

The Analysis of Mathematical Literacy on Realistic Problem-Based Learning with E-Edmodo Based on Student's Self Efficacy

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Article Information Abstract

History Articles

Received:

July 2017

Accepted:

August 2017

Published:

August 2017

Keywords:

mathematical literacy,

PBL, E-Edmodo,

self efficacy

This study aims to: (a) analyze the effectiveness of the realistic approach of project-based learning with E-Edmodo as a media, which is proven if the mathematical literacy ability of the experimental class: (1) passes the classical completion as at least 75% of the students reach minimum score of 70; (2) is better than the control class; (3) is increasing, (b) analyze the mathematical literacy ability of the experimental class based on student's self efficacy. The mixed method was used in this study. The subject of the qualitative study was the students of class VII C (experimental class) and class VII A (control class), while the subjects of the qualitative study were 6 selected students from class VII C consisting of two students each in high, medium, and low self-efficacy groups. The data collection techniques included observation, test, interview and documentation. Based on the data analysis, it can be concluded that: (1) Realistic project-based learning with E-Edmodo was effective, shown by the achievement of classical completion, the average mathematical literacy ability of the experiment class students was higher than the control class, and there was improvement of mathematical literacy ability on Realistic project-based learning with E-Edmodo by 62%. (2) Students with high self-efficacy achieved excellent level of mathematical literacy ability, while students with medium self-efficacy achieved good mathematical literacy ability, and students with low self-efficacy achieved sufficient degree of literacy mathematics ability.

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[p-ISSN 2252-6404](#)

[e-ISSN 2502-4515](#)

INTRODUCTION

Nowadays, Indonesia faces an issue on the low quality of education. According to Noer (2009), TIMSS study revealed that Indonesian students are having difficulties in solving non-routine questions related to justification, solving problems that require mathematical reasoning, finding generalizations, and finding relationships between data or facts provided. Whereas in PISA study, Indonesian students are said to be weak in solving problems focused on mathematical literacy. Mathematical literacy is shown by the their ability to use mathematics they have learned to solve problems in everyday life.

Based on a survey of Trends International Mathematics and Science Study (TIMSS) in 2011, Indonesia ranked 38th out of 42 countries with a score of 386. It falls below the International Average score of 500. This average score is decreasing compared to 2003, Indonesia was ranked 34th out of 45 countries with an average student score of 411. In 2007, Indonesia was ranked 36th out of 49 countries with an average score of 405. Based on a the Program for International Student Assessment (PISA) report, their achievement is even worse. In 2003, Indonesia was ranked 39th out of 40 countries participating in PISA. In 2009, Indonesian students were ranked 61 out of 65 participating countries with an average score of 371. Indonesia's score was far below the international average score of 496. In 2012, Indonesian students were ranked 64th out of 65 countries. While in PISA 2015, Indonesia was still ranked 62 out of 70 countries with the average score of 403. These low Indonesian student scores are caused by the lack of student training to solve PISA and TIMSS problems which substance is contextual, demanding reasoning, argumentation, and creativity in solving the problem (Wardhani and Rumiati, 2011). Nizam (in Kompas, 2016) discloses TIMSS 2015 results that Indonesia was again ranked below with a math score of 397, putting Indonesia at the number 45 out of 50 countries.

If a student possesses a mathematical literacy ability, the student can prepare himself in

associating with modern society (OECD, 2014). The ability of mathematical literacy is defined as the ability to understand and apply basic knowledge of mathematics in everyday life (Wong, 2005). The ability of mathematical literacy can help students to understand the rules that make mathematics a reference to reality and to make judgments and decisions necessary by constructing, using, and reflecting oneself as a member of society. Therefore, this ability must be developed, one the ways is by providing a contextual problem that stimulates students to improve their literacy ability in solving it. Problem Based Learning (PBL) can be utilized to help in applying this method. This is in line with Chakrabarty (2013) who states that PBL has positive implications for developing problem-solving skills, critical thinking, and communication skills. PBL is also able to assist students in relating mathematics with its application in the real world.

