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HOW STUDENTS' SELF-EFFICACY CAN AFFECT THEIR MATHEMATICAL CRITICAL THINKING ABILITY?

Tutin Suhartini[1], Heris Hendriana[2], Harry Dwi Putra[3]

[1]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
tutinsuhartini229@gmail.com
[2]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
herishen@ikipsiliwangi.ac.id
[3]IKIP Siliwangi, Jl. Terusan Jend. Sudirman, Cimahi, Indonesia.
harrydp@ikipsiliwangi.ac.id

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ABSTRACT

Critical thinking is an essential skill that students must possess in order to face various academic challenges and the dynamic development of scientific knowledge. Among psychological factors, self-efficacy plays a significant role in students' mathematical critical thinking skills, enabling them to solve tasks or problems in specific situations. This study aims to examine the influence of self-efficacy on students' mathematical critical thinking abilities. The research employed a quantitative approach with a correlational design to analyze and explore in depth how self-efficacy affects students' mathematical critical thinking skills. The sample consisted of 25 students from SDN Harapan Mulya. Data analysis was conducted using simple linear regression to determine the extent to which students' self-efficacy influences their mathematical critical thinking abilities. The results showed a positive and significant influence between self-efficacy and critical thinking skills ($p < 0.05$), with a coefficient of determination of 0.224. This indicates that students' self-efficacy contributes 22.4% to the variation in their mathematical critical thinking abilities. Therefore, the conclusion of this study is that the higher the students' self-efficacy, the higher their mathematical critical thinking skills, which means that self-efficacy significantly influences students' mathematical critical thinking. These findings highlight the importance of strengthening self-efficacy through various learning approaches to enhance students' mathematical critical thinking skills.

Corresponding Author:

Tutin Suhartini,
Department of Mathematics Education,
Institut Keguruan dan Ilmu Pendidikan Siliwangi,
Jl. Terusan Jend. Sudirman, Cimahi, Indonesia
Email: tutinsuhartini229@gmail.com

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INTRODUCTION

Mathematics is a fundamental discipline that is closely related to real-life situations. Students' success in learning mathematics, particularly when connected to real-world contexts, is influenced by several abilities. One crucial skill that needs to be developed in students today is critical mathematical thinking. Critical mathematical thinking is an essential competency that students must possess to face the challenges of the 21st century. According to Ennis (Hidayat, 2012), "Critical thinking is reasonable, reflective thinking focused on deciding what

to believe or do, a concept I have elaborated elsewhere." This means that critical mathematical thinking is a reasoning process aimed at making rational decisions to determine whether a belief or statement can be justified and acted upon accurately.

Ennis (Hidayat, 2012) also identified six core elements of critical mathematical thinking, abbreviated as FRISCO: Focus, Reason, Inference, Situation, Clarity, and Overview. Meanwhile, (Facione, 1990) explained that critical thinking includes the skills of analyzing, evaluating, and interpreting information logically and systematically to solve mathematical problems. In the context of mathematics education, critical thinking not only helps students understand concepts more deeply but also supports them in making accurate decisions based on data.

However, several studies have shown that students' critical mathematical thinking skills remain low. One of the main causes is the continued use of conventional teaching methods, which fail to stimulate higher-order thinking. Additionally, low motivation and self-confidence among students also hinder the optimal development of critical thinking skills.

There are several factors that influence students' critical mathematical thinking. First is the learning strategies employed by teachers in the classroom. These strategies play a key role in enhancing students' critical thinking. For instance, research by (Hake, 1998) found that interactive methods such as Problem-Based Learning and Inquiry-Based Learning are more effective in fostering critical thinking than traditional lecture-based approaches. The second factor involves the students' learning environment, including both the physical facilities and classroom conditions, which can encourage students to be more active in thinking and exploring ideas (Vygotsky, 1978; Andriyani, 2018). The third factor stems from the students themselves, particularly self-efficacy. Self-efficacy plays a vital role in fostering students' confidence in their ability to tackle challenging mathematical tasks (Novianty Patty et al., 2022).

Based on these elements, critical mathematical thinking focuses on one's belief in doing what is right. In other words, students will think critically not by simply accepting others' opinions, but by investigating and reasoning through the truth (Batubara et al., 2022). According to Alfina et al., (2021), this is a skill students must enhance, as critical mathematical thinking is a high-order skill that allows learners to manipulate learned concepts in various situations rather than merely memorizing or reciting information.

