Mathematical problem-solving ability based on self-efficacy in junior high school

H R Fatmasari*, S B Waluya, and Sugianto
Universitas Negeri Semarang, Indonesia

*Corresponding author: hanindyanarangetyas@students.unnes.ac.id

Abstract. Problem-solving ability is one of the standard mathematical abilities that students must have. This ability can be mastered well by students if students have affective abilities, one of which is self-efficacy. The aim of this research is to determine the ability of junior high school mathematics problem-solving based on student self-efficacy. Descriptive qualitative research is the method approach used in this research. The research subject is one student who represents the levels of self-efficacy. The results showed that students with high self-efficacy were able to master four indicators of mathematical problem-solving, students with self-efficacy were mastering three indicators, and students with low self-efficacy were only able to master one indicator. The conclusion of this research are students who have high self-efficacy are able to solve problems according to the indicators of mathematical problem-solving abilities compared to students who have medium and low self-efficacy, because students with high self-efficacy are more can to withstand math problems and do not give up hope in meeting failure. Meanwhile, students with moderate and low self-efficacy are able to solve all problems but are less able to meet the problem-solving ability indicators because they have doubts and give up easily in solving math problems.

1. Introduction
Problem-solving is the focus of the mathematics curriculum at every level which is expected to be able to apply the knowledge and skills learned to solve any problems encountered [1-2]. Mathematical problem-solving ability is part of mathematics learning which is very important to be applied in solving a non-routine problem [3]. However, the students' problem-solving ability is still low. Many students do not have the desire to find solutions to problems and only wait for an explanation from the teacher, and only focus on the correct answer [4]. According with the opinion [5] which state that the results of international research related to the performance of students in Indonesia in solving problem-solving problems are still not satisfactory.

Low problem-solving abilities result in low student learning outcomes. So that the problem-solving ability of students is very important to be developed because it is in accordance with the goals of education in Indonesia. A question or problem posed to students is a problem for him if the question or problem cannot be solved immediately by students with routine procedures but provides stimulation and challenges to answer. A person's low achievement is caused by the person's low self-efficacy in solving math problems [6].

Self-efficacy plays an important role because its existence will motivate someone to be more organized and assess themselves as a form of preparation for facing challenges in order to achieve planned goals [7]. Self-efficacy is one of the most important affective aspects of every individual [8]. According to [9], self-efficacy is a person's belief in his ability to achieve the expected results. Self-
Efficacy is also the strongest determinant of human endeavors and their achievement in the future [10]. Self-efficacy refers to how much a person believes about his ability to carry out a number of learning activities and can achieve goals in the learning process [11]. The measurement of a person's self-efficacy refers to three dimensions, namely magnitude, strength, and generality according to Bandura.

Based on the description, theoretically problem-solving abilities and self-efficacy have a mutually influential relationship and play an important role in achieving learning goals. The absence of similar research, this motivates and becomes the basic reason for researchers to conduct research related to mathematical problem-solving ability based on students' self-efficacy.

2. Methods
Qualitative descriptive research is the method approach used in this research. The research was conducted in the 2019/2020 in 8th grade of MTs Negeri 1 Semarang. Research subjects were selected by subject selection criteria using purposive sampling technique. The criteria in question are that students have received rectangular material, have complete answers, meet the criteria for self-efficacy, and can communicate well. Each of the high, medium, and low self-efficacy categories was represented by one subject so that the number of research subjects was three subjects. The three subjects are symbolized by S1, S2, and S3. Subjects were selected based on the test scores of mathematical problem-solving abilities and the results of a self-efficacy questionnaire and conducted interviews to determine mathematical problem-solving abilities based on self-efficacy. Table 1 is a way to determine high, medium, and low self-efficacy.

| Interval Category | Category |
|-------------------|----------|
| (μ + 1.0σ) ≤ X   | High     |
| (μ - 1.0σ) ≤ X < (μ + 1.0σ) | Medium |
| X < (μ - 1.0σ) | Low      |

Note:
- X = Students’ self-efficacy scores of each respondent
- μ = Average self-efficacy score of all sample students
- σ = Standard deviation of the entire sample