According to Nalole (2008) relating to the presentment of mathematics that begins with something concrete, Netherlands have long developed Realistic Mathematics Education (RME). Realistic Mathematics Education (RME) refers to Freudenthal's view that mathematics must be related to reality and mathematics is a human activity. Realistic Learning by Webb (2011) is not only due to its relation to the real-world context, but it is also related to the imagined emphasis. Realistic learning offers students the problem with imaginable situation. Learning with Realistic approach can also be combined with Scientific learning. As explained in Kemdikbud (2013), it suggests that the scientific approach is an approach that highlights the rule of the scientific method. Scientific approach features emphasizing the learning on observation, reasoning, discovery, validation, and the explanation of truth. In addition, the learning process is said to be scientific when its learning materials are fact-or phenomenon-based that can be explained using scientific logic. Therefore, Realistic-Scientific approach is associated with the reality of contextual problems, with mathematics is an activity of

human beings and the application of scientific methods in learning.

Students has a tendency of being pessimistic in learning mathematics because they see it as a difficult and scary subject. If this mindset is still growing, it will be the students' barrier in thinking and facing math problems. Therefore, it takes a strong self-efficacy in the students themselves in order to succeed the process of learning mathematics. According to Hacket & Betz (in Nicolaidou & Philippou, 2004), the impact of self-efficacy on performance in mathematics is as strong as the effect of mental ability in general. Self-efficacy influences motivation that also relates to students' success. A student who has high self efficacy will enthusiastically/strives to show his/her ability to achieve success. Conversely, a student with low self-efficacy tends to avoid assignment or do it halfheartedly thus he/she quickly gives up when encountering obstacles (Schunk, 1981).

For example, published studies on mathematical literacy, self-efficacy and realistic approach were conducted by Rusmining, et. al. (2014) & Gulten (2013) who examined mathematical literacy, self-efficacy and quantitative realistic approach. The studies did not provide detailed information about the way to grow students' mathematical literacy and self-efficacy as well as the factors supporting the improvement of learning. Consequently, teachers did not find the suitable learning method to grow and improve students' mathematical literacy.

Learning by using the internet or e-learning has the potential to create meaningful and fun learning. The use of internet in learning can help students to access, select and interpret information, recognize patterns, relationships and behaviors, evaluate in a quick and accurate manner to be able to do direct improvement, increase efficiency, be creative and a risk-taker, gain confidence and independence (Princess, et. al. 2013). One of the social networks holding enough features to support learning is E-Edmodo.

E-Edmodo is a web portal, devoted to education by combining social network to get the convenience of teaching so as to create a classroom-like situation. Edmodo is a private

social network that provides free, secure learning for students and teachers (Thongmak, 2013).

Geometry is a branch of mathematics. This material is taught at various levels of education, one of which is in junior high school. Flat shapes are, part of geometry, also taught in the 2nd semester of class VII. Many students have difficulty in understanding this material, especially when solving open-ended questions. As Wardono et. al. (2014) pointed out, students still have difficulties in learning geometry. This can be seen from the results of daily test of some students in a Semarang junior high school that are below the defined minimum score.

Teachers are the educators who carry out the task of teaching and learning in order to achieve student success particularly in learning mathematics and produce qualified, reliable and competitive graduates for the future (Masrukan, 2015). In addition, to achieve the objectives of learning, it requires the appropriate learning model and strategy. Realistic project-based learning with E-Edmodo is one of the potential method to apply. It can be used by teachers to analyze the process of student's mathematical literacy in solving questions of flat shapes in grade VII.

Built upon the above description, this study focuses on the analysis of mathematical literacy ability in solving the problem of flat shapes in grade VII by using Realistic Problem-Based Learning with E-Edmodo based on student's self efficacy.

The purpose of this study is: (1) to test the effectiveness of Realistic Problem-Based Learning model with E-Edmodo. (2) to analyze students' mathematical literacy abilities by applying Realistic Problem-Based Learning model with E-Edmodo.

METHODS

Mixed method (quantitative and qualitative methods) was used in this study. It is a combination of quantitative and qualitative methods to be used jointly in a research activity in order to obtain more comprehensive, valid, reliable and objective data (Sugiyono, 2014). The

design used in this study is concurrent embedded with quantitative method as the primary method.

