics learning outcomes. The obtained correlation coefficient was -0.741 , indicating a strong negative relationship between mathematics anxiety and mathematics learning outcomes. Although this study focused on learning outcomes, the findings are relevant as mathematical reasoning ability is an essential component in achieving good mathematics learning results.

The Direct Effect of Self-Efficacy on Students' Mathematical Reasoning Ability

In the third hypothesis, based on the results of the hypothesis testing, it was found that self-efficacy affects the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru. This is indicated by a path correlation coefficient of 0.289 and a p -value of $p - v$, less than 0,05, which means that self-efficacy has a positive and significant effect on students' mathematical reasoning ability. This finding aligns with the research conducted by Lestari et al. (2022), which found that self-efficacy positively affects mathematical reasoning ability, with a path coefficient of 0.245. Furthermore, the study by Akuba et al. (2020) also supports this finding, where self-efficacy positively affects mathematical concept mastery with a path coefficient of 0.175. Although the focus of this study was on mathematical concept mastery, mathematical reasoning ability is an integral part of concept mastery, making these findings relevant to the current research.

The Direct Effect of Self-Efficacy on Students' Mathematical Reasoning Ability

In the fourth hypothesis, based on the results of the hypothesis testing, it was found that critical thinking ability affects the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru. This is indicated by a path correlation coefficient of 0.500 and a p -value of $p - value = 0,011 < 0,05$ which means that critical thinking ability has a positive and significant effect on students' mathematical reasoning ability. This finding aligns with the research conducted by Werdiningsih (2022), which revealed a significant relationship between critical thinking and mathematical reasoning ability. Furthermore, the study by Fadhillah et al. (2022) also supports this finding, stating that critical thinking has a significant effect on students' mathematical reasoning ability. This study shows that students with higher levels of critical thinking tend to have better mathematical reasoning ability compared to students with lower levels of critical thinking.

The Effect of Learning Discipline on Students' Mathematical Reasoning Ability through Critical Thinking Skills

In the fifth hypothesis, based on the results of the hypothesis test, it was found that learning discipline affects the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru through their critical thinking skills. This is indicated by a path correlation coefficient of 0.116 and a $p - value = 0,022 < 0,05$ which means that learning discipline exerts a positive and significant indirect effect on students' mathematical reasoning ability via critical thinking ability. This finding aligns with Werdiningsih (2022), who demonstrated a significant relationship between learning discipline and critical thinking with mathematical reasoning ability. It suggests that students with higher levels of learning discipline tend to develop stronger critical thinking skills, which ultimately leads to improved mathematical reasoning ability.

The study conducted by Setiawan & Yulianti (2021) demonstrated a positive correlation between learning discipline and critical thinking with mathematical reasoning ability. The regression analysis in their research revealed that learning discipline has a direct effect on critical thinking, with a regression coefficient of 0.462 and a significance level of 0.000. Furthermore, critical thinking directly influences mathematical reasoning, with a regression coefficient of 0.518 and a significance level of 0.000. Thus, it can be concluded that critical thinking acts as a mediator in the relationship between learning discipline and mathematical reasoning.

The Effect of Mathematics Anxiety on Students' Mathematical Reasoning Ability through Critical Thinking Skills

In the sixth hypothesis, based on the results of the hypothesis test, it was found that mathematics anxiety has a negative and significant indirect effect on the mathematical reasoning ability of eighth-grade students at UPTD SMPN 2 Barru through their critical thinking skills. This is indicated by a path correlation coefficient of -0.104 and a p – value = $0,038 < 0,05$. This finding aligns with Arpin et al. (2022), who reported an inverse relationship between mathematics anxiety and students' critical thinking ability: students with low anxiety averaged a critical thinking score of 57.14, compared to 31.43 for moderate anxiety and 23.33 for high anxiety. This demonstrates that as mathematics anxiety increases, critical thinking ability decreases.

Furthermore, Zafira & Syaiful (2023) found that mathematics anxiety significantly influences students' critical thinking ability, accounting for 27.4% of the variance.

The influence of self-efficacy on students' mathematical reasoning ability through their critical thinking skills.

