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Mathematics Modelling Ability of Students on the Set Materials of VII Class with Problem-Based Learning (PBL)

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ABSTRACT
This research is motivated by the low ability of students in mathematical modelling, especially in the set material. To overcome this problem, the Problem-Based Learning (PBL) learning model is used. This study aims to describe how students' abilities related to mathematical modelling on the set material using the PBL model. This research took place at SMP Negeri 1 Muara Pinang, Empat Lawang Regency for the 2021/2022 academic year, involving 14 students as research subjects. The research method used is descriptive with quantitative and qualitative data analysis techniques based on mathematical modelling indicators. Data were collected using tests and interviews. From the results of the study, it was shown that the students' ability to model the set material was categorized enough with an average student score of 45.1 with a percentage of 50%.

Keywords: *Mathematical Modelling Ability, Set, Problem-Based Learning*

1. INTRODUCTION

Mathematics is one of the important lessons, in the world of education, understanding mathematics is very important for the life and development of science and technology today, to connect mathematics with everyday life, mathematical modelling skills are needed, according to [1-3] Mathematical modelling is a bridge that connects mathematical problems with everyday life, mathematical modelling is also defined as the process of converting real-world problems into mathematical form as an effort to find solutions to a problem [4]. Therefore, to be able to model mathematics, mathematical modelling is needed to be able to solve problems in everyday life.

The importance of mathematical modelling is contained in Permendikbud RI No. 22 of 2016 that solving a mathematical problem includes the process of understanding the problem, designing mathematical models, completing the models, and interpreting the solutions obtained [5]. The stages in mathematical modelling based on the book [6] are identifying problems, identifying variables, formulating mathematical models. DOIng mathematical work, checking back, and reporting results.

This research started from several studies that showed the low ability of mathematical modelling on set material, according to research by [7] onset questions when faced with story problems there are still students who find it difficult to make mathematical models, then from the research of [8] states that students experience problems in the procedural process where students' errors are in manipulating problems into the form of mathematical models, from the researcher's statement above shows that modelling is still a problem, so that students' mathematical modelling abilities on the set material are low.

As one of the factors that cause low student learning outcomes because the mathematics learning tools provided by the teacher are not with the learning objectives, characteristics, and abilities of students, this causes low student learning outcomes [9]. Therefore, a deeper analysis is needed in the preparation of learning tools, in this study using the KIkuduko Guide. KIkuduko-based Learning Toolkit is a learning tool developed based on (Competencies, Indicators, Keys, Supporters, Complexes) preparation of learning plans starting from analyzing Graduate Competency Standards (SKL), Core Competencies (KI), and Basic Competencies (KD), then continued with the formulation of Competency Achievement Indicators

(IPK), after that it was continued at the stage of preparing learning tools, according to [10].

In addition to overcoming this, an appropriate learning model will be used to train students' mathematical modelling skills, the learning model that will be used in this research is the Problem-Based Learning (PBL) model. Previous research stated that students' mathematical modelling could be improved through the PBL model, this was revealed by research from [11]. The PBL model is a learning model by presents a problem that requires students to investigate the problem and solve it as well as the skills to participate in the team [12]. Therefore, in this study, the learning tools were arranged using the PBL model. Based on previous research, there has been no research that examines student mathematical modelling on set material using the PBL model. Therefore, researchers are interested in researching with the title of "Mathematics Modelling Ability of Students on The Set Materials of VII Class with Problem-Based Learning (PBL)".

2. METHOD

This research uses quantitative and qualitative descriptive research which aims to see the mathematical modelling ability of junior high school students on the set material using the PBL learning model. This research was conducted at SMP Negeri 1 Muara Pinang, Empat Lawang Regency in the academic year 2021/2022, with a subject as many as 14 students of class VII D. This study will be categorized into 5 levels, namely very good, good, sufficient, poor, and very poor. will describe how students' mathematical modelling abilities through PBL learning will be described. To obtain data on students' mathematical modelling abilities on the set material, tests and interviews were conducted. The written test is given consists of 2 description questions to see how the students' mathematical modelling abilities are. Student test results were checked based on the scoring guidelines in table 1.

