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# Mathematical Literacy Ability Reviewed From Self-Efficacy In Realistic Mathematics Education Approach

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**Abstract**

Mathematical literacy is one of the abilities of students assessed by PISA studies in terms of formulating, applying, and interpreting mathematical problems in various contexts. This ability is believed to increase if students are given structured training to solve problems close to their daily lives. Structured training can be done with a project or expository approach and both have their own strengths in eliciting student self-efficacy. The study aimed to analyse students' mathematical literacy ability reviewed from their self-efficacy in Realistic Mathematics Education (RME) model both in project and expository approach. The research was a mixed methods study with sequential explanatory design. There were 60 students, selected by simple random sampling, equally distributed in the experimental class with project based learning and control class with expository based learning. Data of students' mathematical literacy were collected by using tests and were triangulated with observational dan document data analysis. The results showed that the average mathematical literacy ability of the experimental class is better than that of the control class. The mathematical literacy were influenced by students' self-efficacy variables of 53.5%. The effect of self-efficacy on mathematical literacy of the way students solve problems was discussed.

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## INTRODUCTION

The rapid development in the field of science and technology enables students to obtain information quickly and easily. Students are expected to be able to obtain, choose, manage, and utilize information received. This ability requires students to think logically, systematically, critically, and creatively. One of the subjects that can foster the ability to think logically, analytically, systematically, critically and creatively is mathematics (Wardono et al., 2016).

Minister of Education and Culture Regulations No. 21 of 2016 concerning the standards of content for secondary school states that mathematics lessons need to be given to all students starting from elementary school. This should be done since mathematics is very useful in all aspects of human life (Akinmola, 2014). Mathematics is expected to be able to develop the abilities of students and shape the personality of students in learning science.

The purpose of learning mathematics according to National Council of Teachers of Mathematics (NCTM) (2000) consists of five competencies. They are mathematical problem solving, mathematical communication, mathematical reasoning, mathematical connection, as well as mathematical representation. These five competencies are covered in mathematical literacy. Ojose (2011) defines mathematical literacy as knowledge to know and to apply the basic mathematics to solve problems in everyday life. Maria (2017) Mathematical literacy is a person's ability to formulate, apply and interpret mathematics in various contexts This ability should have been owned by students from an early age. If mathematical literacy has been trained since the beginning, then students will increase their confidence in solving mathematical problems. The confidence that is fostered painstakingly by mathematics teachers will foster confidence to be able to solve mathematical problems.

The importance of mathematics literacy ability has not been matched by Indonesia's achievements in mathematics. This can be seen from the results of Indonesia's participation in the main international scale assessment, the Programme for International Student Assessment (PISA). PISA is held by the Organisation for Economic Co-operation and Development (OECD) once in three years to find out the literacy skills of mathematics, science and reading of students who are 15 years old since 2000. The focus of PISA is literacy which emphasizes the skills and competencies of students obtained from schools to be used in daily life and in various situations (OECD, 2009). The results of the 2015 PISA study, which was attended by 70 countries, also showed that the average mathematical literacy score obtained by Indonesia was still low but better than the previous year's score of 386 and ranked Indonesia 63rd (OECD, 2016).

The results of the study showed that the low mathematical literacy of students was apparently due to the low basic mathematics skills (Maulana, 2016). Students are also suspected of being unable to understand narrative questions and construct them into mathematical models (Holis et al., 2016). To improve it, active learning is needed Nilam (2019) teachers can take advantage of learning media that are in accordance with student characteristics and the material to be delivered to increase student interest in learning so that learning objectives can be achieved properly.

This is in line with the results of interviews conducted with mathematics teachers at VIII MTs Al Miftah Sindangjaya. Based on the results of the interview, it was revealed that most students did not understand the concept of the material that had been conveyed. This can be seen when students learn mathematics problems, they have not been able to answer according to the standard stages of solving mathematical problems. In addition, it was also revealed that students were not brave enough to take their own initiative to present the results of the discussion in front of the class. This situation explains that students have not shown adequate self-efficacy which results in low mathematical literacy.

