



# The Correlation Between Self-Efficacy and Critical Thinking Skills of Senior High School Students on the Pythagorean Theorem Material

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## Abstract

The objective of the research is to examine the correlation between self-efficacy and mathematical critical thinking skills among senior high school students within the context of the Pythagorean Theorem. Self-efficacy refers to students' beliefs in their ability to complete learning tasks, while mathematical critical thinking involves analyzing problems, evaluating strategies, and making logical decisions. Employing a quantitative correlational design, the research involved 140 tenth-grade students from a senior high school in Jakarta selected using purposive sampling. Data were collected using a mathematical critical thinking test and a self-efficacy questionnaire. The normality test indicated that the data were normally distributed; therefore, Pearson's correlation analysis was applied. The results revealed a positive and statistically significant relationship between self-efficacy and students' critical thinking ability, with a correlation coefficient of  $r = 0.771$  and a significance value of  $p < 0.01$ . These findings indicate that higher levels of self-efficacy are associated with stronger mathematical critical thinking skills. The study highlights the importance of fostering students' self-efficacy as an affective foundation to enhance critical thinking skills and offer meaningful implications for improving teaching and learning practices in secondary education.

**Keywords:** correlation; mathematical critical thinking skills; self-efficacy

## Abstrak

Penelitian ini bertujuan untuk mengkaji korelasi antara efikasi diri dan kemampuan berpikir kritis matematis siswa SMA pada materi Teorema Pythagoras. Efikasi diri merupakan keyakinan siswa terhadap kemampuannya dalam menyelesaikan tugas belajar, sedangkan kemampuan berpikir kritis matematis berperan dalam menganalisis, mengevaluasi, dan mengambil keputusan secara logis. Penelitian ini menggunakan pendekatan kuantitatif dengan desain korelasional yang melibatkan 140 siswa kelas X SMA di Jakarta yang dipilih menggunakan teknik *purposive sampling*. Data dikumpulkan melalui tes kemampuan berpikir kritis matematis dan angket efikasi diri. Berdasarkan uji normalitas, data dinyatakan berdistribusi normal sehingga analisis korelasi Pearson dapat diterapkan. Selanjutnya, hasil analisis korelasi mengungkapkan adanya hubungan positif dan signifikan antara efikasi diri dan kemampuan berpikir kritis matematis siswa, dengan koefisien korelasi sebesar  $r = 0,771$  dan nilai signifikansi  $p < 0,001$ . Temuan ini mengindikasikan adanya hubungan linier positif yang kuat antara efikasi diri dan kemampuan berpikir kritis matematis. Penelitian ini menegaskan pentingnya menumbuhkan rasa percaya diri siswa sebagai landasan afektif untuk meningkatkan keterampilan berpikir kritis serta memberikan implikasi yang bermakna bagi peningkatan praktik pengajaran dan pembelajaran di tingkat pendidikan menengah.

**Kata Kunci:** efikasi diri; kemampuan berpikir kritis matematis; korelasi

## 1. INTRODUCTION

Critical thinking is a fundamental cognitive skill that is necessary for overcoming educational challenges, particularly in the domain of mathematics. It enables students to analyze problems, evaluate solution strategies, and make logical, evidence-based decisions. Facione (2015) defines critical thinking as a deliberate and reflective process that involves the evaluation of beliefs or actions. It encompasses the ability to analyze, infer, and evaluate information in a disciplined manner (Basori et al., 2023; Mastuti et al., 2022; Zakiyah et al., 2024). In mathematics learning, critical thinking skills provide an important foundation, helping students not only to master procedures but also to understand concepts and apply them meaningfully in problem-solving.

In addition to cognitive aspects, affective elements such as self-efficacy play an important role in supporting successful mathematics learning. Self-efficacy is defined as an individual's belief in their ability to organize and complete academic tasks. According to Zega (2020), self-efficacy significantly influence students' approach to confronting learning challenges, the selection of problem-solving strategies, and the demonstration of perseverance in the presence of adversity. Students with high self-efficacy typically demonstrate confidence, persistence, and active engagement in the learning process. These qualities have been shown to contribute to the development of higher-order thinking skills, including mathematical critical thinking.

Within Indonesian education, strengthening mathematical critical thinking has become ever more urgent, particularly with the implementation of Deep Learning, an approach that emphasizes higher-order cognitive development and character formation. Results from the *Asesmen Kompetensi Minimum* (AKM) reveal that many Indonesian students struggle with mathematics problems that require higher-order thinking skills, such as reasoning, analysis, and nonroutine problem-solving. This is consistent with data from the Programme for International Student Assessment (PISA), which demonstrates that Indonesian students' mathematical literacy remains low, especially in reasoning and problem-solving. These circumstances indicate that mathematics instruction in formal schools still prioritizes procedural mastery, which does not adequately foster the development of critical thinking skills. Furthermore, students' low self-confidence when confronted with mathematical obstacles has appeared as a significant barrier to engagement and persistence in learning.