Quantitative research requires population and sample. The population of this study was the students of class VII SMP N 4 Semarang, while the samples were obtained through random sampling technique. This technique is chosen because of the limitations of the researchers' authority in a wide range. The samples were selected randomly regardless any particular criteria in the population. Out of all grade VII classes in SMP N 4 Semarang, 2 classes were selected as the research sample in accordance with research design.

The population for the qualitative data was all students of grade VII of SMP N 4 Semarang, with 2 classes randomly selected as the research samples. The subjects of the qualitative research were 6 students from each level of student's TKLM and self efficacy based on the respective questionnaire results. Non-probability sampling technique was used in the qualitative research, where each object of the research taken do not have equal opportunity to be the subject of research. The technique used is purposive sampling, that is taking the subjects to be used based on certain considerations.

Data analysis techniques used were (1) data analysis of learning material validity; (2) data analysis of instrument testing the learning result consisting of validity, reliability, level of difficulty, and distinguishing potency; (3) data analysis of effectiveness consisting of completion test, mean difference test, and improvement of learning achievement test.

RESULTS AND DISCUSSION

This research was conducted in SMP N (State Junior High School) 4 Semarang. The school is located in Sawah Besar village, Gayamsari sub-district, Semarang, Central Java. This research took class VII A as the control class and class VII C as the experimental class. Class VII A consisted of 35 students, while class VII C consisted of 35 students. There was no preferred class, the students of both classes had equal math skills.

Based on the interview with mathematics teacher mentoring VII C, this selected class had not received realistic project-based learning model with E-Edmodo before. The results of this research are expected to be a policy determinant in order to improve the student's learning outcome in a more effective, efficient, and interesting way. The data used in the analysis were the initial and final data. The preliminary data was the result of mathematical literacy pretest, whereas the final data was the result of mathematical literacy post test. The data of students' mathematical literacy ability used in this study was taken from 70 students as the research subjects, consisting of 35 students of experimental class and 35 students of control class. From the pretest preliminary data, it was found that both samples were homogeneous or received relatively similar portion in getting math lessons. This indicated that the initial analysis of both samples had the same variance. In addition, the equality test of initial mathematical literacy average results of the experimental and control class students were not significantly different.

The Completion of Mathematical Literacy Ability on Realistic Project-Based Learning with E-Edmodo

Before performing the test of completion and difference, prerequisite test as called the normality test was done to see whether the distribution of students' grades in the class was normal. From the final data, it was found that the post test data of mathematical literacy ability of the experiment class students and control class students were normally distributed. Based on the calculation of classical completion test with the z_{test} , it was obtained the value of $z_{\text{count}} = 2$ and $z_{\text{table}} = 1.64$ therefore H_0 was rejected. The classical completion of the experimental class was more than 70 and it achieved the classical completion. Thus, it can be concluded that the completion of classical learning in the experimental class meeting the minimum passing score of 70 has reached more than 75%. This is in line with Etherington (2011) who states that learning mathematics with PBL model can build

and improve students' thinking ability in solving real life problems.

The Differences of Mathematical Literacy Ability in Realistic PBL with E-Edmodo

T test was conducted to see if the experimental class was better than the control class. Both classes consisted of 35 students. The mean of the experimental class's post test grades was 81.20, while the mean of the control class's post test grades was 74.94. By calculating the difference of both classes' mean score, the t value of 2.62 was obtained with the degrees of freedom (df) of 68. A testing with a significant level of 5% resulted in $t_{table} = t_{(680.05)} = 1,67$ and obtained the value of $t_{count} > t_{table}$ or $2.62 > 1.67$. By all means, H_0 was rejected since the average ability of the experimental class mathematical literacy was better than the control class. Based on the mean value of the post test score, the students' literacy ability of the experimental class of 81.20 was higher than the students' literacy ability of the control class of 74.94. Thus, it can be concluded that the average ability of the experimental class students mathematical literacy is better than the control class students.

