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# **The Role of Self-Efficacy in Enhance Metacognitive and Academic Performance Through Problem Solving**

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## **ABSTRACT**

This research analyzes the role of self-efficacy in enhancing metacognitive and academic performance of students through problem-solving learning. Metacognitive refers to thinking about thinking and knowledge about cognitive phenomenon. While self-efficacy is an individual's belief in their competence to solve problems and achieve goals. We research some students from senior high school in Malang. This research uses mixed methods with surveys, interviews, and analysis of students' learning outcomes. At the first meeting, students were asked to fill survey about the dimensions of self-efficacy, which are magnitude, strength, and generality. Moreover, we interviewed students to explore their metacognitive activities that they do, such as awareness, regulation, and evaluation. After that, we analyze their learning outcomes to determine their academic performance. This research result shows that students with a high dimension of self-efficacy tend to show better metacognitive activity than the other. Furthermore, students with a high dimension of self-efficacy tend to show better academic performance than others.

Keywords: Academic Performance, Metacognitive Activity, Problem Solving, Self-Efficacy

## **INTRODUCTION**

Problem-solving skill is an important ability needed by students. School institutions often suggest problem-solving skills as a measurement for academic success (Greiff et al., 2013; Molnár et al., 2013). This skill consists of problem identification, alternative invention, analysis answer, and implementation of the best solution. One of the best ways to enhance problem-solving skills is to give problem-solving questions to students (Pimdee et al., 2024). Mathematical learning models with problem-solving can help students to extend their cognitive comprehensively (Sormin & Pasaribu, 2023). However, students are not accustomed to solving problem questions. They find it difficult to define the problem, outline alternatives, and analyze the best solutions (Tambychik & Meerah, 2010). Students tend to use a method that ensures finding one correct answer from several possible answers (Walida et al., 2022).

Problem-solving skills are related to metacognitive and self-efficacy. Many researchers stated that metacognition is related to problem-solving (Ader, 2013; Güner & Erbay, 2021; Faoziah, et al., 2023). Students with high metacognitive will solve problems better than others. By understanding metacognitive, students will easily determine the objectives of the problem, outline possible strategies, and determine the best solution to solve the problem.

Self-efficacy also demonstrates a positive relation to problem-solving (Aurah et al., 2014; Kozikoğlu, 2019). Students with high self-efficacy will find it easier to work on problem-solving questions. Self-efficacy will make students more resilient in solving

questions that take a long time, confident in solving difficult problems, and always seeking other methods in more effective ways.

We use academic performance as the output of metacognitive and self-efficacy. Metacognitive and self-efficacy have a positive effect on academic performance. The higher metacognitive and self-efficacy of students, the higher their academic performance will be.

In general, researchers discuss metacognitive and self-efficacy as a unified concept, and there are still few who discuss aspects of metacognitive or self-efficacy as predictors of academic performance. We use metacognitive activity from Magiera & Zawojewski (2011) which consists of awareness, regulation, and evaluation. Meanwhile, for self-efficacy, we use three dimensions of self-efficacy from Bandura (1997) which consist of magnitude, strength, and generality. Therefore, the aim of this research is to describe the role of student self-efficacy in strengthening metacognitive and academic performance using problem-solving questions.

### **The Effect of Self-Efficacy on Metacognitive**

The main concept of self-efficacy revolves around experiences and psychological conditions. Self-efficacy is an individual's belief in their competence to solve problems and achieve goals (Pajares & Graham, 1999; Regier & Savic, 2020; Schunk, 1991). Bandura (1997) identifies four sources that can influence self-efficacy: individual successful experiences, observing others' experiences, social persuasion, and psychological and emotional states. Students with more successful experiences will demonstrate higher levels of self-efficacy (Raofi et al., 2012).

We use three dimensions of self-efficacy from Bandura: magnitude/level, generality, and strength. Magnitude refers to an individual's belief in their ability to tackle difficult tasks. The higher the magnitude, the more confident the person is in their ability to solve difficult problems. Generality pertains to the extent of someone's perceived self-efficacy across various situations. The higher the generality, the more they believe they can accomplish anything. Lastly, strength denotes how steadfastly someone sticks to their decisions. Individuals with high strength will persevere in tasks they're working on, even if they are long or exhausting (Chen et al., 2011).

Metacognitive refers to thinking about thinking and knowledge about cognitive phenomenon (Flavell, 1979). Furthermore, metacognitive is an individual's awareness of how they learn, assess difficulties in problems, evaluate their level of understanding, utilize information to achieve goals, and evaluate the learning process (Sumampouw, 2011; Vrieling et al., 2012). With metacognition, students can oversee and control their learning process (Ku & Ho, 2010; Laamena & Laurens, 2021). With these abilities, students are able to achieve better academic performance.