Brophy & Wentzel (2014: 144), stated that student who has good self-efficacy will be more confident of achieving information, while for student who has less self efficacy, believes that he or she is unable to solve a problem. This is in line with the research of Yulita (2014) which assumed that the success of a learning can be influenced by the character of students who involved in learning, one of them is self-efficacy. The higher self-efficacy, the greater the effort and power and tenacity of students in solving a problem. Yati (2018) revealed that students 'constructivism and self-efficacy approaches affect students' mathematical communication skills.

Based on the Bandura (2008) self efficacy is divided into three dimensions, namely magnitude (task difficulty level), strength (strength of belief), and generality. Each of the three dimensions of self-efficacy has a relationship in growing students' performance cognitively. Each individual has self-efficacy with different dimensions. Students who have self-efficacy with good magnitude dimensions are not necessarily good on strengths and general dimensions. Therefore, the teacher must be able to train three dimensions to students in order to optimize their self-efficacy.

One of the learning model that provide students to focuses on the main concepts and principles of a discipline; involve students in problem solving activities and other tasks; giving students the opportunity to work autonomously to construct their learning; as well as enhance self-efficacy is project-based learning (PjBL). PjBL is a learning model that gives teachers opportunity to manage learning in the classroom by involving project work (Isriani and Dewi, 2012: 127) and had a positive effect on students 'self-efficacy (Nurrohmah, 2019). Vivi (2017) revealed that from the data analysis the results of the research carried out could show that there was a significant effect of the PjBl model on student learning outcomes.

According to Danarti (2014: 103), PjBL activities are close to nature, broaden students' horizons, and encourage them to appreciate their environment. Learning activities will be better if carried out based on the` natural environment of student life. Students are invited directly to nature and the community as a real learning resource.

Nalole (2008) states that the presentation of mathematical problems in the form of real events has begun in the Netherlands through Realistic Mathematics Education (RME). RME refers to Freudenthal's opinion that mathematics must be linked to reality and mathematics is a human activity. That means mathematics must be close to the children life and relevant to everyday situations.

To connect real situations into mathematical concepts can be done using a media, one of which is a problem card. Using problem cards as a medium in PjBL will bring mathematics learning more realistic. Eka (2015) stated that by using problem cards as a media in mathematics learning could improve mathematical communication skills of students as well as their learning activities. The same result was revealed by Rahayu et al. (2014) that assisted by problem cards in mathematics learning can significantly improve students' mathematical communication skills that is part of mathematical literacy.

The purpose of this study was to analys the quality of the PjBL learning model of the RME approach assisted by problem cards to improve the mathematical literacy ability of students and to find out the description of the mathematical literacy abilities of students using the PjBL learning model of the RME approach assisted by a problem card viewed from the self efficacy.

## METHODS

The study was a mixed methods with sequential explanatory design. The population of this study was grade VIII students of MTs Al Miftah Sindangjaya consisting of 118 students. Simple random sampling was employed to determine subject for experimental and control class. It obtained grade VIII B as the experimental class and grade VIII C as the control class each of 30 students.

The quality of learning was assessed from the planning, implementation, and evaluation stages. At the evaluation stage a mathematics literacy ability (MLA) test was performed. The learning is considered qualified if the results of the validation, the instrument of the learning tools, the results of observations, student learning outcomes with the PjBL model of the RME approach assisted by the problem cards reach the minimum criteria 70.

The determination of the learning quality of the PjBL model with the RME approach assisted by problem cards was based on the achievement of the learning outcomes. It was included the average of the mathematical literacy ability after learning using the PjBL model of the RME approach assisted by problem cards which was better than the average of the mathematical literacy ability using the expository model. Indicators of mathematical literacy ability in this study were (1) communication, (2) mathematics uses, (3) representation, (4) reasoning and argument, (5) devising strategies for solving problems, (6) using symbolic, formal, and (7) using mathematical tools.

## RESULTS AND DISCUSSION

The measurement of students' self-efficacy was carried out before the implementation of the model for the analysis of their mathematical literacy abilities. The results of the self efficacy questionnaire of the students and the percentage in grade VIII MTs Al Miftah Sindangjaya can be seen in the Table 1.

