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Students' Mathematical Literacy Ability in Terms of Self Efficacy Through Problem Based Learning with PMRI Approach

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Abstract

This research aims to (1) find out whether mathematical literacy through Problem-Based Learning with PMRI Approach (PBL-PMRI) achieves Actual Completion Limit (ACL); (2) find out whether mathematical literacy through PBL-PMRI is classically complete; (3) to find out whether the average and proportion of mathematical literacy through PBL-PMRI is more than the average and proportion of mathematical literacy through PBL; (4) knowing whether students' self-efficacy influences mathematical literacy through PBL-PMRI; (5) describe mathematical literacy through PBL-PMRI based on students' self-efficacy. The research method used is a mixed method with a sequential explanatory design. Sampling in this research with cluster random sampling. While taking the subject with purposive sampling. The results of this research are: (1) mathematical literacy through PBL learning with the PMRI approach achieves Actual Completion Limit (ACL); (2) mathematical literacy through PBL-PMRI learning achieves classical mastery; (3) the average and proportion of students' mathematical literacy through PBL-PMRI are more than the average and proportion of mathematical literacy through PBL; (4) self-efficacy affects mathematical literacy through PBL-PMRI; (5) description of students' mathematical literacy with categories: (a) self-efficacy on fulfilling the four indicators; (b) self-efficacy is in the moderate of fulfilling 3 indicators and tends not to fulfill 1 indicator; (c) lower self-efficacy tends to fulfill 2 indicators, tends not to fulfill 1 indicator, and does not fulfill 1 indicator.

1. Introduction

Education is one of the important things in the progress of the nation and something that must be obtained for humans in order to realize a dignified nation. The better the quality of education of a nation, the better the quality of the nation. One of the subjects that must be studied in formal education in Indonesia since elementary school is mathematics. In accordance with the Law of the Republic of Indonesia No. 20 of 2003 concerning the National Education System Article 37 states that mathematics is a compulsory subject for students at the elementary and moderate school levels. Mathematics subjects have an important role in the development of science and technology. Therefore mathematics has a role to help develop students' thinking skills in solving problems in everyday life (Isnaeni et al., 2018).

The goals of learning mathematics in Indonesia according to the National Council of Teachers of Mathematics or NCTM (2000) include: the ability to reason and try, the ability to connect concepts, the ability to solve problem, the ability to communicate, and the ability to show or representation. Problems that are solved are not enough in the form of routine questions but rather problems faced in everyday life, this mathematical ability is what is referred to as mathematical literacy. (Utami et al., 2020).

Based on Fahmy et al. (2018) mathematical literacy starts with real problems, which are divided into two categories, namely content and context. In line with this, the process of mathematical literacy begins with identifying a real problem and formulating the problem mathematically according to the concept and how the relationship is in the problem. The next step after obtaining a mathematical form based on the

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problem, is solving it with certain mathematical steps or procedures to get mathematical results and summed up back to the initial problem (Oktiningrum et al., 2016).

The results of a survey conducted by the Program for International Student Assessment (PISA) state that students' mathematical literacy in Indonesia is still low. Based on observations made by researchers at SMP Negeri 37 Semarang, the problem that occurs at school is the effect of learning during a pandemic which is carried out online (in the network). This causes students to be unable to get away from their cellphones and become lazy to think or do calculations which are generally simple calculations. In addition, students' interest in reading is still low. Based on student scores from the Annual Final Assessment for class VII for the 2021/2022 academic year, it was found that the average student score was still below the MCC (Minimum Completeness Criteria), it is known that the MCC for mathematics at SMP Negeri 37 Semarang is 70.