The Improvement on Mathematical Literacy Ability

The gain test was used to measure the improvement on the mathematical literacy ability. Based on the calculation, it was found that the experimental class gain was 62% and the control class gain was 52%. Furthermore, the difference of increased mathematical literacy ability was tested. Before the mean was tested, the normality of gain score of the experimental class was tested. The result of the difference of gain score mean between the experimental class and the control class obtained the value of $t_{value} = -13.09$. The rejection region of H_0 was $t_{value} \leq -t_{(1-\alpha)}$. The value of $t_{(1-\alpha)}$ in the t distribution table with the probability of 0.950 and $df = 34$ is 1.67. The $t_{value (-13.09)}$ located in the H_0 rejection region. It is concluded that the average of students' mathematical literacy ability of class VII C after applying Realistic PBL with E-Edmodo media is higher than before applying Realistic PBL with

E-Edmodo. The mean score of the increased students' mathematical literacy ability by realistic PBL with E-Edmodo and the control class mean score can be seen in the mean score of the two classes. The result of gain test shows that there is an improvement of students' mathematical literacy ability after learning realistic PBL with E-Edmodo by 62%.

Observed from the learning process, achieving completion and students' mathematical literacy ability can be realized by successfully applying Realistic PBL with E-Edmodo to improve student's individual ability through the student activities. This means that using this learning strategy can improve students' mathematical literacy skills because the students not only passively receive information from their teachers, but also play a more active role of exploring the information needed with the defined goals. Aligned with Webb (2011), learning with a Realistic approach can lead to a formal student reasoning and build relationships between informal and formal mathematical representations. Wardono (2015) states that learning with Realistic approach can improve students' mathematical literacy ability based on PISA. Realistic PBL with E-Edmodo links informal knowledge of mathematics that students acquire from everyday life with the formal concept of mathematics using Edmodo in the learning process. Students will feel more excited, interested, and enthusiastic in learning that make learning becomes more meaningful. In addition, students become more active in their learning process, not only actively use the e-learning tools.

Based on the mathematical literacy comparison test, the experimental class is better than the control class. This is because Realistic PBL Realistic with E-Edmodo involves student activity in the learning process. They not only perform classroom learning but also habitual practice of active and interactive questions in E-Edmodo. In addition, students are active in the learning process because it uses contextual problems that construct students to think critically.

Students' Literacy Ability Profile Data Based on Student's Self-Efficacy

Student's Self-Efficacy of class VII C was categorized into high, medium, and low self-efficacy. Each item of the inventory statement was given the highest score of 5 and the lowest score of 1. Each student was asked to fill the self-efficacy scale before receiving Realistic PBL with E-Edmodo. Based on the analysis results, it was obtained a calculation showing the variation of student's self-efficacy of class VII C.

The data of students' literacy ability profile in this research was the data of students ability in solving mathematical literacy problem in accordance with the criterion of mathematical literacy ability. The students' mathematical literacy ability in this research was viewed from several criteria according to Draft Mathematics Framework of PISA 2012. Processing capability is defined as a person's ability in formulating, employing, and interpreting. Mathematical literacy assessment framework in PISA 2012 states that the processing capability involves seven important points, they are (1) Communication, it means students' ability to communicate and understand the problem, (2) Mathematizing, means students' ability to be able to change real-world problems to mathematical form or vice versa, (3) Representation, means students' ability to restate a problem or a mathematical object through things such as selecting, interpreting, translating, and using graphs, tables, drawings, diagrams, formulas, equations, or concrete

objects to capture the problem more clearly, (4) Reasoning and Argument, means students' ability to give reason or opinion. This ability is rooted in logical thinking skill to analyze information in order to produce a reasonable conclusion, (5) Devising Strategies for Solving Problems, it is defined as students' ability to use strategies to solve problems. Some problems may be simple and the solution strategy is clearer, but there are also problems that need quite complicated solving strategies. (6) Using Symbolic, Formal and Technical Language and Operations, it means the students' ability to use symbolic language, formal language, and technical language, (7) Using Mathematics Tools, it is defined as the ability of students to use mathematical tools, such as performing measurements, operations and so on.