Previous studies have shown a positive correlation between self-efficacy and critical thinking skills (Kaustsari et al., 2024; Nuraeni et al., 2019; Umam et al., 2023). However, most of these studies remain general and do not specifically examine the correlation between the two variables in the context of senior high school mathematics learning. In particular, there is a lack of focus on strong mathematical reasoning in contexts such as the Pythagorean Theorem. Moreover, studies that explicitly link empirical findings to pedagogical effects on mathematics learning design are limited.

This study contributes to the literature by providing empirical evidence on the relationship between self-efficacy and mathematical critical thinking skills among senior high school students within the specific context of learning the Pythagorean Theorem, a topic that requires conceptual understanding and geometric reasoning but has received limited attention in prior correlational studies. Accordingly, this research aims to examine the relationship between these variables while highlighting the strategic role of self-efficacy as an affective foundation for developing mathematical critical thinking skills. The findings are expected to provide insight for mathematics teachers and educators in designing learning activities that emphasize conceptual understanding and deliberately strengthen students' self-efficacy through strategies that promote confidence, active participation, and effective problem-solving.

## **2. RESEARCH METHODS**

### **2.1 Research Design**

A quantitative approach with a correlational design was employed to examine the correlation between self-efficacy and students' mathematical critical thinking skills without any experimental intervention. self-efficacy was designated as the independent variable and mathematical critical thinking skills as the dependent variable. The relationship between the variables was subjected to analysis using Pearson's correlation coefficient. This prerequisite enabled a statistical assessment of the direction and magnitude of the relationship. The analysis was conducted with the explicit understanding that no causal interpretations would be made (Creswell & Creswell, 2018).

### **2.2 Participants**

The research sample included 140 senior high school students selected using purposive sampling to ensure that participants met the study criteria and shared relatively homogeneous academic characteristics. All participants took the mathematical critical thinking skills test and completed the self-efficacy questionnaire. Among them, 80 were female, and 60 were male.

### **2.3 Instruments**

The collection of data was executed by two instruments: a mathematical critical thinking skills test and a self-efficacy questionnaire. The mathematical critical thinking skills test was developed using critical thinking indicators, including the capacity to interpret, analyze, evaluate, and infer, which are pertinent to mathematics learning on the Pythagorean theorem. The test consisted of 3 essay questions adapted from Aini et al., (2023) and R. Pontoh et al. (2025). The instrument was reviewed by two experts in mathematics education to ensure the content validity. The validation process focused on the relevance of items to the intended constructs, clarity of language, and appropriateness to students' cognitive level. Based on expert feedback, several revisions were made to

improve item clarity and alignment with critical thinking indicators before the instrument was administered.

A self-efficacy questionnaire measured students' confidence in solving mathematics problems. The questionnaire assessed optimism, responsibility, self-confidence, and problem-solving ability, drawing on established theoretical and empirical frameworks in education (Baihaki et al., 2022; Usher & Pajares, 2009). The instrument consisted of 24 items developed by adapting and synthesizing indicators from previously validated instruments, particularly the scale proposed by Usher and Pajares (2009), which has demonstrated strong construct validity and reliability. Additional item considerations were informed by prior empirical studies on mathematical self-efficacy (Baihaki et al., 2022). Therefore, the instrument was considered appropriate for use in this study, with minor modifications to align with the research context.

#### **2.4 Data Collection Procedure**

Data collection was conducted through the administration of a written test and a self-efficacy questionnaire directly in the classroom. Prior to data collection, permission was obtained from the school, and students were informed about the purpose of the study. The instruments were administered during regular mathematics class time to ensure consistent and controlled conditions. The mathematical critical thinking skills test was given first, followed by the self-efficacy questionnaire.

Students completed both instruments independently within the allocated time, under the supervision of the researcher and the classroom teacher to ensure that instructions were clearly understood and the procedure was properly followed. All responses were collected immediately after completion to maintain data integrity and ensure that the data accurately reflected students' actual abilities and perceptions.

#### **2.4 Data Analysis**

Data analysis was carried out in two stages: descriptive and inferential. Descriptive analysis was used to describe the characteristics of each variable. Next, a normality test was conducted as a prerequisite for inferential analysis. If the data were normally distributed, the correlation between self-efficacy and mathematical critical thinking skills was analyzed using Pearson correlation at the 0.05 significance level.

### **3. RESULT AND DISCUSSION**

#### **3.1 Description of Research Data**

Table 1 presents descriptive statistics for self-efficacy variables and mathematical Critical thinking skills among 140 tenth-grade students at one of the senior high schools in Jakarta. These statistics provide a general overview of trends and data variation before inferential analysis is performed.