**Table. 1** The Data Distribution and Percentage of Students Based on Self Efficacy.

| Self efficacy | N | Percentage (%) |
|---|---|---|
| High | 4 | 13.79 |
| Moderate | 23 | 79.32 |
| Low | 2 | 6.89 |
| N | 29 | 100 |

It appears that in general the students were in the moderate category. It appears that students have sufficient confidence in facing mathematics learning. Furthermore, an analysis of the learning process was carried out. This data was used to ensure that learning was carried out in accordance with the learning plan. The implementation of the learning is considered qualified if the results of observations of the quality of the learning and the implementation of learning are at least in the good category. The quality of learning outcomes using the PjBL model of the RME approach assisted by problem cards grade VIIB MTs Al Miftah Sindangjaya problem card and the evaluation of each validator at the planning stage are presented in the Table 2.

**Table 2.** The Results of the Evaluation Score on the Learning Tools.

| Tools | Total Average | Categories |
|---|---|---|
| Lesson Plan | 4.2 | Good |
| Learning material | 4.12 | Good |
| Worksheet | 4.20 | Good |
| MLA | 4.44 | Excellent |
| Syllabus | 4.20 | Good |

The learning process was carried out 4 times. The results of an assessment of the learning quality of the PjBL model of the RME approach assisted by problem cards are presented in the Table 3.

**Table 3.** The Results of Observation of Learning Quality

| Learning Quality | Average | Category |
|---|---|---|
| Meeting 1 | 3.48 | Good |
| Meeting 2 | 3.65 | Good |
| Meeting 3 | 3.79 | Good |
| Meeting 4 | 4.21 | Excellent |

Based on data presented in Table 3, an average score of 3.74 was obtained. Based on the observation, it also can be seen that the category

of learning with the PjBL model of the RME approach assisted by problem cards was considered good. The results of an assessment of the observation of learning with the PjBL model of the RME approach assisted by problem cards are presented in the Table 4.

**Table 4.** The Results of Observation of the Learning Implementation

| No | Implementation | Average | Category |
|---|---|---|---|
| 1. | Meeting 1 | 3.41 | Good |
| 2. | Meeting 2 | 3.62 | Good |
| 3. | Meeting 3 | 3.82 | Good |
| 4. | Meeting 4 | 4.11 | Good |

Based on the observations of the implementation of the learning in Table 4, an average score of 3.74 was obtained. The category of learning feasibility of the PjBL model of the RME approach assisted by problem cards is considered good. Based on Table 4 and Table 5, it can be seen that the average of quality of the learning was included in the good category, therefore, it can be concluded that the ability of researcher to prepare and manage the learning was in good category.

The third stage was the evaluation stage and at this stage of learning, assessment was carried out by giving questionnaires of response to the students about the learning of the PjBL model of the RME approach assisted by the problem cards that have been conducted. Based on the response questionnaire of the students completed by 29 students after obtaining the learning of the PjBL model of the RME approach assisted by the problem cards, students who responded positively to the learning reached more than or equal to 70%. This indicated that the majority of students gave good response to the learning that has been implemented.

The next was the analysis of the mathematical literacy ability tests. In the normality test, the significance value obtained 0.200 = 20% > 5%, the initial homogeneity test obtained significance 0.570 = 57% > 5% indicating that the variance of the experimental class is the same as the control class. In the final data analysis, the final normality test obtained a significance of 0.92 > 0.05. Therefore, H0 is accepted, meaning that the data comes from populations that are normally distributed. For the final homogeneity test, obtained a significance value of 0.83 > 0.05 then H0 is accepted. This results indicated that the experimental class variance is the same as the control class.

Based on the proportion test in this study, which was at $\alpha$ = 5% it was obtained ztable = 1.960 and from the calculation obtained zcount = 2.309. Since zcount > ztable, therefore, H0 is rejected. That is, the proportion of students in PjBL learning models assisted by problem cards who reach the minimum completeness criteria has exceeded 70%.

In the average difference test, obtained t (0.95; 57) = 1.678. From the calculation, tcount = 4.447. Since tcount > ttable, therefore, H0 is rejected. This means that the average of mathematical literacy ability of students in the learning class of PjBL model assisted by problem cards was more than the average of mathematical literacy ability of students in the expository learning class.