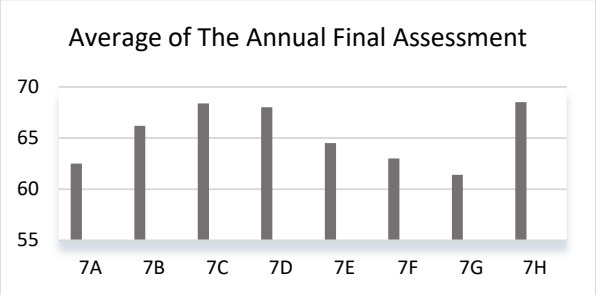

Figure 1. Average of The Annual Final Assessment in Mathematics of SMP Negeri 37 Semarang Academic Year 2021/2022

Apart from the facts above, other facts that show mathematical literacy are the results of the tests given. SMP Negeri 37 Semarang students still have difficulty solving problems with word problems. The researcher gave the questions given to class VIII E students of SMP Negeri 37 Semarang. The test questions tested are as follows.

Lukman is renovating his parents' house and plans to build a new bathroom. The floor in the bathroom will be tiled. The area of the bathroom to be built is 2 m^2. While the area of each tile is 20 cm^2. How many tiles does Lukman need to build the bathroom?

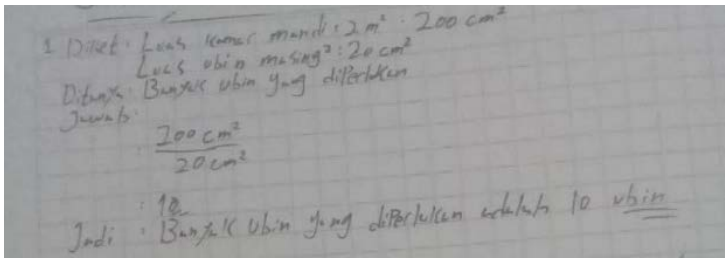

Figure 2. Student Work Results

The results of the completion done by students in the picture above can be said students still have not written the problem solving correctly. From the student's answers it can be analyzed that students still haven't read the questions and solved them carefully, what is asked in the questions is to change the units of m^2 to cm^2. However, the students only changed it from units of m to cm. Therefore the student's answer is not correct. When viewed from the completion process, students have not represented in a structured manner from being known, being asked, being answered, and writing conclusions.

The efforts of SMP Negeri 37 Semarang teachers to be able to improve students' abilities are by using the learning model that is currently being implemented, namely Problem Based Learning (PBL). PBL is a learning model that presents contextual problems so that it can foster student motivation to learn. Classes that use the PBL model or problem-based learning, students work in groups to solve a given problem (Kemendikbud, 2013). This can optimize students' thinking skills through group work processes so that students can hone, test, and improve their thinking skills on an ongoing basis.

The definition of mathematical literacy according to PISA 2015 is "Mathematical literacy is defined as student's capacity to formulate, employ and interpret mathmatics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedure, facts, and tools to describe, explain and predict phenomena. It assists individuals to recognizes the role that mathematics plays in the world and to makte the well-founded judgements and decisions needed by constructive, engaged and reflective citizens." (OECD, 2016). Mathematical literacy can be interpreted as a person's ability to formulate, use,

and interpret mathematics in various contexts. This includes mathematical reasoning and the use of mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena.

The PBL learning model is in accordance with the assessment assessed by PISA, namely mathematical literacy which requires students to reason and be able to solve problems related to contextual problems (Nolaputra et al., 2018). Problems with real-world contexts are a mathematical literacy assessment conducted by PISA. In line with this assessment, the problems presented in the PBL model can be taken from a real problem. Therefore the approach that is suitable and can be used is the Indonesian Realistic Mathematics Education (PMRI) approach. Internationally, the Indonesian Realistic Mathematics Education Approach (PMRI) is known as RME or Realistic Mathematics Education

The advantage of the Indonesian Realistic Mathematics Education (PMRI) approach is that it emphasizes the problems taken, namely problems in real life that students can see and feel. As stated by Wardono & Mariani (2014) the advantage of RME is that it emphasizes learning by doing, in accordance with the concept developed by Freudental by linking things related to real life. Teaching and learning activities carried out in schools will be successful if supported by psychological aspects related to students' attitudes when working on assignments in the form of questions in solving a problem, which requires perseverance and thoroughness in solving the problem. Based on information from the mathematics teacher at SMP Negeri 37 Semarang, students still complain when given challenging questions or problems and there is a fear of being wrong when trying to solve problems in front of the class.

