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Increasing Middle School Students' Self-Efficacy in Solving Mathematics Learning Problems

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Abstract

This research aims to determine the level of students' self-efficacy in learning mathematics and determine the factors that influence their self-efficacy and mathematical problem solving abilities. The research method was descriptive qualitative, with 20 students as research subjects. Data was collected through questionnaires and observations and then analyzed using the Miles and Huberman model. The research showed that 20% of students had high self-efficacy, 60% moderate, and 20% low. Students with high self-efficacy are generally able to understand the context of the problem, determine the right strategy, and solve problems well. Students with moderate self-efficacy can understand the context of the problem but have difficulty solving it, while students with low self-efficacy have difficulty understanding and solving the problem. The implications of this research emphasize the importance of supportive teaching strategies, such as successful experiences, the use of models, positive feedback, and systematic problem-solving strategy training. Further research is recommended to use larger samples and experimental methods to evaluate the effectiveness of various interventions in increasing student self-efficacy.

INTRODUCTION

Mathematics learning is one of the subjects taught from elementary to middle school. However, many students still consider mathematics difficult and stressful (Siregar, 2017). This phenomenon is often seen when students face mathematical problems given by the teacher, which causes their inability to solve the issues well. Problem-solving ability is one of the five standards of mathematical ability that students must have, which includes the ability to reason, prove, communicate, connect, and represent (Siagan, 2016). However, the reality in the field shows that many students still need help solving mathematical problems, as evidenced by low test results, where many students get a score below 50 from the five questions. Students' self-efficacy or self-confidence plays an important role in mathematics learning outcomes. Students with low self-efficacy tend to give up when facing difficulties (Subaidi, 1993). Therefore, researchers suspect that students' low self-efficacy abilities may be the leading cause of difficulties in solving mathematical

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problems. Hence, this research explores the relationship between self-efficacy and mathematical problem-solving abilities in class VII B students at SMPN 2 Arjasa.

Based on previous research, such as Alifia and Rakhmawati (2018), high self-efficacy in students can improve their mathematical problem-solving abilities by creating a fun, active, and motivating learning atmosphere. Sari et al., (2018) found that although student learning outcomes were low on average, there was a positive relationship between self-efficacy and mathematics learning outcomes. Nur'Afianti et al., (2023) showed a significant increase in self-efficacy in students who used the Microsoft Mathematics application. Wiguna et al. (2022) emphasized that students' self-confidence in mathematics tasks prevents them from giving up easily. Pratiwi and Imami (2022) stated that students' self-efficacy is, on average, moderate, but some still need improvement. Marasabessy (2020) identified four primary sources of self-efficacy: problem-solving experience, other people's experiences, verbal persuasion, and psychological conditions. Hidayat and Taufiqurrahman (2022) found that the PBL model with a scientific approach was more effective in increasing students' self-efficacy and problem-solving abilities than conventional learning. This research examines the identification of student self-efficacy, the factors that influence it, and its relationship with mathematical problem-solving.

This research aims to identify the level of self-efficacy of class VII B students at SMPN 2 Arjasa in mathematics subjects, explore the factors that influence students' self-efficacy, and analyze the relationship between self-efficacy and these students' mathematical problem-solving abilities. Theoretically, this research is expected to add insight into the field of mathematics education, especially regarding the influence of self-efficacy on students' problem-solving abilities, as well as contribute to further research regarding the factors that influence self-efficacy and mathematical problem-solving abilities. Practically, this research is expected to provide useful information for teachers in developing learning strategies that can increase students' self-efficacy and problem-solving abilities, help students understand the importance of self-efficacy in the mathematics learning process so that it can motivate them to increase their self-confidence and solving abilities. problems, as well as providing data for schools to design learning programs that are more effective in improving students' self-efficacy and mathematics learning outcomes. In addition, it is hoped that this research will provide a basis for other researchers to conduct further studies related to self-efficacy and mathematical problem-solving, thereby contributing to the ongoing improvement of the quality of learning in mathematics education.

Based on the background that has been explained, this research proposes a hypothesis that a significant positive relationship exists between self-efficacy and mathematical problem-solving abilities in class VII B students at SMPN 2 Arjasa. This hypothesis is based on previous studies showing that high self-efficacy can improve mathematical problem-solving skills by creating a fun, active, and motivating learning atmosphere. In addition, students with high self-efficacy tend to have greater self-confidence when facing mathematics tasks so that they can solve problems well. In contrast, students with low self-efficacy tend to give up easily when faced with difficulties, contributing to their low math test results. Thus, this study aims to test the hypothesis that increasing students' self-efficacy can significantly improve their ability to solve mathematical problems.