In the different proportion test in this study with $\alpha$ = 5%, dk = 29-1 = 28, obtained Ztable = 1.960 and Zscore = 10.26. Since Ztable > Zscore then, H0 is rejected and H1 is accepted. Therefore, the proportion of completeness of the mathematical literacy abilities of students in the learning class of the PjBL model assisted by problem cards is better than the average of the mathematical literacy ability of students in the expository learning class.

Based on the regression test, obtained results based on the test of Anova Table output, Sig value = 0.000 < 0.05, then, H0 is rejected. It is meaning that there is an effect of self-efficacy on the ability of mathematical literacy. Then, the coefficient of determination obtained in the R square column, namely the output summary of 0.535 or 53.5%. This value indicated that the variation of the mathematical literacy variables can be influenced by the self-efficacy variables at 53.5%, meanwhile,the remaining 46.5% is

influenced by other variables that did not examined in this study.

The mathematical literacy ability based on indicators can be seen in Figure 1.

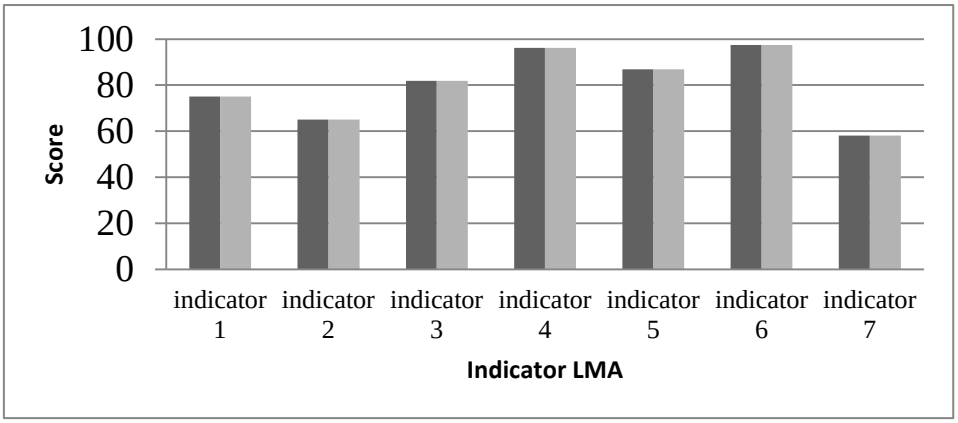


**Figure 1.** The Score of Indicator of Mathematical Literacy Ability (MLA)

Figure 1 shows that the achievement indicators of the mathematical literacy abilities of students have been fulfilled. In indicators 2, 6, and 5, namely reasoning and argument, using symbolic, formal and technical language and operations, and devising strategies for solving problems obtain very good criteria. Students were able to provide logical reasons at the final step of solving the problem. In applying the mathematical terms such as writing down units and calculating operations it was considered appropriate. The strategy used in the settlement was appropriate and the application of the concept of material was in accordance with the problem presented.

In the indicators 4, 5, and 6 namely representation, communication, and mathematical were in a good criteria. Most of students were able to represent the problem in the form of graphics well. Provided information on the graph in accordance with the instructions in the problem. The understanding of problems of students by changing real world context problems into the mathematical sentences was already good. The understanding of students on the question and their way in recognizing the problem was considered good. However, the indicator 7, which was in using the mathematical tools was in the moderate criteria. On these indicators, students show that they were not fully skilled in using the mathematical tools such as rulers. The drawings of students were not fully skilled in using the mathematical tools such as rulers. The drawings of students were not according to the specified size. There were still some students who did not use a ruler in solving the mathematical problems.

**1.Communication**

Question: Dinda has a small cube shaped wooden block box toy with a length of 5cm ribs scattered in the living room. Dinda wants to help her mother tidy up her toys. To make it look more presentable, Dinda will insert a small cube shaped alphabet wooden block box into a large cube shaped toy box with 70cm long ribs. How many small cube-shaped alphabet wooden blocks can Dinda put in the large cube-shaped toy box? This question was answered with a variety of responses from three types of self-efficacy. One example of student answers with the high self-efficacy category is presented in Figure 2.