The psychological aspect that greatly influences student success in completing assignments and solving problems well is student self-efficacy, as Lunenburg dalam Najiha & Budi (2017) states that self-efficacy is a person's belief to direct and coordinate its ability to change and deal with a situation. As with Bandura dan Locke dalam Fajri et al., (2016) stated that self-efficacy displays the level of student confidence in the ability to solve various mathematical problems and affects the increase in student learning outcomes. Negative feelings about self-efficacy can cause students to be reluctant to face challenges, not enthusiastic about doing something, and focus on obstacles and poor self-preparation (Rajagukguk & Hazrati, 2021). This is in accordance with what was said by a math teacher at SMP Negeri 37 Semarang that students more often look for answers on the internet and are reluctant to solve problems on their own or discuss with friends.

Based on the problems above, this study aims to: (1) find out whether mathematical literacy through PMRI approach Problem Based Learning (PBL) achieves ACL; (2) find out whether mathematical literacy through PBL with the PMRI approach is classically complete; (3) find out whether the average and proportion of mathematical literacy through PBL with the PMRI approach are more than the average and proportion of mathematical literacy through PBL; (4) knowing whether students' self-efficacy affects mathematical literacy through the PBL PMRI approach; (5) describe mathematical literacy through PBL PMRI approach based on students' self-efficacy.

2. Methods

This research used a mixed method research method with a sequential explanatory research design, namely mixed research with quantitative and qualitative research methods carried out sequentially. The population in this research were students of class VIII SMP Negeri 37 Semarang. Sampling on quantitative resistance was carried out by cluster random sampling obtained class VIII D (control class) and VIII E (experimental class). Subjects in the qualitative research were taken from the experimental class with purposive sampling, 6 subjects were selected with 2 subjects for each category of high, moderate, and low self-efficacy.

Data collection techniques used were tests, non-tests (self-efficacy questionnaires), and interviews. The test used is to measure the mathematical literacy test. The test questions are tested first in the trial class so as to obtain validity, reliability, discriminating power, and the level of difficulty of the questions. The student self-efficacy questionnaire contains 20 statement items. The scale used is a Likert scale in the form of a checklist, with the answer choices being Disagree (D), Less Agree (LA), Agree (A), and Strongly Agree (SA). Interviews were conducted with research subjects with the aim of obtaining mathematical literacy data in terms of students' self-efficacy. Selection of subjects based on scores from student self-efficacy questionnaires.

The quantitative data analysis technique in this study is to test hypothesis 1, namely whether the average mathematical literacy through PBL learning with the PMRI approach achieves ACL using one-party average test statistics (t test). Hypothesis 2 test is used to find out whether literacy through PBL learning through the classical PMRI approach uses the right side proportion test statistic with the z test. Test hypothesis 3 which is used to test whether the average and proportion of mathematical literacy through

PBL learning with the PMRI approach are more than the average and the proportion of mathematical literacy with PBL learning, namely using the statistical test of similarity of two averages with the t test and testing the difference in proportions with the test z. Hypothesis 4 to find out whether there is a significant effect of self-efficacy on mathematical literacy uses simple linear regression test statistics. Qualitative data analysis was carried out in stages: data reduction, data presentation, and drawing conclusions. After that, technical triangulation was carried out, namely checking data from the same source with different techniques.

3. Results & Discussion

3.1. Quantitative Research

In quantitative research, a prerequisite test is carried out before testing the hypothesis. The data was taken from the results of students' mathematical literacy tests. The prerequisite test for the normality test uses the Shapiro-Wilk test and the homogeneity test uses the Levene test with the help of the SPSS program. The results of the experimental class and control class data show that both data are normally distributed and homogeneous. Table 1 shows the results of the mathematical literacy test in the experimental and control classes.