**Table 1.** Descriptive statistics results (N=140)

Variable	Mean	Std. Dev	Min	Max	Median	Skewness	Kurtosis
SE	74,33	7,55	54	95	74,24	0,085	-0,032
CTS	72,14	8,02	52	95	71,51	-0,001	0,006

Ket: SE = self-efficacy

CTS = critical thinking skills

Descriptive statistics show that the students' self-efficacy mean score was 74.33 (SD = 7.55), while the mean score for mathematical critical thinking skills was 72.14 (SD = 8.02). The median and the 5% trimmed mean for both variables were also close to their means, showing a balanced distribution. Self-efficacy scores ranged from 54 to 95, whereas mathematical critical thinking skills scores ranged from 52 to 95, indicating variation in students' abilities. Furthermore, skewness and kurtosis values close to zero reinforce that the data are normally distributed.

### 3.2 Correlation Analysis

Before conducting the correlation analysis, a normality test was carried out to ensure that the self-efficacy and mathematical critical thinking skills data met the requirements for parametric test. The normality of the data was assessed using the Kolmogorov–Smirnov test. The Kolmogorov–Smirnov significance value for self-efficacy was 0.200, and for mathematical Critical thinking skills it was also 0.200. As both values exceeded 0.05, the assumption of normality was satisfied, allowing for the use of Pearson correlation analysis.

To assess the correlation between self-efficacy and students' mathematical critical thinking ability, a Pearson correlation analysis was conducted. The analysis output shows that the correlation coefficient is  $r = 0.771$ , with  $p < 0.01$ . These indicate a strong and statistically significant positive relationship between the two variables. It means that students with higher self-efficacy tend to demonstrate better mathematical critical thinking skills.

### 3.3 Discussion

The results of this study demonstrate a strong and significant positive correlation between self-efficacy and mathematical Critical thinking skills of senior high school students on the Pythagorean Theorem material. The correlation coefficient,  $r = 0.771$  indicates that self-efficacy is an affective factor closely associated with mathematical critical thinking skills. This finding is consistent with the self-efficacy theory put forward by Gerbino (2020), which states that individuals' beliefs in their abilities affect how they organize strategies, maintain effort, and face academic obstacles. Students with high self-efficacy tend to show better learning persistence and are not easily discouraged when facing difficulties.

In mathematics learning, the correlation between self-efficacy and mathematical critical thinking skills can be explained by students' cognitive engagement during the problem-solving. Students with high self-efficacy are more likely to try various strategies, evaluate their steps, and reflect on their mistakes. This process is in line with the core components of critical thinking, namely analysis, inference, and disciplined evaluation of information (Facione, 2015). Therefore self-efficacy functions as an affective foundation that enables the optimal development of critical thinking.

The findings of this study are consistent with previous research that reported a positive correlation between self-efficacy and critical thinking ability. Studies by Kaustsari et al., (2024) dan Umam et al., (2023) showed that self-efficacy has a significant impact on students' cognitive involvement and higher-order thinking skills. Empirical studies in the context of mathematics learning also found that students with high self-efficacy tend to show better analytical and reflective thinking abilities in solving mathematics problems (Mulyono et al., 2020). The alignment of these outcomes strengthens the position of self-efficacy as an important factor in the development of critical thinking skills.

However, this study provides a new contribution by focusing on the context of senior high school mathematics learning and the Pythagorean Theorem material, which requires geometric reasoning. Unlike previous studies that examined self-efficacy and critical thinking in general, this study shows that the relationship between the two variables is also strong in specific mathematics materials that require conceptual understanding and reasoning. Consequently, the results of this study broaden previous findings and highlight the importance of considering material characteristics in developing mathematical critical thinking skills.

From a pedagogical perspective, the findings from this study have important effects on mathematics teaching practice. Teachers should design learning that is not only oriented toward procedural mastery but also systematically strengthens students' self-efficacy by providing challenging but realistic tasks, constructive feedback, and opportunities for reflection. This approach is consistent with the view that the development of higher-order thinking skills requires simultaneous cognitive and affective support (Ismeirita et al., 2025).

Overall, the results of this study emphasize that self-efficacy is an affective factor with a strategic role in developing mathematical Critical thinking skills among senior high school students. Although this study is correlational and does not aim to draw causal conclusions, the strength of the relationship indicates that self-efficacy should be a primary focus in mathematics curriculum design. Further study is suggested to use experimental or long-term designs to examine more deeply the role of self-efficacy in improving mathematical critical thinking skills on an ongoing basis.

#### 4. CONCLUSION

Based on the research results, it can be concluded that there is a positive and significant relationship between the two variables: self-efficacy and mathematical critical thinking skills among senior high school students learning the Pythagorean Theorem. The results directly answer the study goal, namely to examine the correlation between the two variables, and show that students' beliefs in their own abilities are closely related to the quality of mathematical critical thinking demonstrated in problem solving.

In addition, the results of this study emphasize the strategic role of self-efficacy as an affective foundation in the development of mathematical critical thinking ability. Strengthening self-efficacy should be considered an integral part of mathematics learning because it supports students' cognitive involvement and optimizes the development of critical thinking skills. Therefore, mathematics learning in high school should be designed not only to focus on cognitive aspects, but also consciously integrate efforts to strengthen students' self-efficacy.

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