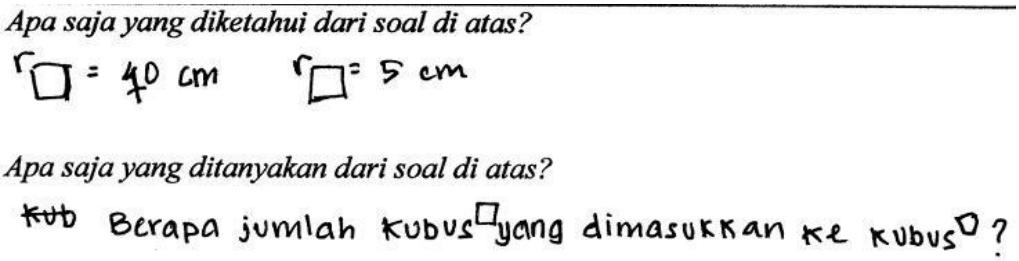


**Figure 2.** The Result of Student' Communication Skill Based on High Self Efficacy

Figure 2 shows that students with high self efficacy can understand what is presented in the problem and are able to write down the information they get in the question. Different answers shown by students with low category self-efficacy. One example of student answers with the low self-efficacy category is presented in Figure 3.

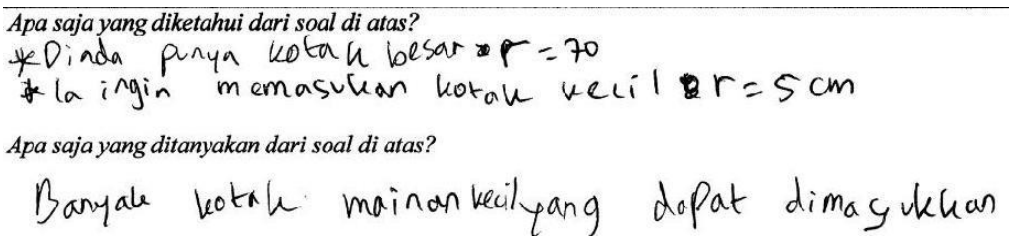


**Figure 3.** The Result of Work of Students on Communication Skill Based on Low Self Efficacy

Based on Figure 3, it shows that students with low self efficacy can understand what is presented in the problem but have not been able to write the information they get clearly.

**2.Mathematics modeling**

In this question, students are asked to state the mathematical equations of the stories given. The answers of students with high category self-efficacy are shown in Figure 4.

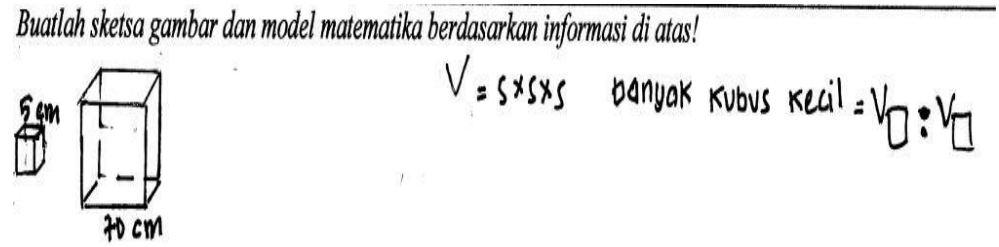


**Figure 4.** The Result of Work of Students on mathematics modeling on High Self Efficacy

Based on Figure 4, it can be seen that students could already mention the mathematical model according to the problem. He seems confidently explain the situation by giving the simple formula and symbols. But, unfortunately students still can not comparing properly the length of the cube. In contrast, student with low mathematics modeling skill and low of self efficacy actually have a good thought in modeling but still face the constrain in writing the mathematics situation as seen in Figure5.


**Figure 5.** The Result of Work of Students on Mathematics Skills on Low Self Efficacy

Figure 5 shows that students who have low mathematics skills can not mention the mathematical model according to the problem, there is no description in the picture. Students seem unconfident in writing the formula and using dot rather than cross in writing the times symbol. But, the good news it that he already understand the problem by trying to scratch the situation.