3. Results and Discussion
The self-efficacy category was obtained based on the total score of the self-efficacy measurement scale. Based on that measurement, the score x ≥ 247 is high self-efficacy, 167 ≤ X < 247 is a medium self-efficacy, and X < 167 is a low self-efficacy. The mathematical problem-solving ability test in this research was used to determine students' mathematical problem-solving abilities. Analysis of students' mathematical problem-solving abilities is based on indicators of mathematical problem-solving abilities, namely (1) building new mathematical knowledge through problem-solving, (2) applying and adjusting appropriate strategies to solve problems, (3) solving problems that arise in mathematics and in other contexts, and (4) monitor and reflect on the process of solving mathematical problems. Interviews were conducted to confirm the answers to the students' mathematical problem-solving abilities so that researchers could find out whether the answers to the tests and interviews were appropriate. Following are items to measure students' mathematical problem-solving abilities. Analysis of answers to mathematical problem-solving abilities and interviews with research subjects based on the self-efficacy categories.
3.1. High Self-Efficacy Subject Analysis

Figures 1 S1N1 (S1 Number 1) and Figure 2 S1N2 (S1 Number 2) show that S1 can write what is known by rewriting the questions and does not illustrate pictures but can understand the questions well when being interviewed. S1 devises a strategy by making a picture illustration and symbolizing the length \( p \), the symbolized width \( l \), the symbolized area of the rectangle \( LPP \), the symbolized area of the square \( LP \). S1 uses a strategy by finding the width first by using the perimeter formula of the rectangle, namely \( K = 2 \times (p + l) \), after finding the width then find the length with the formula that is already known in the problem, namely \( p = l + 25 \), then find the area of the rectangle whose formula is \( LPP = p \times l \), find the sides of the square using the area of the formula is \( s^2 \), and the last one calculates the perimeter of the square with the formula, namely \( 4 \times s \). It can be said that S1 is able to formulate a strategy, namely writing the correct formula and the right unit, meaning that S1 is able to achieve the second problem-solving ability indicator, namely implementing and adjusting the appropriate strategy to solve problems. S1 can also solve problems that arise by implementing the correct strategy and calculation operations according to the formula that has been explained when developing the strategy, meaning that S1 is able to meet the third mathematical problem-solving ability indicator, namely solving problems that arise in mathematics. S1 is able to reflect back on the results of its solutions and write conclusions in accordance with the questions in the questions, meaning that S1 is able to meet the fourth indicator of mathematical solving ability, namely monitoring and reflecting on the process of solving mathematical problems.

Based on these results it can be said that S1 is able to meet the four indicators of mathematical problem-solving abilities very well, because the subject is very enthusiastic and tries seriously in taking part in online and face-to-face learning and has confidence in his abilities. Subjects with a high level of self-efficacy tend to be able to solve all the questions correctly according to the indicators of mathematical problem-solving abilities. Self-efficacy can increase student success in solving math problems well, this is if students who have high self-efficacy will have greater self-efficacy and self-confidence and are confident that they can solve problems in mathematics [13]. This also agree with [14-15] opinion, that students who have strong or high self-efficacy are more able to withstand problems, are full of enthusiasm in learning, have motivation to learn and do not give up on meeting failure.
3.2. Medium Self-Efficacy Analysis

Figure 3. S2N1’s Answer

Figures 3 S2N1 (S2 Number 1) and Figure 4 S2N2 (S2 Number 2) show that S2 wrote what was known by rewriting the question sentences, illustrating pictures and could not write down what was asked, but S2 had a little difficulty understanding the questions when interviewed. S2 strategizes by making image illustrations and providing symbols. Figure 2, S2 represents the length p, the symbolized width l1, the symbolized area of the square L1, the symbolized area of the rectangle L2, the symbolized perimeter of the square K1, and the symbolized perimeter of the rectangle K2. S2 uses a strategy using the concept of squares and rectangles. The error on F1 (False 1) indicates that S2 uses the length to be the side of the square to calculate the area of the square. Another error is that F2 (False 2) shows that S2 did not find the length first so there is no measure p. If the researcher asks again how to strategize, S2 has a little difficulty and cannot implement and adjust the appropriate strategy to solve the problem.