The analysis of mathematical literacy ability profile was based on the student's self efficacy. There are three student's self-efficacy level in this research: high self-efficacy student, middle self-efficacy student, and low self-efficacy student. Two students from each level of self-efficacy was selected as high subjects (SP1 and SP2), middle subjects (SP3 and SP4), and low subjects (SP5 and SP6).

The Result of Student's Mathematical Literacy on High Self-Efficacy Subjects

The improvement of high self-efficacy subjects' mathematical literacy can be seen in Figure 1.

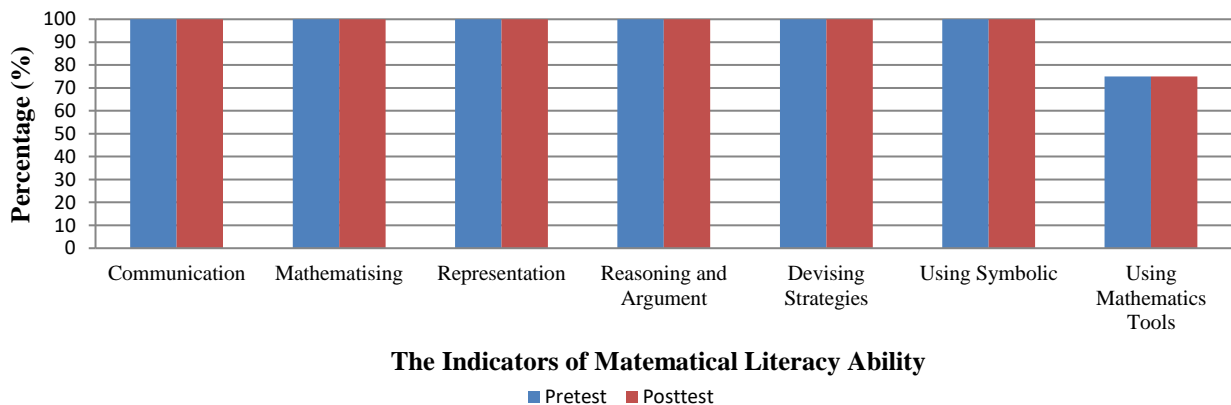


Figure 1. The Histogram of Mathematical Literacy Ability of SP1

The mathematical literacy ability of SP1 is shown in Figure 1. Research subject 1 (SP1) had a fairly stable mathematical literacy ability with the literacy ability mean score of 96% and considered to be in the excellent category. It shows that SP1 was able to master the seven components of mathematical literacy very well. SP1 could summarize the information, understand the context of the problem, present the problem-solving process appropriately, provide explanations well, use mathematical operations appropriately, and skillfully enough to use mathematical tools to help solving a problem.

The mathematical literacy ability of SP2 is shown in Figure 2. The mathematizing ability of

SP2 in the pretest was 50%, while in the post test it has increased by 100%. The acquisition of devising strategies ability in the pretest was 75%, while in the post test it was 100%. SP2 experienced improved mathematizing and devising strategies ability after the application of Realistic PBL with E-Edmodo. It is proven that SP2 was less understanding of the problem context in the pretest, whereas SP2 was able to understand the problem context in the post test thus it could be used to solve the problem. SP2 used a fairly effective procedure that lead to the problem solutions to get the solutions.