**3.Using mathematic tools**

In this aspect, students were asked to use mathematics modeling to describe the situation and solving the problem correctly. The question is "Trashbean in Krapyak Village has an outdated ballot box. The ballot box is a beam with the total length of all the ribs of the ballot box being 560cm. The ballot box is 60cm long and 40cm wide. One of the committees at the polling station wanted to repaint the entire surface of the ballot box because it would be used for voting in the election of the Kudus regent. Every 0.3l of paint can be used to paint a 1m2 surface. How many liters of paint are needed to paint the outside of the ballot box?" Students with high self efficacy could solved the problem in a good manner as provide in Figure 6.

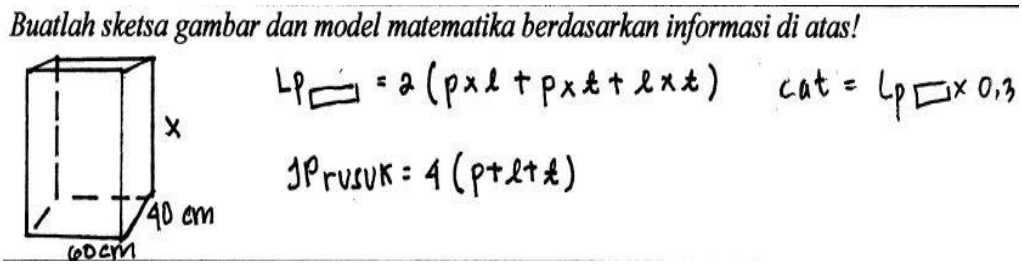


**Figure 6.** The Result of Work of Students on Mathematic Tools on High Self Efficacy

Based on Figure 6, it can be seen that students could already use mathematical tools in a right formula to illustrate the problem. The geometry made in the form of blocks was complete, precise and neat. He was very confident in solving the problem which is seen from how he write the mathematical sentences confidently. It was quite different answer with the low self efficacy student as presented in Figure 7. It shows that student can use a mathematical tool but the solution is not neat and incomplete in providing information.

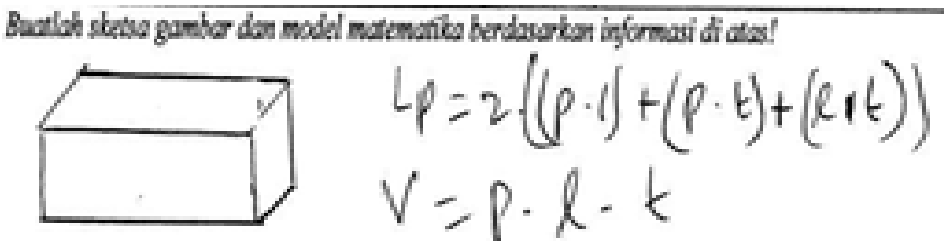


**Figure 7**. The Result of Work of Students on Mathematic Tools on Low Self Efficacy

**4.Devising strategies for solving problems**

In this aspect, students were given a question and were asked to write the strategies in solving the problem. The problem given was "Ulfatul bought a cube rubric at a toy store near his home. Ulfatul was curious about the size of the rubric. Then Ulfatul measured it and found the total length of all the rubric ribs was 84cm. Ulfatul still wants to know the surface area of the rubric. Sinta, Ulfatul's friend, wants to help measure the surface area of the rubric. What is the surface area of the rubric obtained by Sinta?" Student with high self efficacy could write the steps of completion as a strategy to solve the problem as in Figure 8.

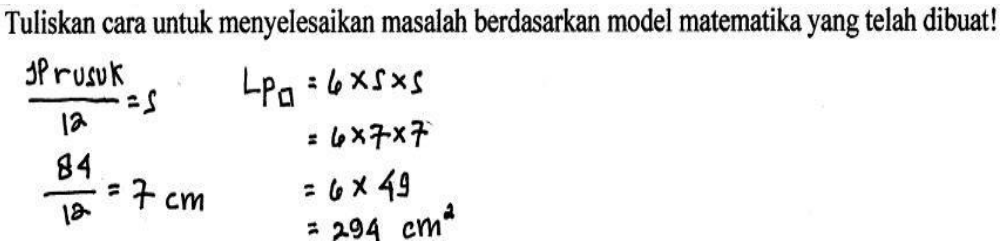


**Figure 8.** Strategy for problem solving on high self efficacy student

In Figure 8, student could write properly the equation and very neat. But student with low self efficacy did oppositely. he tends to be less careful in writing equations and tends to be less precise in calculations. It seemed that he was hastily solving problems and was tending to be careless as seen in Figure 9.