RESEARCH METHODS

This qualitative and descriptive research aims to describe students' self-efficacy abilities. The research subjects were 20 students in class VII B of SMPN 2 Arjasa. The location of this research was at SMP Negeri 2 Arjasa. The variable studied is students' self-efficacy abilities (Creswell, 2013). Instruments used to assist data collection in the field include questionnaires and observations. Questionnaires are used to measure students' level of self-efficacy, while observations are carried out to see students' behavior and responses in the mathematics learning process (Sugiyono, 2018). Calculation of questionnaire scores is done with the help of the Excel application. The data analysis technique used in this research is qualitative data analysis following

the Miles and Huberman (1994) model, which includes three main stages: data collection, data reduction, and data presentation.

The data collection process involved distributing questionnaires to students and making direct observations during the learning process. The questionnaire, which students filled out based on a Likert scale, contained statements related to self-efficacy. Researchers, who maintained a high level of objectivity, observed how students' self-efficacy was reflected in their behavior when they faced mathematics problems (Fraenkel et al., 2012). The process of selecting, focusing, simplifying, and transforming rough data from written notes in the field was crucial. By eliminating irrelevant or unnecessary data, the research team ensured that only data important to the research objectives was retained. This process not only organized the data but also made it more accessible and understandable (Miles & Huberman, 1994).

Furthermore, the reduced data is presented as descriptive narratives, tables, or graphs to facilitate interpretation. The aim of presenting this data is to provide a clear picture of students' level of self-efficacy and the factors that influence it. The data is then analyzed further to conclude (Creswell & Poth, 2018). Using the Miles and Huberman data analysis model, this research is expected to provide a clear and in-depth picture of the self-efficacy of class VII B students at SMPN 2 Arjasa in learning mathematics. This technique allows researchers to identify patterns, themes, and relationships relevant to the variables studied so that the research results can make a meaningful contribution to improving the quality of mathematics learning.

RESULTS AND DISCUSSION

Increasing Student Self-Efficacy in Mathematics Learning

Research conducted shows that students' self-efficacy abilities vary greatly. The following explains how researchers identify the scores obtained by students regarding students' self-efficacy abilities at SMPN 2 Arjasa Jember. The score measurement criteria were modified from research conducted by Liufeto (2012). The determination of the self-efficacy score range used in this table was adapted from theory and previous research, which measured student self-efficacy using a Likert scale (Spector, 1992). These categories are adjusted to describe the level of student self-efficacy based on the distribution of scores obtained from the instruments used. This research is essential to understand variations in self-efficacy among students at SMPN 2 Arjasa Jember. A more critical analysis is needed to understand the factors influencing student self-efficacy. Through this analysis, researchers can better understand student self-efficacy at SMPN 2 Arjasa Jember and how to improve it. The following formula is used to determine the range of self-efficacy scores:

$$i = \frac{skor\ tertinggi - skor\ terendah}{banyaknya\ kategori}$$

$$i = \frac{115-23}{5}$$

$$i = 18{,}4$$

Based on the formula above, determining the level of self-efficacy abilities possessed by students at SMPN 2 Arjasa Jember can be seen from the range of scores in the table below:

Table 1. Measurement of Student Self-Efficacy

No	Score range	Category
1	$96{,}6 \leq x < 115$	Very high
2	$78{,}2 \leq x < 96{,}6$	Tall
3	$59{,}8 \leq x < 78{,}2$	Currently
4	$41{,}4 \leq x < 59{,}8$	Low

This table illustrates how students' self-efficacy scores are divided into four categories, ranging from very low to very high. Using these categories allows researchers to identify and

analyze students' self-efficacy levels distribution to provide more targeted recommendations to improve their self-efficacy and problem-solving abilities. This table was adapted based on existing research and theory to give a clear picture of the distribution of student self-efficacy at SMPN 2 Arjasa Jember. The following details the results of the 20 respondents who completed the research questionnaire.