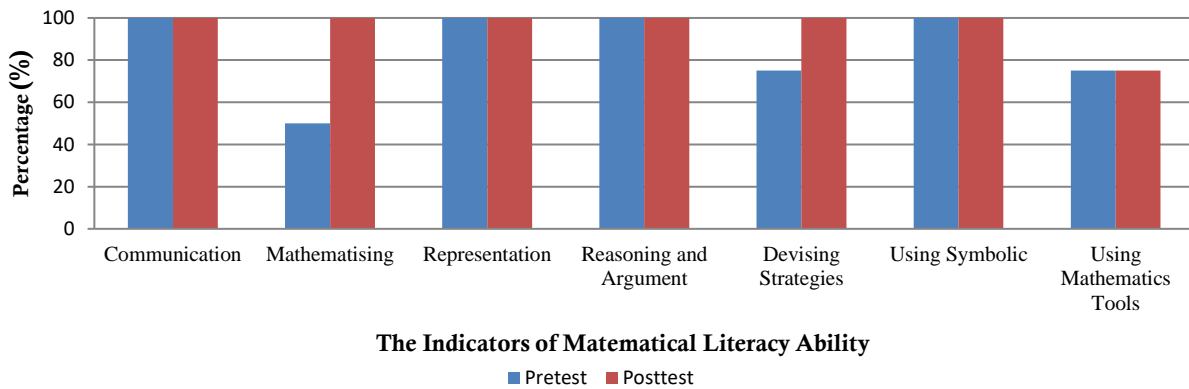


Figure 2. The Histogram of Mathematical Literacy Ability of SP2

The Result of Student’s Mathematical Literacy on Medium Self-Efficacy Subjects

The communication skill of SP3 was 100% in the excellent category. This means SP3 could summarize information, present problem-solving process, and interpret the solutions obtained appropriately. The mathematizing ability of SP3 was 75% and included in the good category. These results indicate that SP3 was lacking of the ability to transform the known points from the problem to define the problem solving process. The use of mathematical model was less profound to explore the context of the problem.

SP3 got a score of 100% for representation ability and included in the excellent category. SP3 understands the use of various mathematical representations in problem solving. The reasoning and argument capabilities obtained by

SP3 was 50% and included in the sufficient category, it means SP3 can not provide a proper explanation on the process of determining the solution of the problem. For devising strategies ability for problem solving, SP3 got 100% and included in the excellent category. SP3 used the right problem-solving planning mechanism to get the right solution. In the ability of using symbol, SP3 got 100% of score and included in the excellent category. SP3 could understand the relationship between the problem context and the representation of the solution in the post test.

For the ability of using mathematics tools, SP3 got 75% of score and included in the good category. SP3 was quite capable of using mathematics tools to describe the mathematical relationship of questions. Figure 3 shows SP3’s mathematical literacy ability. SP3’s

representation ability in pretest was 75%, while in post test it was 100%. SP3 improved the representation ability after the application of Realistic PBL with E-Edmodo. In the post test, SP3 was able to represent the problem very well.

SP4 was capable in using simple symbols on the subject matter directly and systematically. SP4 got 50% for the ability to use mathematics tools and included in the sufficient category.

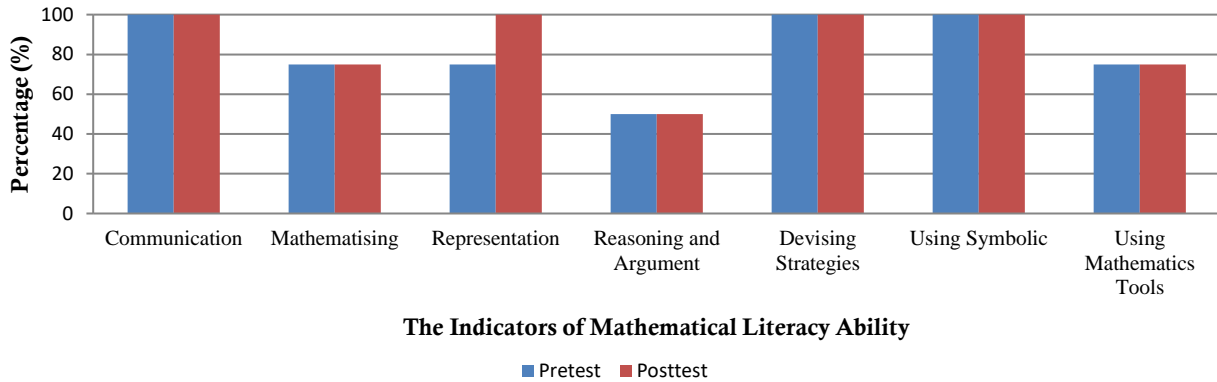


Figure 3. The Histogram of Mathematical Literacy Ability of SP3

In this case, SP4 used less mathematical tools. As a result, the solution obtained by SP4 was less precise. The mathematical literacy ability of SP4 is shown in Figure 1.4. SP4's mathematizing ability in pretest was 0%, while in post test it was increased by 50%. SP4's ability of mathematizing and devising strategies ability were improved after applying Realistic PBL with

E-Edmodo. SP4 was sufficiently good in understanding the problem context and the problem solving. In addition, SP4's devising strategies ability in the pretest was 75%, while in the post test it was 100%. In this case, SP4 was able to use the strategy of problem solving appropriately to obtain the right solution in the post test.