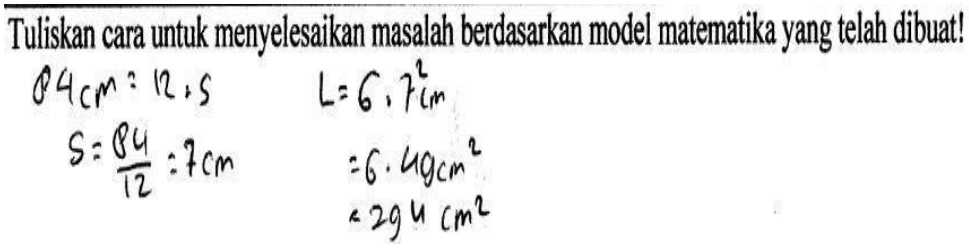


**Figure 9**. The Result of Work of Students on devising strategies for solving problems on Low Self Efficacy

**5.Using symbol, formal and technical language and operation**

In this aspet students were asked to solve the problem by providing the detail solution according to the mathematics model he made. The question was the same as problem number 3 but discusses the using of symbol, formal and technical language and operation aspect. Student with high self efficacy could write completely and structurally as in Figure 10.

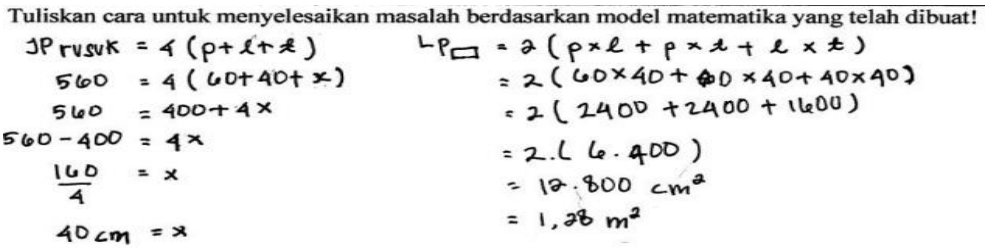


**Figure 10.** Using symbol, formal and technical language and operation on student with high self efficacy

Based on Figure 10, it can be seen that students were able to make the mathematical symbols in accordance with the given problem, could understand and explain the use of mathematical symbols that have been made. While students who have low ability cannot understand mathematical symbols well.

**6.Reasoning and argument**

Question: Yoga has a hobby of maintaining ornamental fish. Yoga maintains some ornamental fish in an aquarium in the living room of his house. Yoga has just ordered the aquarium at her aquarium shop. The aquarium has a surface area of 468 $cm^2$ with a ratio of p: l: t = 4: 3: 2. Before being filled with fish, reached 70% of classical completeness, the ability of mathematical literacy is also better than the ability of mathematical literacy using expository.

Students 'mathematical literacy ability using the PjBL learning model from the RME approach which is assisted by a problem card is better than the proportion of students' mathematical literacy ability using an expository learning model. self-efficacy affects the ability of mathematical literacy. This is in accordance with previous research expressed by Aprisal (2019), there is a strong relationship between mathematical reasoning skills and self-efficacy. The relationship obtained is a relationship with a positive direction. This means that the higher the student's self-efficacy, the higher the mathematical reasoning ability.

## CONCLUSION

This study shows that the achievement of students' mathematical literacy using the PjBL model of the RME approach aided by problem cards has reached 70% of classical completeness, the ability of mathematical literacy is also better than the ability of mathematical literacy using expository. Students 'mathematical literacy ability using the PjBL learning model from the RME approach which is assisted by a problem card is better than the proportion of students' mathematical literacy ability using an expository learning model. self-efficacy affects the ability of mathematical literacy.

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