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Analysis of Students' Ability to Solve Mathematical Literacy Problems in terms of Mathematical Self-efficacy

Fifi Khairun Nisa [1], Elly Arliani [2]

[1, 2]Departement of Mathematics Education, Universitas Negeri Yogyakarta, Jl.Colombo 1 Yogyakarta, Indonesia

* Correspondence: [1]fifi0041pasca.2020@student.uny.ac.id, [2]arlianielly@uny.ac.id

Abstract

This research is a survey research with qualitative and quantitative approaches. This study also aims to describe the ability of grade VIII Junior High School students at D.I.Yogyakarta in solve mathematical literacy problems in terms of students' mathematical self-efficacy. The results of this study indicate that the ability of grade VIII Junior High School students in D.I.Yogyakarta in solve mathematical literacy problems is in a low category and the mathematical self-efficacy of grade VIII Junior High School in D.I.Yogyakarta in solve mathematical literacy problems is in the medium category. Students' average mathematical literacy is correlated with their average level of mathematical self-efficacy. Therefore, the higher the students' mathematical self-efficacy, the higher the students' ability to solve mathematical literacy problems. Students with high self-efficacy also tend not to give up easily when faced with difficult questions, and maximum effort because they have confidence that they can solve mathematical literacy problems. Students with medium self-efficacy tend not to give up easily in solving mathematical literacy problems, but they doubt their abilities when facing difficult mathematical literacy problems. Students with low self-efficacy tend to give up easily when faced with difficult questions and are not confident that they can solve them because they consider themselves lacking in their mathematical abilities.

Keywords: Mathematical Literacy; Mathematical Self-efficacy.

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Introduction

Literacy in mathematics is essential (Sunisa et al., 2017). One of life skills is mathematical literacy, which occupies a significant position. One of the primary goals of school instruction was mathematical literacy (Steen et al., 2007). The goal of teaching mathematics in schools was to give students the ability to use and observe mathematical knowledge in real-world situations outside of school.

According to the OECD (OECD, 2012), "mathematical literacy" refers to a person's capacity to identify and comprehend the role that mathematics plays in the world, to make sound judgments, and to engage mathematics in a manner that meets the needs of the individual's current and future life as constructive, caring, compassionate citizens. A person's mathematical literacy, as defined by the Organization for Economic Cooperation and Development (OECD), is their capacity to formulate, apply, and interpret mathematical concepts in a variety of contexts. Mathematical modeling, specifically the capacity to formulate mathematical models, employ knowledge and skills to work on models, and interpret and evaluate results, are closely related to mathematical literacy (Kaye S & Ross T., 2015).

The components of the assessment in mathematical literacy are referred to as the domain of mathematical literacy. Mathematical literacy has 3 domains, namely: context domain includes personal, education/occupational, societal, and scientific; the content domain is quantity, space & shape, change & relationships, and uncertainty; and domain processes include formulate, employ, and interpret (OECD, 2003).

