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# Problem-Based Mathematics Learning to Analyze The Mathematical Literacy Ability of VIII Class Students Reviewed Based on Minimum Competence Assessment Type (AKM)

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**Abstract**
*This study aims to determine the trajectory of learning that is oriented towards mathematical literacy skills and to find out the results of learning that are oriented towards mathematical literacy abilities with problem-based learning in terms of AKM-type questions. This type of research is design research, descriptive model. The research subjects were 20 students in the experimental class and 7 students in the research class. The results of the study were obtained by carrying out 2 learning meetings and 1 meeting for the test. In general, the steps of the research carried out are: (1) provide real problems related to opportunity material on the topic of sample space and sample points, (2) provide problems related to opportunity material on the topic of opportunity events, (3) provide a final test in the form of real problems presented with the AKM type. The learning outcomes after undergoing a problem-based mathematics learning process are: (1) Students can mention the sample space and sample point of an event, (2) students can mention the formula for the probability of an event and the probability of not happening, (3) Students have not fulfilled the 3 basic competencies of mathematical literacy.*
**Keywords:** *Mathematical Literacy, Problem-Based Learning, Minimum Competency Assessment*

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## INTRODUCTION

One of the objectives of learning mathematics listed in the attachment to Permendikbud No.58 of 2014 is to use patterns as conjectures in problem solving, and be able to make generalizations based on existing phenomena or data, and use reasoning on properties, perform mathematical manipulations in simplification, as well as analyze components existing in solving problems in the context of mathematics and outside mathematics (real life, science, and technology) which includes the ability to understand problems, build mathematical models, complete models and interpret the solutions obtained, including in the context of solving problems in everyday life(Kemendikbud, 2020).In addition, according to Cokroft, mathematics needs to be taught to students because (1) it is used in all aspects of life, (2) all fields of study require appropriate mathematical skills, (3) it is a strong, concise and concise means of communication, (4) can be used to present information in various ways, (5) improve logical thinking skills, accuracy, and spatial awareness, and (6) give satisfaction to efforts to solve challenging problems(Permatasari et al., 2015). Mathematics used in terms of life is called mathematical literacy.(Pratiwi & Ramdhani, 2017).

Mathematical literacy is a person's ability to formulate, apply, and interpret mathematics in various contexts, including the ability to reason systematically and use concepts, procedures, and facts to describe, explain, or predict phenomena or events(Pratiwi & Ramdhani, 2017).Based on the results of interviews with teachers at school, the teacher said that students' literacy skills were still lacking. This makes it difficult for students to solve the questions given. In addition, based on the results of PISA in 2018, math literacy skills in Indonesia received an average score of 379. (McComas, 2014). The ability of Indonesian students' mathematical literacy is at level 2. The highest level achieved by Indonesian students is level 3.

One of the efforts made by the government to find out and improve the ability of students in Indonesia is to carry out a basic competency assessment or commonly known as the Minimum Competency Assessment (AKM).AKM is different from the National Examination (UN), AKM no longer evaluates the learning outcomes of individual students, but evaluates and maps the education system in the form of inputs, processes and results.AKM presents problems in a variety of contexts that students are expected to be able to solve by using literacy and numeracy competencies.There are two basic competencies that are measured through the AKM, namely literacy and numeracy/mathematical literacy.The form of AKM questions consists of true-false, multiple choice, complex multiple choice, matchmaking, short entries, and descriptions.

One of learning model that can be used to improve students' mathematical literacy skills is problem-based learning.Problem-based learning is a learning model in which students face real problems so that they are expected to construct their own knowledge, develop higher-order thinking skills and problem-solving skills, empower students and increase their self-confidence.(Pratiwi & Ramdhani, 2017)

Based on the description above, the purpose of this research is to find out the learning trajectory of students who are oriented towards mathematical literacy abilities with problem-based mathematics learning reviewed based on questions of the Minimum Competency Assessment (AKM) type and to find out the results of learning that is oriented towards mathematical literacy abilities with problem-based mathematics learning reviewed based on Minimum Competency Assessment (AKM) type questions.The novelty in this study is that it will discuss the design of problem-based mathematics learning processes that are oriented towards students' mathematical literacy abilities and how to teach them in teaching and learning activities in class, as well as describe student learning outcomes that are oriented towards students' mathematical literacy abilities.In addition, the Minimum Competency Assessment (AKM) is one of the new policies from the Ministry of Education and Culture.Thus, the

questions used by researchers are questions adapted from the Minimum Competency Assessment (AKM).