Table 1. Guidelines for scoring students mathematical modelling ability test

Indicator	Descriptor	Score
Identify the problem	Identify what information is in the question	3
	Formulate the problem asked in the question	3
Making Assumptions and Defining Variables	Using symbols or symbols to make mathematical models fit	3
	Making the Right Assumptions	2
Doing math	Formulate a mathematical model based on the given information and previously defined variables.	3
	Solve the model mathematically to get the correct solution	3
Analyze and assess solutions	Interpreting the solution of the obtained mathematical model	2
	Write down whether the solution obtained is reasonable	2
Check again	Checking the results obtained through the mathematical model that has been made	2
	Checking the results obtained through the mathematical model that has been made	2
Applying the Model	Interpreting solutions to the real world	2
	State the conclusion based on the solution obtained as a solution to the problem	2

Written test results are calculated based on the total score obtained

$$\text{Test Score} = \frac{\text{Total score obtained}}{\text{Maximum score}} \times 100 \quad (1)$$

Furthermore, the scores obtained are categorized as follows:

Table 2. Categories of mathematical modelling abilities

Test score range	Category Mathematical Modelling Ability
81 - 100	Very good
61 - 80	Good
41 - 60	Enough
21 - 40	Less
0 - 20	Very less

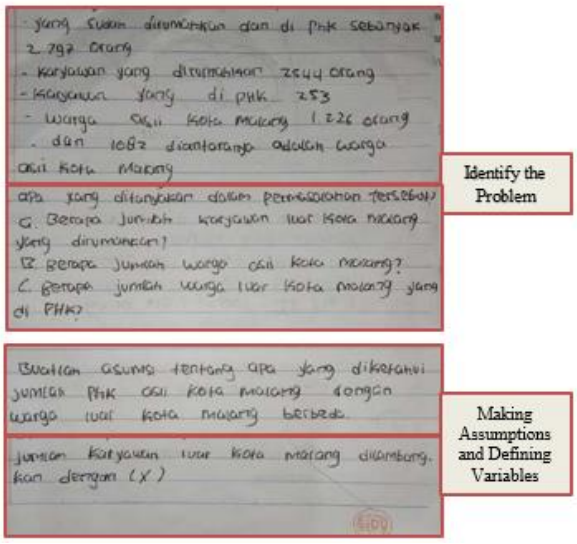
After the categorization of student scores, a percentage test is carried out on each indicator and then analyzed what appears in the results of the student's mathematical modelling test. Furthermore, the results of the data test will be analyzed qualitatively by selecting one of each student in each category based on the indicators of mathematical modelling, data and information obtained and then concluding.

3. RESULTS AND DISCUSSION

The preparation of this research begins by compiling learning tools in the form of IPKD with PBL learning and a mathematical modelling approach, then compiling LKPD containing one problem with a solution adapted to the stages of mathematical modelling, followed by making an assessment instrument in the form of test questions consisting of 2 description questions. The instruments in this study refer to mathematical modelling. The instruments that have been compiled have been validated by lecturers and teachers.

The research was conducted in three meetings with details of two meetings of the learning process using the PBL model and one written test. Each learning meeting uses LKPD which contains a set of problems, the provision of LKPD in each meeting is carried out by guiding and training students in mathematical modelling, the time allocation in each meeting is two hours of lessons, one lesson hour consists of 40 minutes. At the third meeting on Friday, October 8, 2021, a 60-minute written test was held, which was attended by 14 students of class VII D, by working on 2 test questions that had been prepared. After carrying out the test, a score is carried out on student answer sheets according to the scoring guidelines in table 1. The maximum score for each question is 29.

The following are the results of scoring the number 1 AF student in solving mathematical modelling test questions.