Based on these results it can be said that S2 is able to meet the three indicators of problem-solving ability. S2 had doubts about adjusting the problem-solving strategy, so the problem was not resolved properly. This agree with [16] opinion that if students do not have good self-efficacy, students will feel hesitant in using mathematical concepts to be applied to other mathematical concepts.

3.3. Low Subject Self-Efficacy Analysis

Figure 5. S3N1’s Answer

Figure 6. S3N2’s Answer

Based on these results it can be said that S2 is able to meet the three indicators of problem-solving ability. S2 had doubts about adjusting the problem-solving strategy, so the problem was not resolved properly. This agree with [16] opinion that if students do not have good self-efficacy, students will feel hesitant in using mathematical concepts to be applied to other mathematical concepts.
Figures 5 S3N1 (S3 Number 1) and Figure 6 (S3 Number 2) show that S3 wrote down what was known by rewriting the problem number 1 and illustrating the picture in the problem number 2 and writing down what was asked correctly. S3 strategizes by making image illustrations and providing symbols such as S1 and S2. Error F3 (False 3) indicates that it doesn't look back at what it knows, resulting in S3 not completing correctly. Another error is shown in F5 (False 5) that S3 incorrectly uses the add operation which should be subtracted, and S3 does not reflect back on the answer and does not write the correct conclusion indicated by F4 (False 4) and F6 (False 6).

Based on the results above, it can be seen that S3 has difficulties in adjusting strategies and often feels hopeless in solving problems so that the problems are not resolved properly. This agrees with [17] opinion that the low self-efficacy of students in mathematics is indicated by students not wanting to try more to do math problems and tend to give up more quickly when they get difficult assignments.

4. Conclusion
Based on the results of the research it can be concluded that students who have high self-efficacy are able to solve problems according to the indicators of mathematical problem-solving abilities compared to students who have moderate and low self-efficacy, because students with high self-efficacy are more able to face math problems and do not give up in meeting failure. Whereas students with moderate and low self-efficacy are able to solve problems but cannot meet the problem-solving ability indicators because they have doubts and give up easily in solving math problems.

References
[1] Dwiyogo W 2016 *J. New Horiz. Educ.* 6 121
[2] Siswono T Y E, Kohar A W, and Sartono H 2017 *J. Phys.: Conf. Ser.* 812 012046
[3] Setyadi T Y, Mardiyana, and Triyanto 2019 *AIP Conference Proceedings* 2194 020115
[4] Ellumbe M R 2017 *Int. J. Nov. Res. Educ. Learn.* 4 (5) 54
[5] Junaedi, I 2012 *Kreano* 3 (2) 125
[6] Riskiningtyas and Wangid M N 2019 *J. Phys.: Conf. Ser.* 1157 042067
[7] Hanifah, Waluya S B, Rochmad, Wardono 2020 *J. Phys. : Conf. Ser.* 1613 012062
[8] Vanhaltren C J 2016 *Int. J. Manag. Soc. Sci.* 4 (8) 145
[9] Benawa A 2018 *IOP Conf. Ser.* : Earth Environ. Sci. 126 012086
[10] Keşan C and Kaya D 2018 *Int. Online J. Educ. Sci.* 10 (2) 45
[11] Koyuncu İ, Guzeller C O, Akyuz D 2016 *Int. J. Assess. Tools Educ.* 4 (1) 19
[12] Azwar S 2016 *Penyusunan Skala Psikologi Edisi* 2 (Yogyakarta: Pustaka Pelajar)
[13] Amalia A, Syafitri L F, Sari V T A, and Rohaeti E E 2018 *J. Pembelajaran Mat. Inov.* 1 (5) 887
[14] Hassan A E H, Abdulaziz A, Eldood Y E A 2015 *Int J Educ Res* 3 283
[15] Wilde and Hsu 2019 *Int. J. Educ. Technol. High. Educ.* 16 (26) 1
[16] Ningrum H U 2020 *Unnes J. Math. Educ.* 9 (2) 139
[17] Toharudin U, Rahmat A, and Kurniawan I S 2019 *J. Phys.: Conf. Ser.* 1157 022074