## METHODS

This research was conducted in May 2023 in class VIII of SMP SionTimika in the 2022/2023 class year as a trial class and in class VIII of SMP YosuaTimika in the 2022/2023 research class. The research object to be examined is the design of mathematics learning in the matter of opportunities and students' mathematical literacy abilities.(Niss, 2015). This research is design research. The researcher chose design research because it will design a learning design that is oriented towards students' mathematical literacy abilities to develop opportunity materials. This research was conducted by following several procedures as follows: 1) identifying problems to be solved, 2) formulating problems, objectives, and research benefits, 3) designing learning trajectories, determining research subjects, and determining data collection instruments, 4) collecting data and analyzing data, 5) writing articles. The process of collecting data is done through assessment of learning outcomes and interviews.(Hidayat et al., 2021). In this study, the instruments used were learning achievement tests and interviews related to students' mathematical literacy abilities. The following is a grid of learning outcomes tests and interview sheets used.

**Table 1: Test Grid of Learning Outcomes**

| Question Indicator | Question Form | Question Number |
|---|---|---|
| Determine the probability of an event occurring | PG Complex | 1 |
| Determine the probability that an event will not occur | BS | 2 |
| Determine the probability of a simple event | Matchmaking | 3 |
| Determine the sample space, sample points, and probability of an event | Essays | 4 |

**Table 2: The Grid of Interview Sheet**

| Indicators of Mathematical Literacy Ability | Sub-Indicators of Mathematical Literacy Ability | Question Items |
|---|---|---|
| Able to formulate problems mathematically | State the outline of a given problem | 1 |
| | State what is known, asked, and change the problem into mathematical form | 2,3 |
| Able to use concepts, facts, procedures, and reasoning in mathematics | Explain the procedure or steps appropriate to solving the problem | 4 |
| | Describe the implementation of the settlement strategy used | 5 |
| Interpret, apply, and evaluate the results of a mathematical process | Summing up the results obtained | 6 |
| | Re-check the answers and adjust them to the problems given | 7 |

## RESULTS AND DISCUSSIONS

The learning process for the trial class and research class was carried out in two meetings each.At the first meeting of the trial class, it was a learning trajectory 1 trial, the goal was for students to be able to determine the sample space and sample points of an event.After carrying out the trial, the researcher evaluated the learning activities, then held the first meeting in the research class.The second meeting of the trial class is the learning trajectory 2 trial, the goal is for students to be able to determine the

probability of an event occurring or not occurring. The subjects in the trial class were 20 students of class VIII-C SMP SionTimika.The first meeting was held on 12 May 2023 and the second meeting was held on 17 May 2023.The research subjects in the research class were 20 students of class VIII SMP YosuaTimika. The first meeting was held on 19 May 2023 and the second meeting was held on 25 May 2023.(Bakker, 2014) The learning process in the trial class and research class was carried out using the Problem Based Learning (PBM) model.In the learning process, the researcher gave 3 real problems related to the opportunity material.

**Description of the Learning Process and Learning Outcomes of the Trial Class**

*Learning Process*

Learning with PBM consists of 5 phases that must be carried out, with the following details:

1. Provide Orientation on The Problem to Students

   In this phase, the researcher conveys the learning objectives to the students, then the researcher reviews the relations and functions material that has been studied.After that, the researcher gave examples of problems related to opportunities that occur in everyday life, such as throwing dice when playing snakes and ladders.The researcher then asked the students to mention other problems, the students responded by mentioning the tossing of a coin.At the second meeting, the researcher reminded students of the material that had been learned at the previous meeting.The indicator of the achieved mathematical literacy ability is indicator 1.