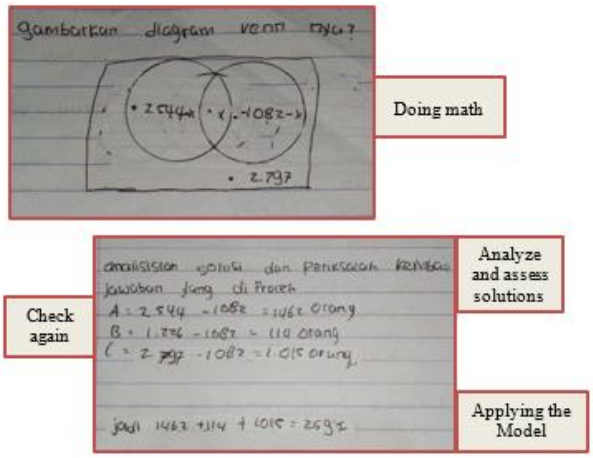


Figure 1 AF student answer to test question number 1

Based on the answers, the subject of AF can correctly identify the problem in the question so that it gets a score of 6, on the indicators of making assumptions and defining variables, it can be seen that students can make assumptions while defining the answer variables the answers are still incomplete getting a score of 4, then on the indicators of working on Mathematics AF subjects can formulate a mathematical model, but it is still not complete, while in doing mathematics, AF subjects have worked but not based on the model that has been made so that the score on this indicator is 4, on the indicator of analyzing and assessing the solution the subject gets a score of 2, on re-examination it can be seen that the subject did this step but was still wrong so the score obtained was 2, on the indicator of the application of the AF subject model the answer was still wrong so the score obtained on this indicator was 2. Based on the answer from the AF subject, it was categorized as good because meet the indicators.

The following are the results of scoring item number 2 for DHS subjects in solving mathematical modelling test questions.

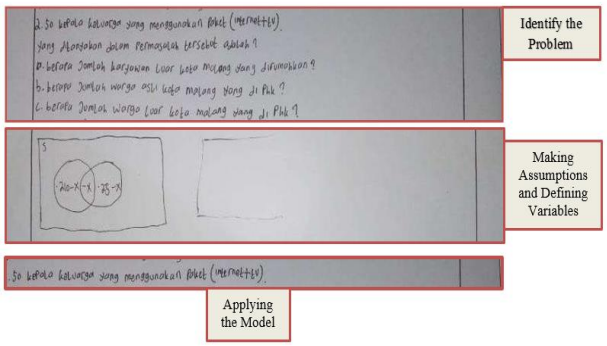


Figure 2 DHS student answer to test question number 2

Based on the results of the answers, on the indicator of identifying the problem, the DHS subject was able to formulate what was asked in the question correctly but

was wrong in writing what was known on the question so that it obtained a score of 4, on the indicator of making assumptions and defining variables, it was seen that students were able to define variables but did not make assumptions. assumptions so that the score obtained is 3, then on the indicator of doing mathematically, DHS subjects can formulate a mathematical model, but are still confused in working based on the model made so that the subject only gets a score of 3, on the indicator of analyzing and assessing solutions it does not appear that the subject writes answers on this indicator, as soon as the indicator checks again, the DHS subject also skips this stage, in the sixth indicator applying the model it appears that the subject wrote the answer but it was still wrong so the score obtained was 2.

After scoring the student's answers, then proceed with determining the category of mathematical modelling abilities according to the categories in table 2. The test data was also analyzed quantitatively to determine the categories of students' abilities in mathematical modelling, by categorizing students' abilities into 5 categories as shown in table 3.

Table 3. Percentage result of mathematical modelling abilities

Test value range	Category Mathematical Modelling Ability	Frequency	%
81-100	Very Good	0	0%
61-80	Good	2	14,3%
41-60	Enough	7	50%
21-40	Less	4	28,6%
0-20	Very Less	1	7,1%

The table above shows the categories of mathematical modelling abilities of the students of SMP Negeri 1 Muara Pinang. Based on the analysis of the results of the mathematical modelling ability test, there are no students who achieved the very good category, but the test results showed 14.3% of students were in a Good category, 50% of the students were in the Enough category, 28.6% of the students were in the Less category and 7.1% of the students were in the Very less category. The average grade VII D of SMP Negeri 1 Muara Pinang is 45.1%.

Then from the test results, the percentage of students' abilities in each indicator of mathematical modelling, the highest occurrence is in the Problem identification indicator by 85.7% of the students who master it, on the indicator of making assumptions and defining there are 49.2% of students who master it, on the indicator of working independently Mathematics there are 44.6% of students who master it, on indicators of analyzing and assessing solutions there are 18.7% of students who master it, on indicators of checking back there are 8.9% of students who master it, on indicators of model application there are 41.9% of students who master it. The highest percentage of the indicator identifies the problem and the lowest percentage is on the indicator of checking again.

The Indicator identifies the problem with the percentage of occurrences of 85.7%. In this indicator students are able to identify the information that is known on the question and formulate the problem asked in the question, in identifying the information that is known on the question there are students who are able but there are still a small number of students who are still incomplete in identifying the information that is known on the question, While in formulating the problems asked in the questions, students also still experience errors in formulating the problems asked in the questions, there are also students who only identify the information that is known in the questions but do not formulate the problems asked in the questions, based on the results of interviews, the causes of students still have difficulty in identify problems, namely lack of understanding of questions and lack of thoroughness in reading the questions given so that it is difficult to identify problems, this agrees with [13] that students are less careful and thorough in reading questions, so that information still important on the question is not written down.