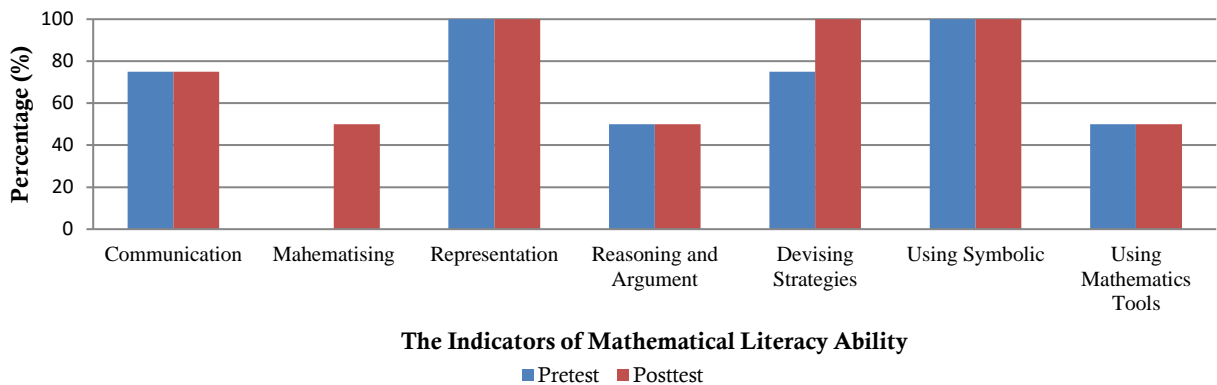


Figure 4. The Histogram of Mathematical Literacy Ability of SP4

The Result of Student's Mathematical Literacy on Low Self-Efficacy Subjects

Based on the observation, the result of the student worksheet and the research subject 5 (SP5) interview, the information about the ability of SP5's mathematical literacy was obtained. SP5 could not precisely reason and argue at the

pretest, however in the post test SP5 could appropriately deliver reason and argument. The capabilities of using symbol and mathematics tools of SP5 in the pretest was 50%, while in post test SP5 got 75% of score. The ability of SP5 to use mathematical operations also improved. The increase was shown by a better use of operations

than ever before. SP5 was able to use mathematics tools to describe mathematical relationships well. This was indicated by the use of calculating tools in the post test. SP5 improved

the ability of mathematizing, reasoning and argument, using symbols, and using mathematics tools after the application of Realistic PBL with E-Edmodo.