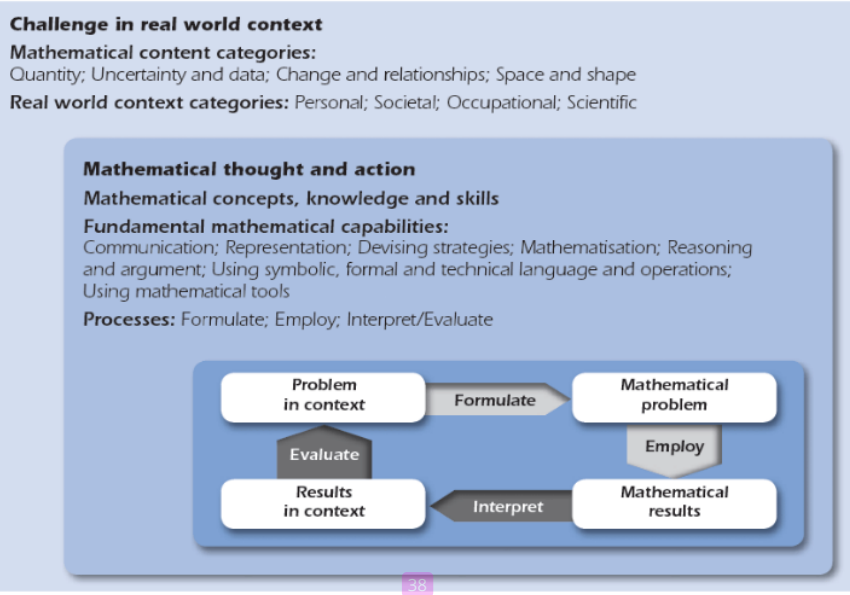

Figure 1. Domain Mathematical Literacy

The process of solve mathematical literacy problems requires a mathematization process is formulate, employ, and interpret/evaluate. PISA views the mathematization process as a process of translating real everyday problems into mathematical models until the process of solving the problem. The mathematization process begins with: problems that exist in the

real world, (1) the problem is formulated into a mathematical problem in the form of a mathematical model, (2) the mathematical model that has been formed is then solved using a mathematical formula and produces a soluation or problem-solving mathematics, and (3) the solutions that have been found are reinterpreted into real problems. The mathematization process is used as a reference in the process of solving mathematical literacy problems. This makes it easier for students to solve mathematical literacy problems because it is structured and systematic.

Even though the importance of mathematics instructional organization has been recognized, there are some problems found in terms of learning mathematics regarding the results of mathematics literacy tests, both nationally and internationally. Some of the national issues are that students forget their prior knowledge of mathematics. They cannot remember, understand, or realize the importance of mathematical knowledge. They also believe that mathematics is not related to their daily life and cannot apply it to their real life (Plangprasobchoke et al., 2008).

As for the international issue, namely the achievement of Indonesia students' mathematics scores is far below the international average (score 500). In 2000, the achievement of mathematical literacy of Indonesia students was ranked 39 out of 41 participating countries. The achievement of students' mathematical literacy remained low at the PISA held in 2003, which was ranked 38 out of the countries, and ranked 50 out of 57 participating countries in 2006 (Puspendik, 2013a). Furthermore, in PISA 2012 the achievement of mathematical literacy of Indonesia students declined to rank 64 out of 65 countries. As a comparison, Vietnam's student literacy achievement was significantly better than Indonesia in PISA 2012. The average score of Indonesia students' mathematics achievement was 375 points, while Vietnam reached 511 points or ranked 17th out of 65 countries (OECD, 2013). These results indicate that the mathematical literacy of students in Indonesia based on international studies is still not satisfactory.

Self-efficacy in mathematics is another factor that affects how well one learns mathematics. Mathematical self-efficacy is defined as the belief in one's ability to complete mathematical tasks (Wolfram S, 2005). Self-efficacy, as defined by Bandura (Bandura, 1997), is the belief that one is capable of planning and carrying out the actions required to achieve specific goals. Line and Bandura (Frank & David, 1995) define mathematical self-efficacy as a person's belief in his or her capacity to successfully complete or perform mathematical tasks or problems. It is possible to say that mathematical self-efficacy is one of the important factors in learning mathematics, particularly mathematical literacy. A person's high mathematical self-efficacy can encourage learning success. Students who have high levels of self-efficacy are more likely to set higher goals, have less of a fear of failing, and develop new strategies when they do fail (Anita W, 2016).

The study's findings explain the connection between mathematical literacy and mathematical self-efficacy (Kurniawati & Ali M, 2019). The students' mathematical self-efficacy in solving mathematical literacy problems in defined as students' self-confidence in solving mathematical literacy problems without comparing with the abilities of others to achieve success in Mathematics learning achievements accompanied by a sense of confidence in the efforts made, the choices that have been determined, and having perseverance.