Table 1. Experimental and Control Class Mathematical Literacy Test Results

Class	Data	Result
Experimental	Average	77.1
	Max	92
	Min	58
Control	Average	68.1
	Max	87
	Min	49

Calculation of hypothesis test 1, using a one-party average test with the test criteria is reject H_0 if $t_{count} \geq t_{(1-\alpha)}$ is obtained from the student distribution list with probability $(1-\alpha)$ and $dk = n-1$. Based on the calculation of the average test for one party (right side) the value of $t_{count} = 8.59$, dengan $\alpha = 5\%$ is obtained $t_{table} = 1.70$. So that $t_{count} = 8.59 > 1.70 = t_{table}$. Therefore it can be concluded that H_0 is rejected, meaning that students' mathematical literacy through the PBL-PMRI has reached Actual Completion Limit (ACL) with $ACL = \bar{x} + \frac{1}{4} \times s$ ($\bar{x}$ =average and s =standard deviation).

Test hypothesis 2, namely the classical completeness test with the testing criteria used is reject H_0 if $z_{count} \geq z_{table}$, with $z_{(0,5-\alpha)}$ and $\alpha = 5\%$. Based on the calculation of the one-party (right-hand) proportion test, the value of $z_{count} = 5.708$, with $\alpha = 5\%$, then $z_{table} = 1.64$. So that $z_{count} = 5.708 > 1.64 = z_{table}$. Therefore, it can be concluded that H_0 is rejected, meaning that the percentage of class VIII E students at SMP Negeri 37 Semarang for the 2022/2023 academic year using the PBL-PMRI has achieved classical mastery.

Hypothesis 3 test on the two-average similarity test has criteria for accepting H_0 if $t \leq t_{1-\alpha}$, with $dk = (n_1 + n_2 - 2)$ and probability $(1-\alpha), \alpha = 5\%$. Based on the calculation of the two-sided similarity test on the average of one party (right side) it is obtained that the value of $t_{count} = 4.557$ with $\alpha = 5\%$ and has a value of $dk = 32 + 32 - 2 = 62$. Then the value of $t_{tabel} = t_{(1-\alpha)(n_1+n_2-2)} = 1.677$. Because $t_{count} = 4.557 > 1.677 = t_{table}$ then H_0 ditolak. That is, the posttest average of students' mathematical literacy in classes that use the PBL-PMRI is more than the average posttest of students' mathematical literacy in classes that only use the Problem Based Learning model.

Meanwhile, the two proportions difference test has criteria for accepting H_0 jika $z_{count} \geq z_{(0.5-\alpha)}$, with $z_{(0,5-\alpha)}$ coming from the list of normal distribution and probability $(0.5-\alpha)$ with $\alpha = 5\%$. Based on the calculation of the difference test of the two proportions, the value of $z_{count} = 3.088$ with $\alpha = 5\%$ is obtained $z_{table} = 1.64$. So $z_{count} = 3.088 > 1.64 = z_{table}$ then H_0 ditolak, meaning that the proportion of students who complete the class using the PBL-PMRI is more than the proportion of students who complete the PBL learning model.

Hypothesis 4 test is used to determine the effect of self-efficacy on mathematical literacy using a simple linear regression test with SPSS. The linearity test has the criteria for rejecting H_0 if the *Sig* value on Deviation from Linearity < 0.05. Based on the ANOVA table, in the Deviation from Linearity section, the

value $Sig = 0.081$ is obtained. Then the $Sig > 0.05$, so H_0 is accepted. This means that the linear regression equation or there is a relationship between mathematical literacy and self-efficacy through the PMRI Problem Based Learning approach. Whereas the regression significance test has testing criteria, namely with a significance level ($\alpha = 5\%$), reject H_0 if *Sig* in *Regression* < 0.05. ased on the ANOVA table, in the Regression section the value $Sig = 0.001$ is obtained. Then $Sig < 0.05$, so H_0 is rejected. This means that the relationship between self-efficacy variables and mathematical literacy variables is significant. The results of the test for the coefficient of determination obtained the R square value of 0.311. This means that the magnitude of the correlation coefficient (R square) is 0.311 which implies that the effect of self-efficacy on mathematical literacy is 31.1%. While the remaining 68.9% is influenced by other variables.