Table 2. Data on Total Student Self-Efficacy Questionnaire Scores

No	Respondent	Total	Category
1	Respondent 1	66	Currently
2	Respondent 2	63	Currently
3	Respondent 3	79	Tall
4	Respondent 4	72	Currently
5	Respondent 5	74	Currently
6	Respondent 6	59	Low
7	Respondent 7	85	Tall
8	Respondent 8	62	Currently
9	Respondent 9	62	Currently
10	Respondent 10	69	Currently
11	Respondent 11	56	Low
12	Respondent 12	60	Currently
13	Respondent 13	75	Currently
14	Respondent 14	49	Low
15	Respondent 15	79	Tall
16	Respondent 16	67	Currently
17	Respondent 17	82	Tall
18	Respondent 18	77	Currently
19	Respondent 19	57	Low
20	Respondent 20	77	Currently

Based on the results of the self-efficacy data analysis of class VII B students at SMPN 2 Arjasa, it can be described as follows: Distribution of Self-Efficacy Scores, namely: 1) Very Low (23 - 41.4): There are no students who fall into this category. 2) Low (41.5 - 59.8): 4 students are in the low category. 3) Medium (59.9 - 78.2): Most students, namely 12, are in the medium category. 4) High (78.3 - 96.6): 4 students fall into the high category. 5) Very High (96.7 - 115): No students fall into this category. Most students (60%) are in the medium category regarding self-efficacy. A small number of students (20%) are in the low category and require special attention. A small percentage of students (20%) are in the high category, showing good self-confidence in solving mathematical problems. This data indicates that although most students have moderate self-efficacy, there is a need to increase self-efficacy for students in the low category to be more confident in solving mathematical problems. Students in the high category show good potential and can be examples for other students.

Several effective strategies can be implemented to increase students' low self-efficacy. First, providing successful experiences is very important in building students' self-confidence. Teachers can give assignments that are challenging but still achievable for students so that they can feel successful. Start with more straightforward tasks and increase their difficulty gradually as students' abilities improve (Bandura, 1997; Pajares, 2002). Second, the use of relevant models is also beneficial. Teachers can show examples or models of other students who have successfully overcome mathematical challenges with great effort. Peer tutoring programs, in which more confident students help students with lower self-efficacy, can be very effective (Schunk, 1987; Schunk & Pajares, 2010).

Third, providing regular positive feedback is critical to student progress. Constructive feedback and praise for small efforts and progress can encourage students to keep trying and not give up easily. Research shows detailed and positive feedback, which emphasizes progress toward goals, can increase student self-efficacy (Hattie & Timperley, 2007; Pajares, 2019). Fourth, involving students in goal setting and providing meaningful feedback can also increase self-efficacy. Inviting students to set specific and realistic goals and providing instructions on how to achieve them will make them feel more confident in their abilities. Fifth, teaching students to use self-assessment can help them understand what they are learning and what needs to be improved. Through self-reflection, students can see their progress and identify areas that require further attention (Pajares, 2019). By implementing these strategies, students' low self-efficacy can be significantly improved, improving their ability to solve mathematical problems.

The Influence of Self-Efficacy in Mathematics Learning

Self-efficacy is a person's belief in their ability to complete a task or achieve specific goals. According to Bandura, four main factors influence student self-efficacy (Subaidi, 1993). Several essential things need to be done in learning mathematics in educational institutions. First, the experience of success or failure in doing something. Someone who has experienced success tends to have high self-efficacy, while failure can reduce a person's self-efficacy. Second is the influence of vicarious experience, namely, seeing others succeed or fail in a task. If someone sees other people with comparable abilities succeed, their self-efficacy will increase, and vice versa if they see failure (Bandura, 1997). Third, verbal persuasion, namely, information or encouragement from other people regarding a person's abilities. Positive comments and support can increase a person's self-efficacy. Fourth, physical and emotional condition. Physical conditions, such as fatigue or illness, and emotional conditions, such as stress or anger, can affect self-efficacy. Adverse conditions tend to reduce self-efficacy, while favorable conditions can increase it.

Self-efficacy is very influential in the student learning process at SMPN 2 Arjasa Jember. According to Bandura and Pariani (2019), self-efficacy influences one's actions, efforts, persistence, adjustment, and realizing one's goals. High self-efficacy can help someone make decisions, act, survive, and adapt to various activities. Self-efficacy also influences how a person regulates their thought patterns and emotions (Pariani, 2019). In mathematics learning, self-efficacy plays a vital role in problem-solving. Mathematics learning cannot be separated from problem-solving activities because by solving problems, students can apply the basic facts, concepts, and procedures they have learned. The problem-solving process requires students to dig up information and demonstrate critical thinking skills, from understanding problems, planning strategies, and implementing plans to evaluating results (Haryani, 2011). These problem-solving indicators show the importance of self-efficacy in the success of learning mathematics.