Mathematical self-efficacy has dimensions that affect a person's performance. Bandura (Bandura A, 1997) divides self-efficacy into three dimensions: level/magnitude, generality, and strength. Each of these self-efficacy dimensions is made indicator. The indicator for the level/magnitude dimension is the belief in the ability to be able to solve mathematical literacy problems with different levels of difficulty. The indicator for the generality dimension is the belief in solving mathematical literacy problems in various situations. Furthermore, indicators for strength are persistent, diligent, and tenacious in solving the given mathematical literacy questions, and believe that the efforts that have been made have a positive impact.

Mapping literacy skills in Indonesia has been carried out in several areas, in various junior high schools and senior high schools. Like the mapping of mathematical literacy skills carried out by Mahdiansyah & Rahmawati (Mahdiansyah & Rahmawati, 2014) in senior high schools in several areas and carried out by Muhazir et al. (Muhazir et al., 2019) in senior high schools in Banjarmasin. Meanwhile, research on mapping mathematical literacy skills throughout D.I.Yogyakarta is mostly carried out at the senior high school level. Similar to the study by Sari and Wijaya (Sari & Wijaya, 2017), which mapped senior high school mathematical literacy in DIY and found that Yogyakarta's senior high school students fell into the very low category for mathematical literacy. Meanwhile, there is no mapping of mathematical literacy in all junior high schools in D.I.Yogyakarta. Considering starting in 2022 at the junior high school level, there will be an Assessment Literacy and Numeracy (ALN) which is held in all public junior high schools in DIY from grades VII-IX of junior high school regularly every year. The assessment was conducted to determine the ability of students from each state junior high school in D.I.Yogyakarta, which would be averaged for each school.

Based on the description above, and considering that there is no mapping of the ability to solve mathematical literacy problems and students' mathematical self-efficacy, especially in all junior high schools in D.I.Yogyakarta. Considering this, this study aims to describe the student's ability to solve mathematical literacy problems in terms of the mathematical self-efficacy of students grade VIII students of SMP D.I.Yogyakarta.

Methods

This research is a survey research with qualitative and quantitative approaches. This study also aims to describe the ability of grade VIII Junior High School students in D.I.Yogyakarta in solving mathematical literacy problems in terms of students' mathematical self-efficacy. Students at a public junior high school in D.I. Yogyakarta (DIY) served as the study's subjects. There are 213 state-run junior high schools in Yogyakarta. This study's population consisted entirely of eighth-grade students attending state junior high schools in DIY. After classifying schools into A (high), B (medium), and C (low) according to the ASPD (Assessment Standard Pendidikan Daerah) value for junior high schools in DIY in 2021, a sample was taken using stratified random sampling. There are 46 state schools in DIY with category A, 75 schools with category B, and 92 schools with category C. The schools from each category in each district in DIY are 5 districts, so a total of 15 public schools in DIY are taken, with 1 pilot school, and 14 sample schools. Based on the calculations obtained 3 samples of category A schools, 5 samples from schools of category B, and 6 samples of schools from category C.

Tests are used in this study to collect data.The purpose of the test instrument is to assess students' ability to solve problems related to mathematical literacy. The test instrument used to measure the ability to solve mathematical literacy prolems is in the form of multiple choice questions that include three process components in mathematical literacy, namely formulate, employ, and interpret. The mathematical literacy questions will be made in several contexts, namely personal, societal, scientific, and occupational. In addition, the distribution of mathematical content used in the problem in space & shape, uncertainty & data, change & relationship, and quantity.

The mathematical self-efficacy questionnaire is the next tool, and it measures a student's level of confidence in their ability to solve mathematical literacy problems. Positive and negative statements are included in the instrument. The Likert scale with five points is the scale model used in this study. According to Kurniawati and Ali M (Kurniawati & Ali M, 2019), self-efficacy is broken down into three dimensions: strength, generality, and level/magnitude. The Bandura dimension is used to organize the indicators that are used in this instrument to measure the level of mathematical self-efficacy (Bandura A, 1997).