We use metacognitive activity which consists of awareness, regulation, and evaluation (Firmansyah et al., 2022; Magiera & Zawojewski, 2011; Purnomo et al., 2016). Awareness involves students' consciousness in the problem-solving process, their knowledge, and their understanding related to learning or problem-solving process. Regulation occurs when students utilize their metacognitive abilities to plan, set goals, determine actions to be taken, or choose new actions. Lastly, evaluation is the student's

assessment of their thought process, thinking abilities, limitations, and the difficulties they encounter (Wilson & Clarke, 2004).

Many researchers have indicated a positive relationship between self-efficacy and metacognition, where students with high self-efficacy tend to have better metacognitive (Nurjanah et al., 2021; Usher, 2009). Students with high self-efficacy tend to: (1) perceive challenges as opportunities for growth, (2) view failures as controllable and improvable variables, and (3) quickly recover from failures by exerting more effort for better outcomes (Kustos & Zelkowski, 2013; Peacock et al., 2020). Furthermore, students with high self-efficacy tend to be more effective in utilizing the necessary information to regulate the learning process (Cho et al., 2017; Alamudin, et al., 2022). Students with high self-efficacy will utilize metacognitive skills more effectively and work harder to complete tasks (Gurat & Medula, 2021). Thus, self-efficacy has a positive influence on metacognitive.

### **The Effect of Self-Efficacy on Academic Performance**

Academic performance measures the success of students in the learning process (Supervía et al., 2022). Performance is a multi-dimensional concept, depending on the targets and expected outcomes. Researchers divide performance into two categories based on how it's measured: first, quantitatively and target-based, and second, qualitatively and subjectively assessed. We use quantitative assessment.

Many researchers identify a relationship between self-efficacy and academic performance, where students with high self-efficacy tend to have high academic performance as well (Feldman & Kubota, 2015; Grigg et al., 2018; Horvath & Broadbent, 2016; Suherman et al., 2018; Herlina, et al., 2022; Yanisa, et al., 2022). Students with high self-efficacy tend to set high academic targets (Jayanthi et al., 2014), spend more time learning (Torres & Solberg, 2001), and enjoy the learning process more than other students (Hakyemez & Mardikyan, 2021). Furthermore, students with high self-efficacy view challenges as opportunities to develop their academic abilities, motivating them to maximize their cognitive development (Zander et al., 2018). Thus, self-efficacy has a positive influence on academic performance.

### **METHOD**

We used a mixed-methods research approach to analyze the role of self-efficacy in relation to student metacognition and academic performance. They employed semi-structured interviews, surveys, and analysis of student learning outcomes. The participants in this study consisted of 40 students from several high school schools in Malang, selected randomly.

The survey method is used to determine the self-efficacy of students. We gave a self-efficacy questionnaire to 40 students, consisting of 20 statements, namely 11 positive statements and 9 negative statements. Statements 1-8 are about the magnitude dimension, statements 9-14 are about generality, and statements 15-20 are about strength. The questionnaire follows a Likert scale with four options: Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD).

Furthermore, we will conduct interviews with 10 students to understand the students' metacognitive activities. We will use Wilson's (2001) metacognitive card as a

basis for the interview. Students can respond with "No," "Rarely," and "Often." Afterward, the researcher can develop further questions to ensure clarity about their metacognitive processes.

We will use quantitative scores on both available questions to measure academic performance. Each researcher will assign scores independently to the students. Then, the researcher will compare the scores and answers of the students and compare the scoring of each student with other researchers to ensure objectivity in scoring. These student responses can also be used to clarify the metacognitive activities possessed by the students.

## RESULT AND DISCUSSION

We analyzed the self-efficacy data with a Cronbach's  $\alpha$  value of 0.771. This indicates that the data used is reliable and suitable for the research. Below are the self-efficacy results for all research subjects.

Table 1. Result of Student Self-Efficacy ( $n = 40$  *cronbach*  $\alpha = .771$ )

	Self-Efficacy		
	Magnitude	Strength	Generality
High	6	6	5
Medium	27	29	26
Low	7	5	9
M(SD)	23.68(3.11)	18(3)	17(2.3)

We randomly selected 10 students for interviews out of that 40 students. The selected students represent high, moderate, and low categories in each dimension of self-efficacy.

Table 2. Result of Student Self-Efficacy ( $n = 10$ )

	Self-Efficacy		
	Magnitude	Strength	Generality
High	2	4	2
Medium	5	4	6
Low	3	2	2

Based on the interview results and the students' answer sheets, it's evident that students with high magnitude, strength, and generality demonstrate high awareness both in the first and second questions. When working on the first question, they reflect and become aware of the knowledge they need to answer the question, which is the knowledge about the characteristic of square numbers having an odd number of factors. Meanwhile, in the second question, they utilize their mathematical knowledge about division and remainders in dividing polynomials.

Students with low to medium magnitude and generality, demonstrate low awareness in both the first and second questions. This is because they show little metacognitive awareness activities when solving the questions, despite reading the questions repeatedly and reflecting on what they know about the questions. They struggle to apply their mathematical knowledge effectively. On the other hand, students with low to medium strength show low awareness in the first question and medium awareness in the second question.