Field observations show that many students face difficulties in achieving critical mathematical thinking. In one study involving fifth-grade students, only 10% were able to demonstrate critical mathematical thinking—mostly high-achieving students. This reflects the low level of critical thinking abilities among students in real classroom settings. Many students tend to answer unfamiliar problems carelessly, as they are not yet trained to solve higher-order thinking (HOTS) questions that require critical thinking skills.

This finding aligns with research by Tresnawati et al. (2017), which indicated that students struggle with non-routine questions, particularly in analyzing questions, constructing coherent answers, forming relevant arguments, and verifying their responses. Furthermore, Hendriana & Soemarmo (2014) emphasized the importance of critical mathematical thinking as a foundational concept in developing students' critical abilities at the elementary level. Students who experience contextual teaching approaches tend to be more critical and independent in learning. Hidayat (in Tresnawati et al. 2017) also highlighted the role of affective factors—particularly self-efficacy—in supporting students' critical mathematical thinking when solving complex mathematical problems.

According to Bandura (in Hendriana & Kadari SD, 2019), self-efficacy is one's belief in their ability to organize and execute actions required to achieve specific goals. Self-efficacy can influence students' critical thinking skills, as it encourages confidence in their ability to perform tasks successfully in specific situations. When students have strong self-efficacy, their dependence on others to solve problems decreases, and they begin to rely on their own critical mathematical thinking skills.

Based on the problems described above, this study aims to analyze the influence of self-efficacy on elementary school students' critical mathematical thinking skills. Through this research, it is expected that the findings can contribute to the development of more effective learning strategies that take into account students' psychological aspects as a key factor in achieving mathematical competence.

METHOD

The research method used was a quantitative approach with a correlational design, aimed at analyzing the influence of self-efficacy on students' mathematical critical thinking abilities (Sugiyono, 2019). The research subjects consisted of 25 fifth-grade students from SDN Harapan Mulya, located at Jl. Karyawangi No. 81, Karyawangi Village, Parongpong Subdistrict, West Bandung Regency. The sample was selected using saturated sampling technique due to the small population size.

The research instruments included a non-test instrument, namely a self-efficacy questionnaire consisting of 30 items, developed based on theory Bandura, (1997). Meanwhile, the test instrument consisted of four items designed to measure mathematical critical thinking skills, constructed based on critical thinking indicators from (Ennis, 2011; Hendriana et al., 2017)

The research procedures involved planning, instrument validation, data collection, and scoring and data processing. The data analysis technique used was simple linear regression, intended to determine the extent of the influence of self-efficacy on students' mathematical critical thinking ability. Prior to this, assumption tests such as normality and linearity tests were conducted using SPSS version 27.

RESULTS AND DISCUSSION

Results

Based on the research objective, which is to analyze the influence of self-efficacy on elementary school students' mathematical critical thinking ability, several findings were obtained through a self-efficacy questionnaire and a mathematical critical thinking test administered to 25 fifth-grade students at SDN Harapan Mulya.

The analysis results presented include prerequisite tests, namely the normality test and linearity test, conducted using the SPSS 27 software. The results of the normality test are presented in Table 1 as follows:

Table 1. Normality Test Results for Two Variables between Self-Efficacy and Mathematical Critical Thinking Ability

	Shapiro-Wilk		
	Statistic	df	Sig.
Self-Efficacy	.168	25	.068
Mathematical Critical Thinking Ability	.140	25	.200

In Table 1, it is shown that the normality test conducted using the Shapiro-Wilk method resulted in significance values greater than 0.05 for both variables. The self-efficacy variable obtained a significance value of 0.068, and the mathematical critical thinking ability variable obtained a value of 0.200. Therefore, it can be concluded that the null hypothesis (H_0) is accepted, indicating that the sample comes from a population with a normal distribution.