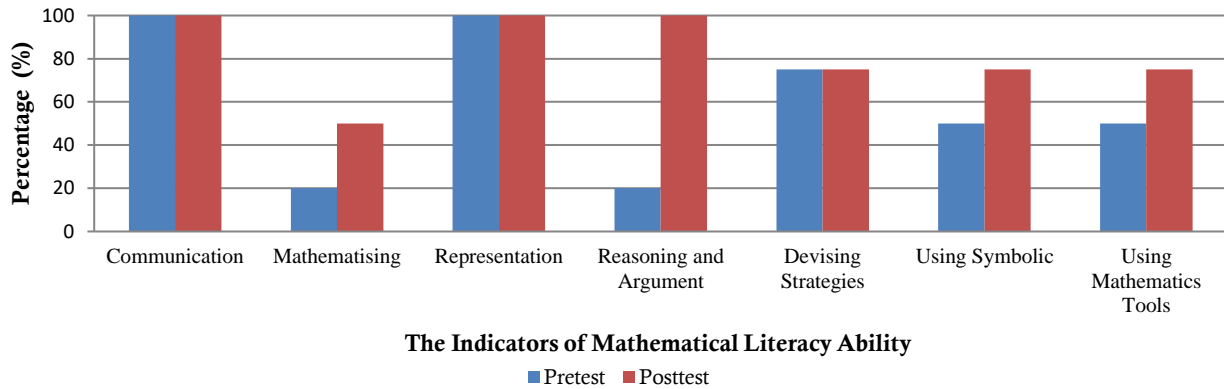


Figure 5. The Histogram of Mathematical Literacy Ability of SP5

Based on the result of observations from the student worksheet and interview, it obtained the information about SP6's mathematical literacy ability. In the pretests, SP6 could make a mathematical representation of real-world problems but there were some less precise solutions. It was corrected by SP6 in the post test which was shown with the accuracy of the solution obtained. SP6's ability of reasoning and argument in the pretest was 50%, while in the post test the result was 75%. SP6 was able to compile the information obtained from the problem more well, transform it into problem-solving process, and provide a fairly precise explanation of the solution obtained.

SP6 has improved the capability in designing problem solving strategies after the application of Realistic PBL with E-Edmodo. The right problem-solving strategy provided a fairly precise solution to the post test. SP6 was able to use mathematics tools to describe mathematical relationships well. This was indicated by the use of calculating tools in the post test. SP6 has improved the ability of mathematizing, representation, reasoning and argument, devising strategies and using mathematics tools after Realistic PBL application with E-Edmodo.

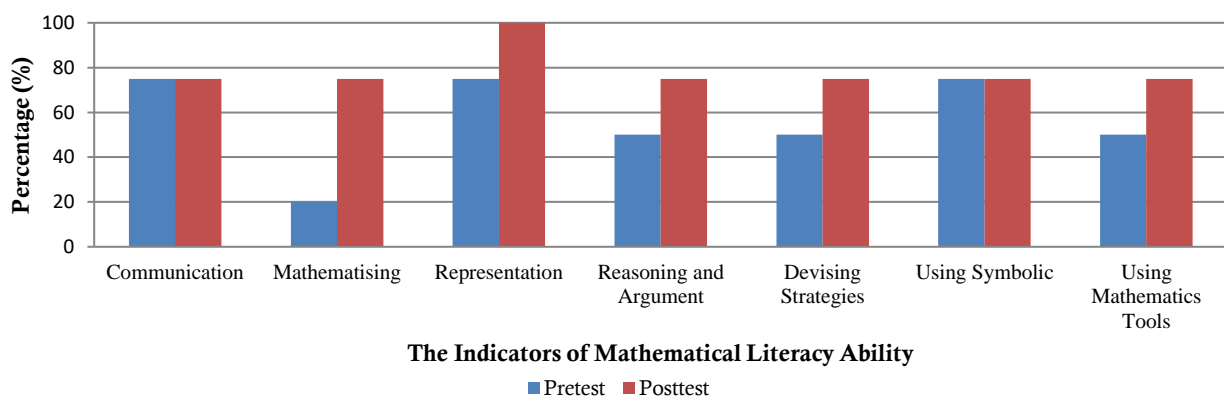


Figure 6. The Histogram of Mathematical Literacy Ability of SP6

CONCLUSION

Based on the analysis and discussion, it can be concluded that Realistic PBL with E-Edmodo is effective, which is proven with the achievement of classical completion of the experimental class reaching more than the minimum score of 70, the mean of students' mathematical literacy ability on Realistic PBL with E-Edmodo is higher than the control class, and there is an increase in the mathematical literacy ability of the experimental class by 62%. Based on these results, learning through Realistic PBL with E-Edmodo can improve students' mathematical literacy ability. Students with high self efficacy have achieved excellent degree of mathematical literacy ability. Students at this level can work using broad thinking with appropriate solving-problem strategies. Students with medium self-efficacy has achieved a good degree of mathematical literacy ability. Students at this level can summarize information, present problem-solving processes, and interpret solutions. Students with low self-efficacy have achieved a good degree of mathematical literacy ability. Students at this level can solve the problem in a simple way.

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