Interviews were conducted to gain a deeper understanding of students' abilities to respond to mathematical literacy questions in terms of their mathematical self-efficacy. The students who were asked had a level of mathematical self-efficacy that was either high, medium, or low. The format of the questions also aims to confirm the results of students with high, medium, or low mathematical self-efficacy.

A predetermined scoring rubric was used to score the data derived from students' test response results. Additionally, based on the problem's formulation, data analysis was performed on the data. This study employed quantitative data analysis with descriptive statistics as the method of data analysis. When converting quantitative data to qualitative data, use the ideal mean and an ideal standard deviation to determine the criteria for the measurement results. Descriptive statistics, such as the mean, standard deviation, maximum and minimum scores, were used to describe the data. By triangulating the results of questionnaires, tests, and student interviews, data on students' mathematical self-efficacy and their ability to solve math literacy problems were also strengthened.

Results

1. Students' Ability to Solve Mathematical Literacy Problems

The results of the analysis of the ability of Junior High School VIII graders in D.I.Yogyakarta in solving mathematical literacy problems showed an average score of 34,53, a standard deviation of 14,08, and only 1% of the total achieved the KKM. In general, 99% of them are a low category, and 1% are the high category. The conclusion that can be drawn from the analysis findings is that the ability of students Junior High School grade VIII at D.I.Yogyakarta in solve mathematical literacy problems is a low category. Table 1 and figure 2 provide descriptions of students' abilities to solve mathematical literacy problems across all strata.

Table 1. Description of Students' Ability in Solve Mathematical Literacy Problems in General and Based on Schools Strata

Descriptive Statistic	School Strata			General
	A	B	C	
Average	48,85	34,66	27,38	34,53
Standard Deviation	15,60	11,87	8,67	14,08
Score ≥ 75	5%	1%	0%	1%
Score < 75	95%	99%	100%	99%
Ideal Highest Score	100	100	100	100
Highest Score	79,17	75	50	79,17
Ideal Lowest Value	0	0	0	0
Lowest Score	16,67	8,33	8,33	8,33
Total Students	91	160	185	436

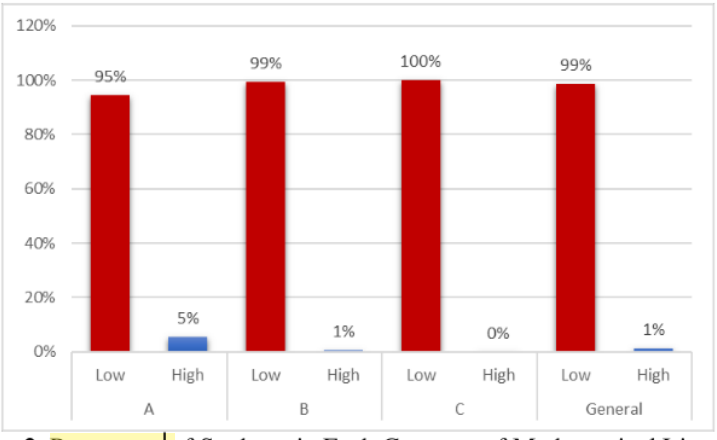

Figure 2. Percentage of Students in Each Category of Mathematical Literacy

If viewed based on schools strata, from table 1 and figure 2 can be seen that students in grade schools have an average of 48,85, with 95% (low category) and 5% (high category); students in grade B schools have an average of 34,66, with 99% (low category) and 1% (high category); and students in grade C schools have an average of 27,38, with 100% of students in the low category.