Subsequently, a linearity test was conducted to determine whether there is a linear relationship between self-efficacy and the mathematical critical thinking ability of fifth-grade students. The results of this test are presented in Table 2 as follows:

Table 2. Self-Efficacy Linearity Test Results on Mathematical Critical Thinking Ability

			Sum of Squares	df	Mean Square	F	Sig.
Soft Skill * Hard Skill	Between Groups	(Combined)	255.250	4	63.812	1.660	.199
		Linearity	229.687	1	229.687	5.976	.024
		Deviation from Linearity	25.562	3	8.521	.222	.880
	Within Groups		768.750	20	38.438		
	Total		1024.000	24			

Based on the results presented in Table 2, the relationship between self-efficacy and the mathematical critical thinking ability of fifth-grade elementary school students shows a significance value (Sig.) of 0.880, which means that Sig. > 0.05. Additionally, the F_calculated value of 0.222 is greater than the F_table value. Therefore, it can be concluded that, based on the results of the linearity test, there is a significant linear relationship between self-efficacy and the mathematical critical thinking ability of fifth-grade students.

After conducting the normality and linearity tests, the next step is to perform a regression statistical analysis on the obtained data to determine whether there is an influence of self-efficacy on the mathematical critical thinking ability of fifth-grade elementary school students. The results of the regression analysis are presented in Table 1 as follows:

Table 3. Self-Efficacy Regression Test Results on Mathematical Critical Thinking Ability

Model		Sum of squares	df	Mean Square	F	Sig.
1	Regression	229.688	1	229.688	6.651	.017[b]
	Residual	794.313	23	34.535		
	Total	1024.000	24			

Based on Table 3, it is shown that the significance value (p-value) is 0.017, which is less than 0.05. This indicates that self-efficacy has a significant influence on the mathematical critical thinking ability of fifth-grade elementary school students. The results of the coefficient of determination (R^2) test are presented in the following table:

Table 4. Determination Coefficient Results

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.474[a]	.224	.191	5.877

In Table 4, the correlation coefficient (R) is shown to be 0.474, and the coefficient of determination (R square) is 0.224. This means that self-efficacy contributes 22.4% to students' mathematical critical thinking ability, while the remaining 77.6% is influenced by factors outside of self-efficacy.

These results reinforce the finding that the higher a student's self-efficacy, the higher their mathematical critical thinking ability. Students who have confidence in their abilities tend to be more self-assured when solving mathematical problems that require high-level reasoning and reflective thinking.

Discussion

The results of this study indicate a significant influence of self-efficacy on the mathematical critical thinking ability of elementary school students, with a contribution of 22.4%. These findings are consistent with theory Bandura, (1997), which posits that self-efficacy is an individual's belief in their ability to complete, organize, and execute actions to achieve a specific performance. In the context of mathematics learning, students with high self-efficacy tend to be more confident when facing challenging problems and are less likely to give up when encountering difficulties. Mathematical critical thinking ability itself is an essential competency that needs to be developed in order to adapt to the demands of the 21st century. This is in line with Facione, (1990) (in R. Ennis, 2011), who describes mathematical critical thinking as the ability to analyze, evaluate, and draw logical conclusions from a problem. When students have high self-efficacy, they are more likely to explore mathematical ideas, test hypotheses, and construct logical arguments based on evidence.

The findings of this study are also supported by previous research, such as Safitri, (2020), who stated that self-efficacy plays a crucial role in the development of students' mathematical critical thinking. Furthermore, the research conducted by Tresnawati et al., (2017) indicates that students who have confidence in their abilities are more capable of analyzing non-routine problems and constructing logical mathematical arguments.

However, the contribution of self-efficacy to mathematical critical thinking ability is not entirely dominant, as presented in the results of this study, which show a contribution of 22.4%. This suggests that other factors also play a role, such as teaching strategies, the learning environment, and the motivation of the students themselves (Angelika & Siregar, 2023). This is also in accordance with the findings of Hermiyati, (2024), who revealed that although self-efficacy plays an important role, other factors, such as the teaching methods employed by the teacher, also influence students' mathematical critical thinking levels. Meanwhile, Batubara et al., (2022) emphasize that not only self-efficacy but also other elements, such as social interaction and learning experiences, also contribute to the development of students' mathematical critical thinking abilities.

Thus, while self-efficacy has a significant contribution to students' mathematical critical thinking abilities, this study shows that other factors also play an essential role in shaping these abilities.

CONCLUSION

So, it can be concluded that based on the results of the data analysis that has been presented, there is an influence of self-efficacy on the mathematical critical thinking abilities of fifth grade elementary school students, with the positive influence of self-efficacy being 22.4% and the remainder being influenced by factors other than self-efficacy.

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