Students with high magnitude, strength, and generality, show medium evaluation on one problem and high evaluation on another. Specifically, students with high magnitude

and generality demonstrate medium evaluation on the first problem and high evaluation on the second. This is evident as, when working on the first problem, students seldom evaluate their answers, failing to discern the intended pattern, thus leading to an inability to solve the problem. This is further clarified during interviews, where students also acknowledge the limitations of their thinking abilities. However, on the second problem, students are able to evaluate the methods they use, enabling them to solve the problem. This contrasts with what is observed in students with high strength, who show high evaluation on the first problem and medium evaluation on the second. This is shown by their frequent evaluation of answers to the given problems, enabling them to solve problems. However, on the second problem, students seldom evaluate the methods and answers they provide, even though the solution may be correct, they are unable to complete it.

Students with low and medium magnitude, strength, and generality, demonstrate medium evaluation. This is due to their lack of assessment of the methods they employ, even though they can evaluate the limitations of their thinking abilities, resulting in their inability to solve the given problems, both in the first and second problems.

Students with high magnitude and generality, demonstrate medium regulation. This is evident when working on problems, students can plan, set goals, and determine the actions to be taken, allowing them to find the best strategies to solve the problems during the process.

Whilst high strength students, they show high regulation. This is demonstrated when working on problems, students can plan the use of strategies and understand the purpose and goals of the problems.

For students with low and medium magnitude, strength, and generality, they show low regulation. This is because students do not plan or set goals, nor do they determine the actions to be taken, resulting in less effective strategies being employed.

Based on the responses of the ten students and comparing the scores given by each researcher, the final academic performance of each student is determined. The average scores for students with high magnitude are 60 for the first problem and 90 for the second problem. Meanwhile, students with low and medium magnitudes have average scores of 72.5 for the first problem and 71.25 for the second problem.

Students with high strength obtained an average score of 72.5 for the first question and 80 for the second question, while students with low and medium strength scored an average of 68.33 for the first question and 71.66 for the second question.

Students with high generality achieved an average score of 60 for the first question and 90 for the second question, while students with low and medium generality scored 72.5 on the first question and 71.25 on the second question.

Tabel 3. Analysis Result of Students' Metacognitive and Academic Performance

Dimension	Category	Metacognitive						Average Academic Performance	
		Awareness		Evaluation		Regulation		1 <sup>st</sup>	2 <sup>nd</sup>
		1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>	1 <sup>st</sup>	2 <sup>nd</sup>		
		12	14	12	14	12	14		
		problem	problem						
Magnitude	High	High	High	Medium	High	Medium	Medium	60	90
	Low	Medium	Low	Low	Medium	Medium	Low	Low	72.5
Strength	High	High	High	High	Medium	High	High	72.5	80
	Low	Medium	Low	Medium	Medium	Medium	Low	Medium	68.3
Generality	High	High	High	High	High	Medium	Medium	60	90
	Low	Medium	Low	Low	Medium	Medium	Low	Low	72.5

Based on that results, we can analyze several things as follows. Firstly, the dimension of strength has a better average metacognitive than magnitude and generality. Students with high strength show high metacognitive in almost all activities, except for evaluation in the second question. Secondly, students with high self-efficacy dimensions tend to have higher metacognitive than students with lower self-efficacy dimensions. Thirdly, students with high strength have the highest average score for the first question compared to others, while students with high magnitude and high generality have the highest average score for the second question compared to others. These results are consistent with the research by Wibowo et al. (2018). Fourthly, in the first question, only students with high strength have a higher average score compared to students with lower strength. Whereas students with high magnitude and generality, have a lower average score than students with lower magnitude and generality in the first question. For the second question, students with high self-efficacy dimensions have a higher average score compared to students with lower self-efficacy dimensions.

Furthermore, we found some findings that can be further discussed. First, there is one student with low magnitude, low strength, and medium generality who scored 100 on both the first and second questions. Moreover, he also tends to show high metacognitive in both questions. Second, students with high magnitude and high generality score low on the first question, even though their awareness tends to be high in that question. Further analysis is needed to determine whether they experience metacognitive failure (Rozak et al., 2020) or self-assessment errors, such as overestimation or underestimation (Gonida & Leondari, 2011).

## CONCLUSION

There are two important contributions to this research: first, students with high self-efficacy dimensions tend to have higher metacognitive activity compared to students with the same dimensions but lower self-efficacy; second, students with high self-efficacy dimensions tend to have higher academic performance compared to students with the same dimensions but lower self-efficacy. Furthermore, the high strength dimension plays a larger role in increasing metacognitive activity compared to other dimensions, namely magnitude and generality in the high category. High generality and magnitude play a larger role in improving academic performance compared to other dimensions, namely high strength.

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PAGE 1

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PAGE 2

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PAGE 3

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PAGE 4

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PAGE 5

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PAGE 6

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