2. Students' Mathematical Self-efficacy to Solve Mathematical Literacy Problems

The analysis of the mathematical self-efficacy of grade VIII students at D.I. Yogyakarta Junior High School revealed an average score of 75,74 and a standard deviation of 11,47 from the overall results for students. In general, 16% of students have a high level of mathematical self-efficacy when to solving mathematical literacy problems, 14% have a low level, and 70% have a medium level. The analysis shows that the grade VIII students at D.I. Yogyakarta Junior High School have a medium level of mathematical self-efficacy when it comes to solving math literacy problems. The description of mathematical self-efficacy to solve mathematical literacy problems as a whole and based on strata table 2 and figure 3 below.

Table 2. Description of Students in General Mathematical Self-efficacy and Based on School Strata

Descriptive Statistic	School Strata			General
	A	B	C	
Average	80,23	72,79	76,09	75,74
Standard Deviation	9,83	11,51	11,48	11,47
Ideal Highest Score	120	120	120	120
Highest Score	105	120	115	120
Ideal Lowest Value	1	1	1	1
Lowest Score	60	48	45	45
Total Students	91	160	185	436

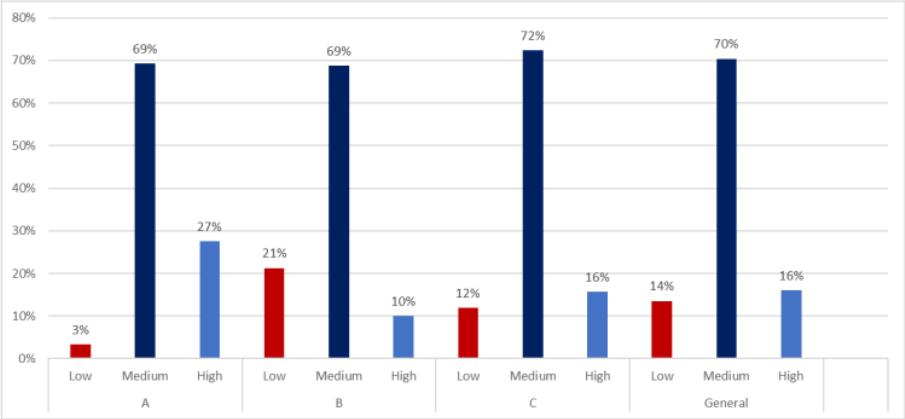

Figure 3. Percentage of Students in Each Category of Self-efficacy Mathematics

If viewed based on schools strata, from table 2 and figure 3 it can be observed that students in grade A schools have an average of 80,23 (medium category), with a medium percentage of 69%; students in grade B schools have an average of 72,79 (medium category), with a medium percentage of 69%; and students in grade C schools have an average of 76,09 (medium category), with a medium percentage of 72%. Based on these observations, it can be concluded that students in the A schools strata possess the highest level of mathematical self-efficacy.

3. Students' Ability to Solve Mathematical Literacy Problems in Terms of Students' Mathematical Self-efficacy

Students in grade VIII of the Junior High School in D.I.Yogyakarta have an average level of high mathematical self-efficacy (94,31), medium mathematical self-efficacy (74,57), and low mathematical self-efficacy (57,28) when it comes to solving problems related to mathematical literacy. Table 3 provides additional information about the average category of students' mathematical self-efficacy.

Table 3. Description of The Average Category of Mathematical Self-efficacy with Mathematical Literacy

Level of mathematical self-efficacy	Descriptive Statistic	Mathematical Self-efficacy	Mathematical Literacy
High mathematical self-efficacy	Average	94,31	42,20
	N	70	70
	Std. Deviation	6,74	16,68
Medium mathematical self-efficacy	Average	74,57	33,55
	N	316	316
	Std. Deviation	6,00	13,56
Low mathematical self-efficacy	Average	57,28	30,00
	N	50	50
	Std. Deviation	5,15	8,62

From table 3 it can be seen that students who have high mathematical self-efficacy have an average mathematical literacy of 42,40, students who have medium mathematical self-efficacy have an average mathematical literacy of 33,55, and students who have low mathematical self-efficacy have an average mathematical literacy is 30,00. The higher the average mathematical self-efficacy of students, the higher the average mathematical literacy of students. From some of these things, it can be concluded that the higher the students' mathematical self-efficacy, the higher the students' ability to solve mathematical literacy problems.