The indicator makes assumptions and defines the percentage variable for the percentage occurrence of 49.2%. In this indicator only some students can make so that it affects the next step of work, based on the results of interviews that students still do not understand in making assumptions from questions so they do not write down their answers, while in using symbols to make mathematical models, only some students can answer correctly but not completely, some of the other students were still wrong, there were even students who did not use symbols to make mathematical models, based on the results of interviews when asked they could answer but were not accustomed to assuming information whose value was unknown related to difficulties in defining variables, This is in line with the research of [14] that students do not assume the information on the problem before they change to a mathematical model.

In Indicators doing mathematically, the appearance indicator is only 44.6%. The test results showed that only some students were able to formulate a mathematical model and complete the model mathematically, some other students were still wrong and incomplete, so the results obtained were still not correct. Based on the results of the interview, it is known that some of them are still confused in understanding the meaning of the question so the misinformation they use in solving the problem causes

the solution obtained to be wrong. This is in line with the opinion of [8] that the student's error is not understanding what is meant by the problem so the solution obtained is not right because it is wrong to use the information needed to solve the problem.

In Indicators analyzing and assessing solutions the emergence of indicators is only 18.7%, in this indicator only some students interpret the completion of the model made and write down whether the solution obtained is correct, even though it is still incomplete and wrong. In analyzing the solutions, many students are still wrong because the steps that were completed were still not correct, and in assessing the solution many students did not write answers at all, based on the results overviews the cause was that students were not able to express the right reasons to support their answers, this is in line with research from [15] that students are less able to assess solutions because not all students state and support and decide the answers they get are correct.

In the Indicator re-checking the occurrence of the indicator is only 8.9%, and is the lowest occurrence indicator, in this indicator only a few students check the results obtained and prove the truth of the results obtained, although they are not complete, some other students do not write answers, based on the results Interviews on indicators re-examine students feel that they are sufficient at the problem-solving stage so that the model obtained is not rewritten to prove whether it is correct, this is in line with research from [16] that other students feel that the results of their work are correct so they don't need to be done. another check.

The Indicator applies the indicator emergence model of 41.9%, in this indicator only some of the students interpret solutions to the real world and state the conclusions from the solutions obtained, and there are still students who are wrong in interpreting solutions to the real world and stating conclusions, there are even students who do not solve the problem completely so that they do not get a solution, as a result, they do not interpret the solution to the real world and do not state the conclusion of the solution obtained, based on the results of interviews, students are still wrong in the process of working mathematically so they do not write down interpreting the solutions obtained in the real world and do not state conclusions The results obtained, this is in line with research from [17] which states that in drawing conclusions students write answers without any reason and have not even completed the answers so that they have difficulty in stating conclusions. from the solution obtained

4. CONCLUSION

Based on data analysis, students' mathematical modelling abilities on set material through the PBL model are categorized as adequate with an average value of 45.1. the percentage per category is 14.3% of students are in a good category, 50% of students are in enough category, 28.6% of the students are in the less category and 7.1% of the students are in the very less category.

Based on the indicators of mathematical modelling ability, it can be seen that the highest percentage of occurrences is found in the problem identification indicator, meaning that students can identify known information and can formulate what is developed in the problem, but there is still an incomplete student. incomplete in defining variables not making assumptions, on indicators of doing mathematics students, can make models from Venn diagrams but they are not complete, models are made to find solutions, on indicators of analyzing and assessing solutions there are still many students who do not write down answers because students think it is correct, on indicators re-checking the percentage of occurrence is low, there are still many students who do not rewrite the process of finding solutions and proving the solutions obtained, on the indicators of model application There are still many students who do not state conclusions and interpret solutions to the real world, they immediately write the results obtained based on the stages of the completion model. Thus, based on the results of research analysis, students' mathematical modelling abilities on set material still need to be considered and more often given about matters relating to the stages of mathematical modelling so that they are more accustomed to solving problems with mathematical modelling on set material. and in giving questions, it is necessary to pay attention to the appropriate time allocation to process them so that the results obtained are as expected.

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