3.2. Qualitative Research

Qualitative data analysis in this study includes data reduction, data presentation, and data verification (drawing conclusions). Data reduction by summarizing the results of interviews for each subject and arranged in an organized and easy-to-understand language. Examination of the results of students' mathematical literacy test results is carried out with reference to the guidelines for assessing mathematical literacy tests. The analysis described is based on a mathematical literacy test that fulfills the stages of mathematical literacy in each item.

After knowing the description of the achievement of each stage, a description of the results of the mathematical literacy test is carried out based on students' self-efficacy. The next step is presenting the data with tables and brief descriptions. This stage makes it easier to understand the data because the data can be neatly arranged, organized, and arranged in a data relationship pattern that helps to draw conclusions.

Table 2. Grouping of Mathematical Literacy Viewed from Student Self Efficacy

Self Efficacy	Mathematical Literacy	
	Students	Category
High Category	4	High
	3	Moderate
	0	Low
Moderate Category	2	High
	17	Moderate
	1	Low
Low Category	0	High
	3	Moderate
	2	Low

3.2.1 Mathematical Literacy in the High Self Efficacy Category

The results of the analysis of mathematical literacy which fall into the high category of self-efficacy are able to solve problems regarding mathematical literacy based on the four indicators well. This is evidenced by the achievement of each student's mathematical literacy indicator. According to the student self-efficacy questionnaire, there are 7 students who fall into the upper self-efficacy category. Then 2 research subjects were taken to analyze their mathematical literacy. All the problems from the items have been done very well according to the existing indicators. The two subjects completed the items by writing down the procedures known, being asked, answered, and providing conclusions.

In the first indicator of mathematical literacy, namely identifying problems, both subjects were able to write down what information was known and asked the questions correctly. In the second indicator, namely changing the problem into mathematical language, both subjects were able to write mathematical models/symbols correctly. In the third indicator, namely applying the design of a mathematical model to find a solution, the two subjects have solved the problem well. As well as on the fourth indicator, namely interpreting mathematical model solutions and evaluating solutions, the two subjects tend to fulfill this indicator because they can write conclusions correctly, but there is one question where the writing of the conclusions is not quite right. So it can be said that the subject with the category of self-efficacy meets the indicators of mathematical literacy.

This is consistent with the research results of Hidayat & Noer (2021) that students who have high self-efficacy are able to solve problems carefully, but on the contrary students who have low self-efficacy tend to be less good at solving problems. Likewise, it is also supported by the theory which states that students with high self-confidence can form confidence in themselves regarding the ability to never give up when

facing problems faced or given (Leonardo & Amanah, 2014). Students with the high self-efficacy category in solving the problems they face are able to be optimistic about their own potential, have a commitment when solving problems, have a positive attitude when faced with various kinds of situations and conditions, and are able to use previous experience as a guide. It was proven that when conducting interviews the two subjects were able to provide precise, firm and detailed explanations, and seemed to understand the material being studied.

3.2.2 Mathematical Literacy in the Moderate Self Efficacy Category

The results of the analysis of mathematical literacy that fall into the moderate category of self-efficacy are being able to solve problems regarding mathematical literacy based on the four indicators well. This is evidenced by the achievement of each student's mathematical literacy indicator. Based on completing the student self-efficacy questionnaire, there were 22 students who were in the moderate self-efficacy category. Then 2 research subjects were taken from 22 students who were in the moderate category of self-efficacy to analyze their mathematical literacy. All the problems of the items have been done properly according to the existing indicators. However, some of the subject's work results tend not to meet the mathematical literacy indicators.