It is supported by interviews with student representatives regarding the level of mathematical self-efficacy at each high, medium, and low school, in addition to the results of the mathematical literacy test. More information about students' abilities to solve mathematical literacy problems is gleaned from interviews with representatives of students with high, medium, and low mathematical self-efficacy. From the triangulation of the results of the questionnaire, test results, and student interviews, data were obtained about students' abilities in solving mathematical literacy problems in terms of students' mathematical self-efficacy levels. Based on the results of research and discussion of students' abilities in solving mathematical literacy problems in terms of students' mathematical self-efficacy levels, it can be concluded as follows :

a. **Students Who Have High Self-efficacy in Solve Mathematical Literacy Problems**
   Because they are able to involve the mathematization process, students whose self-efficacy in solving mathematical literacy related problems is high can successfully complete the stages of the process of solving problems related to mathematical literacy, specifically the formulate, employ, and interpret stages. At the formulate stage students can make mathematical models by connecting facts and concepts; able to determine the systematics of problem-solving; be aware of the process and results of thinking in identifying information that is known as a source for solving problems; able to identify the real problem being asked so that they are aware of the direction and purpose in solving the problem; and able to design problem-solving plans based on the basics in identifying possible ways, strategies, formulas, or other information that can be used to

solve problems. At the employ, stage students can determine the relationship between concepts in solving problems; able to be aware of the process and results of their thinking in choosing and using strategies to solve mathematical literacy problems, and able to monitor the correctness of the steps in solve these mathematical literacy problems. While at the interpretation stage students can interpret real problems to solve problems. Because they are confident that they can solve problems related to mathematical literacy, students with high self-efficacy also have a tendency not to give up easily when confronted with challenging questions, have effective time management, and put in maximum effort.

b. Students Who Have Medium Self-efficacy in Solve Mathematical Literacy Problems

Students with medium level of self-efficacy in solving problems related to mathematical literacy tend to be able to complete the stages of the process of solving problems related to mathematical literacy, namely formulate, employ, and interpret strategies, but they are not at their best because they are not fully involved in the mathematicalization process. At the formulation stage students are still confused and not right in making mathematical models from connecting facts and concepts; the subject can realize the process and results of his thinking in identifying information that is known as a source to solve the problem, but has not been able to realize his thinking process in identifying the problem that is being asked so that it does not focus on the core of the problem; and unable to devise a plan or strategy for completion. At the employ stage, students are not right in determining the relationship between concepts in solve problems; students are not able to realize the process and results of their thinking in choosing and using strategies to solve mathematical literacy problems, so they are not aware of mistakes made that cause the results to be inaccurate. Meanwhile, at the interpreting stage, students are less precise in interpreting real problems to solve problems. Students with medium self-efficacy tend not to give up easily in solve mathematical literacy problems they face, but they doubt their abilities when facing difficult mathematical literacy problems.

c. Students Who Have Low Self-efficacy in Solve Mathematical Literacy Problems.

Because they don't carry out the mathematization process well, students who have low self-efficacy in solving mathematical literacy problems typically are unable to complete the stages of the mathematical literacy problem-solving process, specifically at the formulate, employ, and interpret stages. At the formulate stage students are not able to make mathematical models by connecting facts and concepts; students are less able to identify known information and are less aware of their thinking processes in identifying the problems that are being asked so they are not able to design a strategy for solving the problem because they are not aware of the purpose of solving the problem. At the employ stage students are not able to determine the relationship between concepts in solve problems; students are not able to realize the process and results of their thinking in choosing and using strategies and monitoring the correctness of the steps in solving mathematical literacy problems used because they do not know well when formula and procedure take place and have doubts about the calculations carried out. Meanwhile, at the interpreting stage, students are not able to interpret real problems to solve problems.