The Relationship between Student Self-Efficacy and Mathematical Problem Solving

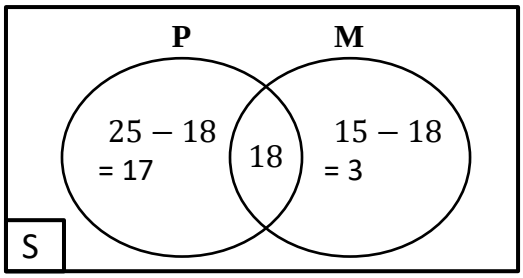
Apart from indicators regarding problem-solving, another factor in determining whether a person is successful when solving a problem is confidence in oneself because if someone feels confident, then that person will try their best to achieve something they want. According to research by Stefy Valentino Akuba et al. in 2020, students' self-efficacy or self-efficacy positively influences their mastery of concepts in mathematics lessons. (Akuba et al., 2020) Mastery of mathematical concepts will later help students determine strategies that will be used to solve a given problem. Below, the researcher will explain the results of solving mathematical problems for students at SMPN 2 Arjasa Jember with high and low levels of self-efficacy. The problem given is in the form of a one-story item on set material; this is done because the material being taught in class is set material.

Respondent	Description of Mathematical Problem-Solving Ability
Respondent 3	Students still do not meet all the problem-solving indicators. The problem given has not been solved, and students still do not know the information on the problem.

Respondent 7	Students can find the information on the problem, but they still need help to solve the problem given.
Respondent 15	Students are still unable to solve the problems given by researchers, and it could be said that they have not met all the indicators for solving mathematical problems.
Respondent 17	Students are able to dig up information from the problems given by researchers and even solve them.

The following are the results of solving mathematics problems by students at SMPN 2 Arjasa Jember with high self-efficacy abilities.

Results of completion by respondent 17



$P = 25$

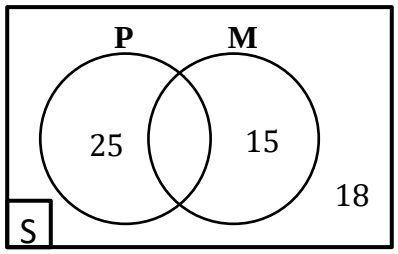
$M = 15$

$P \cap M = 18$

$n(P \cup M) = 50 - 58 = \mathbf{8}$

The problem-solving carried out by respondent 17 shows a good understanding of using Venn diagrams in mathematics. Respondent 17 substituted the information in the problem into a Venn diagram and then used this information to process the data and find the results of the questions given correctly and accurately. This process shows good analytical and problem-solving skills, where respondents can visualize the relationship between data in a Venn diagram and use this visualization to solve problems effectively. In mathematics learning, the ability to use visual aids such as Venn diagrams is essential. Visual aids can help students understand abstract concepts better and develop more effective problem-solving strategies (Ferrer & Corres, 2022). In addition, the ability to process information and present it in an organized form also indicates a high level of self-efficacy because students who are confident in their abilities tend to be more successful in completing complex tasks (Bandura, 1997; Schunk, 1987).

The results of resolving respondent 7's problem are as follows



The answer given by Respondent 7 shows that students at SMPN 2 Arjasa Jember have succeeded in finding and substituting the information in the problem into a Venn diagram. This indicates that students have a basic understanding of organizing information visually, which is an essential step in solving mathematical problems. Venn diagrams help visualize the relationships between data sets and facilitate analysis. However, even though Respondent 7 succeeded in organizing the information well, they failed to solve the problem as a whole. This shows that even though the initial stage of problem-solving is carried out correctly, there are difficulties in the subsequent steps, namely the analysis and interpretation of the results of the Venn diagram to answer the questions given.