In the seventh hypothesis, based on the results of the hypothesis testing, it was found that self-efficacy influences the mathematical reasoning ability of Grade VIII students at UPTD SMPN 2 Barru through their critical thinking skills. This is indicated by a path coefficient value of 0.110 and a p – value = $0,027 < 0,05$ which means that self-efficacy has a positive and significant effect on students' mathematical reasoning ability through their critical thinking skills.

This finding is in line with research conducted by Agus (2021), which found a positive relationship between self-efficacy and critical mathematical thinking ability among junior high school students, with a correlation value of 0.62. This indicates that students with high self-efficacy tend to have better critical thinking skills, which in turn can enhance their mathematical reasoning ability. In addition, a study by Melyana & Pujiastuti (2020) revealed that self-confidence has a significant effect on students' critical mathematical thinking ability, with a contribution of 57.3%. Although the term used is "self-confidence," the concept is closely related to self-efficacy, which reflects students' belief in their ability to complete mathematical tasks.

The direct influence of learning discipline on mathematical reasoning ability is stronger than its indirect influence.

Based on Table 2, the path coefficient of the direct influence of learning discipline on mathematical reasoning ability is 0.177, while the path coefficient of the indirect influence through critical thinking skills is 0.116. This indicates that the direct effect is greater than the indirect effect. It shows that learning discipline has a stronger direct influence on mathematical reasoning ability compared to its indirect influence through critical thinking skills, with a significance level of 0.022. In other words, the direct effect of learning discipline on mathematical reasoning ability is more substantial than its indirect effect through critical thinking. Therefore, students with strong learning discipline can improve their mathematical reasoning ability directly, without necessarily relying on critical thinking skills.

The direct influence of math anxiety on mathematical reasoning ability is stronger than its indirect influence.

Based on Table 2, the path coefficient of the direct influence of math anxiety on mathematical reasoning ability is -0.278, while the path coefficient of the indirect influence through critical thinking skills is -0.104. This indicates that the direct effect is greater than the indirect effect. It shows that math anxiety has a stronger direct influence on mathematical reasoning ability compared to its indirect influence through critical thinking skills, with a significance level of 0.038. In other words, the direct influence of math anxiety has a greater impact on reducing mathematical reasoning ability. Therefore, the higher the level of math anxiety experienced by students, the lower their mathematical reasoning ability tends to be.

The direct influence of self-efficacy on mathematical reasoning ability is stronger than its indirect influence.

Based on Table 2, the path coefficient of the direct influence of self-efficacy on mathematical reasoning ability is 0.289, while the path coefficient of the indirect influence through critical thinking skills is 0.110. This indicates that the direct effect is greater than the indirect effect. It shows that self-efficacy has a stronger direct influence on mathematical reasoning ability compared to its indirect influence through critical thinking skills, with a significance level of 0.027. In other words, the direct influence of self-efficacy on mathematical reasoning ability is more substantial than its indirect influence through critical thinking. Therefore, students with strong self-efficacy can improve their mathematical reasoning ability directly, without necessarily relying on critical thinking skills.

CONCLUSION

The learning discipline of Grade VIII students at UPTD SMPN 2 Barru falls into the moderate category with a percentage of 40%. Students' math anxiety is also in the moderate category at 37%, while their self-efficacy is categorized as low, with a percentage of 38%. Critical thinking skills are in the moderate category at 54%, and mathematical reasoning ability is also in the moderate category with a percentage of 63%. Learning discipline has a direct, positive, and significant effect on students' mathematical reasoning ability, with a path coefficient of 0.177. Math anxiety has a direct, negative, and significant effect on students' mathematical reasoning ability, with a path coefficient of -0.278. Self-efficacy has a direct, positive, and significant effect on students' mathematical reasoning ability, with a path coefficient of 0.289. Critical thinking skills have a direct, positive, and significant effect on students' mathematical reasoning ability, with a path coefficient of 0.500. Learning discipline also has a positive and significant indirect effect on mathematical reasoning ability through critical thinking skills, with a path coefficient of 0.116. Math anxiety has a negative and significant indirect effect on mathematical reasoning ability through critical thinking skills, with a path coefficient of -0.104. Self-efficacy has a positive and significant indirect effect on mathematical reasoning ability through critical thinking skills, with a path coefficient of 0.110. It is recommended that future research consider or explore other factors, aside from learning discipline, math anxiety, self-efficacy, and critical thinking skills, that may influence students' mathematical reasoning ability, including both internal and external factors.

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