In the first indicator of mathematical literacy, namely identifying problems, both subjects were able to write down what information was known and asked the questions correctly. In the second indicator, namely changing the problem into mathematical language, both subjects were quite capable of writing mathematical models/symbols correctly. In the third indicator, namely applying the design of a mathematical model to find a solution, the two subjects have solved the problem well. As well as on the fourth indicator, namely interpreting mathematical model solutions and evaluating solutions, the two subjects tend not to fulfill this indicator because some problems are not thorough in solving so they don't write conclusions correctly.

This is in line with the opinion of Putrisari et al. (2017) that students with moderate or moderate self-efficacy categories have the self-confidence to complete tasks maximally and seriously, but when experiencing difficulties in answering problems students appear anxious and unsure whether they will succeed in achieving the desired results or even experience failure. Subjects who are included in the moderate category of self-efficacy often make a few mistakes, namely not being careful in calculating when solving problems.

3.2.3 Mathematical Literacy in the low Self Efficacy Category

The results of the analysis of mathematical literacy which fall into the low category of self-efficacy are less able to solve problems regarding mathematical literacy based on the four indicators well. This is evidenced by the achievement of each student's mathematical literacy indicator. According to the student self-efficacy questionnaire, there are 3 students who fall into the lower self-efficacy category. Then 2 research subjects were taken to analyze their mathematical literacy. The problem of the items has been done poorly and does not meet the indicators that have been set.

In the first indicator of mathematical literacy, namely identifying problems, the two subjects were less able to write down what information was known and asked questions correctly. In the second indicator, namely changing the problem into mathematical language, the two subjects were quite capable of writing mathematical models/symbols correctly, but some numbers were still not precise. In the third indicator, namely applying a mathematical model design to find a solution, the two subjects have solved the problem but some numbers are still not quite right. As well as on the fourth indicator, namely interpreting mathematical model solutions and evaluating solutions, the two subjects tend not to fulfill this indicator because they are less thorough so they cannot write conclusions correctly.

This is in accordance with the results of Hidayat & Noer (2021) that students who have high self-efficacy are able to solve problems carefully, but on the contrary students who have low self-efficacy tend to be less good at solving problems. Likewise, based on Subaidi (2016) concluded that students in the lower self-efficacy category tend to hesitate and give up easily in solving math problems. In addition, students also have the view that a difficult problem is something that must be avoided. It has been proven that during interviews, the subject finds it difficult to provide an explanation of the answers that have been written and seems to lack understanding of the material that has been studied..

4. Conclusion

Based on the results of the research and discussion, the following conclusions are obtained (1) The average mathematical literacy through PBL-PMRI reaches achieves Actual Completion Limit (ACL). (2) Mathematical literacy through PBL-PMRI achieves classical mastery. 32) The average and proportion of

mathematical literacy through PBL-PMRI is more than the average mathematical literacy of students through Problem Based Learning. (4) Student self-efficacy has a significant effect on mathematical literacy through PBL-PMRI of 31.1%, while the remaining 68.9% is influenced by other variables (5) Mathematical literacy students with categories: (a) self-efficacy high category fulfilling the four indicators, namely indicators identifying problems, applying mathematical model designs to find solutions, changing problems into mathematical language, applying mathematical model designs to finding solutions, and fulfilling the indicators of interpreting mathematical model solutions and evaluating solution; (b) self-efficacy moderate category fulfilling three indicators, namely identifying problems, converting problems into mathematical language, applying mathematical model designs to find solutions, and tends not to meet the indicators of interpreting mathematical model solutions and evaluating solutions; (c) self-efficacy low category tends to meet the indicators of turning problems into mathematical language and applying mathematical model designs to find solutions, tends not to meet indicators of identifying problems, and does not meet indicators of interpreting mathematical model solutions and evaluating solutions.

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