Respondent 7 demonstrated an excellent conceptual understanding of using Venn diagrams to organize information but needed more procedural knowledge to apply that information to concrete solutions. This difficulty often occurs when students understand concepts theoretically but need

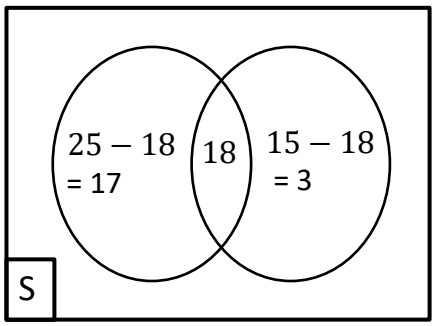
help using them in real contexts (Schunk, 1987). In addition, students' limited self-efficacy or confidence in their ability to solve problems can also influence the final results. Students who feel unsure or anxious may quit before solving the problem (Bandura, 1997). Increasing self-efficacy can be achieved through successful experiences, model observations, and verbal support. Respondents may also need more training in problem-solving strategies, such as breaking problems into smaller parts and using systematic steps to reach solutions (Hattie & Timperley, 2007). To improve students' problem-solving abilities like Respondent 7, it is essential to provide more structured practice using Venn diagrams and other problem-solving strategies. Additionally, teachers must give constructive feedback and build students' confidence in their ability to solve math problems.

Furthermore, the results of students' mathematical problem solving at SMPN 2 Arjasa Jember who have low levels of self-efficacy abilities.

Respondent	**Description of Mathematical Problem-Solving Ability**
Respondent 6	Students still need to be more accurate in obtaining the information; the answers on the problem sheet must be in sync with the strategy used.
Respondent 11	Students still need help finding the information on the problem given. The answers written by students are separate from the strategies used. The answers given by students still needed to be corrected.
Respondent 14	Students are still unable to explore the information available on the problems given, and they do not meet the indicators for solving mathematical problems.
Respondent 19	Students still need help to solve the problems given.

The following are the results of solving mathematics problems by students who have low self-efficacy abilities.

Results of completion by respondent 17



$n(A \cup B)$

$P = 25$

$M = 15$

$P \cap M = 18$

$58 - 50 = 8$

The answer given by Respondent 17 showed that they could substitute existing information into a Venn diagram, but the steps taken to solve it needed to be clarified. Nevertheless, Respondent 17 managed to answer the question correctly. This shows that although there are areas for improvement in the problem-solving process or strategy, Respondent 17's conceptual understanding is strong enough to reach the correct answer. Respondent 17's lack of clarity in completion steps may be due to good intuitive knowledge but needing help explaining or documenting their steps. This could be caused by a need for mathematical communication skills or practice in documenting the problem-solving process (Schunk, 1987). However, the accuracy of the answers shows a high level of understanding of the material. This aligns with Bandura's theory (1997), which states that high self-efficacy can help students stay focused and persistent in completing tasks even when they face challenges.

Students need to learn and practice systematic problem-solving strategies to increase the clarity of solution steps. Hattie and Timperley (2007) emphasize that good feedback and structured practice can help students develop these skills. Respondent 17's success in answering correctly may be influenced by high self-efficacy, even though the steps were unclear. According to The

Education, high self-confidence allows students to remain motivated and persistent in solving problems, even when unsure of each step. From the explanation of the results of solving student problems above and the importance of self-efficacy, it is hoped that teachers will be able to create a pleasant learning atmosphere, activate and develop self-confidence, and always provide good motivation. Researchers suggest that educators train students more often with systematic problem-solving strategies and provide constructive feedback to increase student self-efficacy.

CONCLUSION

Research that has been conducted shows variations in the level of self-efficacy among class VII B students at SMPN 2 Arjasa. There were four students with high self-efficacy, 12 with moderate self-efficacy, and 4 with low self-efficacy. Students' problem-solving abilities also vary according to their level of self-efficacy. Students with high self-efficacy are generally able to understand the context of the problem, determine the right strategy, and solve problems well. On the other hand, students with moderate self-efficacy can understand the context of the problem but need help solving the problem well. Students with low self-efficacy need help understanding the context of the problem and cannot solve the given problem.

This research has significant theoretical and practical implications. Theoretically, the finding that self-efficacy is strongly correlated with problem-solving abilities strengthens Bandura's theory about the importance of self-efficacy in academic achievement. It expands understanding of its influence on mathematics learning. Practically, this research guides teachers to increase student self-efficacy through supportive teaching strategies, such as giving successful experiences, using relevant models, and providing constructive positive feedback. Implementing systematic problem-solving strategies and structured training is also recommended to help students develop the skills necessary to solve mathematical problems, which is expected to increase their self-confidence and academic achievement.

Recommendations for further research could expand these findings in several ways. First, quantitative research with larger samples can provide higher validity and allow broader generalizations regarding the relationship between self-efficacy and mathematical problem-solving abilities. Second, experimental research can be conducted to evaluate the effectiveness of various interventions designed to increase student self-efficacy, such as using role models, providing positive feedback, and systematic problem-solving strategy training.

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