Students with low self-efficacy frequently give up when confronted with challenging questions and lack confidence in their ability to solve them because they believe they lack mathematical skills.

Discussion

The study's findings revealed grade VIII students' abilities of SMP Negeri D.I.Yogyakarta in solving mathematical literacy questions was in a low category. Students who have the highest mathematical literacy ability, only 5% of the total students, are in high strata (A) schools. There are only 1% of strata B schools in the highest category of students' ability to solve math literacy problems, and at C strata schools there are no students who can solve math literacy problems with a high category. That school level characteristics affect academic achievement (Bohlmann C & Pretorius E, 2008) (Chowa et al., 2015). This should get the attention of the government, teachers, and researchers. Students' mathematical literacy skills must be supported by the quality of mathematics instruction, which includes the process of planning, implementing, and evaluating learning outcomes. Students' abilities are influenced by school quality (Chowa et al., 2015). The most important factor in raising student achievement in mathematical literacy is the quality of instruction (Retnawati et al.,2018). Literacy can be integrated into the mathematics learning process, as well as into other subjects, to improve the quality of learning and learning assessment (Hilman A, 2014). Jailani, Sugiman, and Apino (Jailani et al.,2017) suggest that the teaching and learning process should incorporate a variety of contexts. Apino & Retnawati (Apino & Retnawati, 2017) also recommend that mathematics education programs be developed to assist students in making connections to real-world situations. Students may find it simpler to comprehend and solve real-world mathematical literacy problems as a result of this.

According to the OECD (OECD, 2016), mathematical self-efficacy aids students in developing their ability to solve mathematical problems. Also known as mathematical self-efficacy, problem-solving skills are a component of mathematical literacy. In addition, a student's mathematical self-efficacy is measured by how well they solve math problems or do well on math tests (Barcha K & Nava M., 2004). The students' mathematical self-efficacy in solving mathematical literacy problems in grade VIII SMP in D.I. Yogyakarta was found to be medium in this study. Overall, students have a fair amount of self-assurance, which includes being tough and tenacious when faced with challenges and having faith in their ability to learn mathematics.

Conclusion

Based on the research and discussion, it can be concluded grade VIII students at SMP D.I. Yogyakarta have a medium level of mathematical self-efficacy when it comes to solving mathematical literacy problems. Students' average mathematical literacy is correlated with their average level of mathematical self-efficacy. As a result, students' ability to solve math literacy problems is correlated with their level of mathematical self-efficacy. Students who have high levels of self-efficacy are more likely to persevere through challenging questions, manage their

time effectively, and put in maximum effort because they are confident that they can solve problems related to mathematical literacy. Students who have a medium level of self-efficacy are less likely to give up when faced with difficult math literacy questions, but they do doubt their abilities to solve them because they believe they lack the mathematical skills to do so. On the other hand, students who have a low level of self-efficacy are more likely to give up when confronted with difficult math literacy questions.

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Conflicts of Interest

In relation to the publication of this manuscript, the authors declare that there is no conflict of interest. In addition, the ethical issues, including plagiarism, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies, have been completed by the authors.

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PAGE 1

PAGE 2

Article Error You may need to use an article before this word. Consider using the article **the**.

Proofread This part of the sentence contains an error or misspelling that makes your meaning unclear.

Verb This verb may be incorrect. Proofread the sentence to make sure you have used the correct form of the verb.

PAGE 3

Missing "," Review the rules for using punctuation marks.

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Prep. You may be using the wrong preposition.

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Article Error You may need to remove this article.

Wrong Article You may have used the wrong article or pronoun. Proofread the sentence to make sure that the article or pronoun agrees with the word it describes.

PAGE 5

Article Error You may need to remove this article.

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P/V You have used the passive voice in this sentence. You may want to revise it using the active voice.

Article Error You may need to use an article before this word. Consider using the article **the**.

Word Error Did you type **the** instead of **they**, or have you left out a word?

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