2. Organizing Students to Research

   The researcher asked students to form groups and then gave Student Worksheets (LKS) 1 which consisted of two problems for students to work on.Students are asked to solve the problem in any way.While the students were discussing, the researcher walked around to check the students' work.It can be seen that several groups of students were still confused and asked for directions to solve the problem.The researcher provides support by asking students to recall the material that we just reviewed at the beginning of the meeting.After being given support, students returned to discussing with their group mates.(Robert & Brown, 2004)The researcher went around and checked the students' answers, it turned out that in problem 1 there were 2 groups of different answers.Answer group 1 uses an arrow diagram and a set of ordered pairs to solve the problem, while answer group 2 uses a Cartesian diagram and a set of ordered pairs to solve the problem.In problem 2, it can be seen that each group was able to solve the problem by looking back at the completion process of the previous problem.(Junita, 1967)

   In the second meeting, the researcher asked the students to sit back according to the group members.During the process, students are able to work on questions in parts a and b.Students are a little confused when working on points c, d, and e.The researcher then gives a number of supporting questions such as “how many events have occurred out of all possible events, how many are there?”, students then respond “for that c, there are 3 events out of 12 events”.Then the researcher again gave supporting questions so that students could come up with the “$\frac{3}{12}$” shape.

   Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 2.

3. Helping Investigative Research Groups

   The researcher walked around to see the work done by each group.When solving the first problem, some groups used arrow diagrams to determine the

relationship between the dice and the coin. It can be seen that the group still writes the pair as follows:

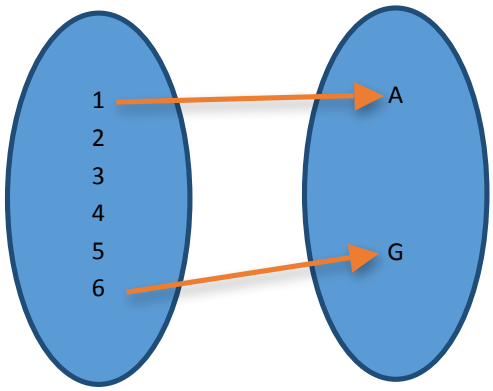



Figure 1: Arrow Diagram of Dice and Coin Relationship of Trial Class

Some groups that use arrow diagrams, still write relationships like the picture above.The researcher then asked why only two pairs were formed? Students then respond by explaining related to function material that members of set A can only have exactly one pair in members of set B.The researcher then asked the students to look again at the relationship material contained in the textbooks owned by the students.After reviewing the material, students begin to understand and correct these mistakes.This also happened to groups of students who used Cartesian diagrams to solve the problem.At the time of solving the second problem, students were able to solve the problem without making a mistake.(Nolaputra et al., 2018)

At the second meeting, it was seen that there were several groups of answers.Some use the sentence “3 of 12” and some directly use the mathematical form “$\frac{3}{12}$”. Groups that still use sentences are given supporting questions so they are able to write them in a mathematical form.

Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 2.

4. Develop and Present The Results of Group Work

In this phase, the researcher asked students to present the results of their group discussions.The researcher chose representatives from answer group 1 and answer group 2.Students then provide solutions to these problems.The researcher guided the presentation and gave appreciation to each group.

The indicator of mathematical literacy ability achieved in this phase is indicator 3.

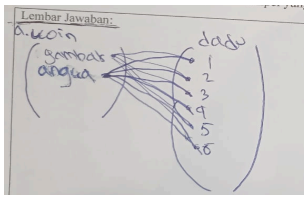
5. Analyze and Evaluate The Problem Solving Process

In this phase, the researcher gives several questions that lead students to make a conclusion, such as “what are the similarities between problems 1 and 2?” and students answered “problems 1 and 2 require data from members of the set to find out the possibilities that occur”.The researcher then provides other supporting questions, so students can conclude what the sample space and sample points are.

At the second meeting, the researcher gave several questions that led students to make conclusions regarding the probability of an event such as “based on your work, what is meant by an event?”, students then answered “results that occurred in the sample room”.The researcher then provides follow-up questions until students are able to make conclusions regarding the probability of an event and the probability that an event does not occur (complementary probability).(Utami et al., 2021)

Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 3.

*Learning Outcomes of Test Class Student*



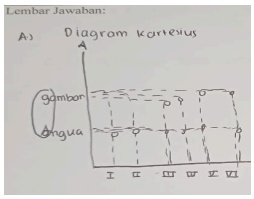




**Figure 2: Work Results of Problem 1**

From the picture above, it can be seen that there are groups of students who use arrow diagrams and there are groups of students who use Cartesian diagrams.The two groups use different ways to solve the problem, but still use a set of ordered pairs to determine the sample space and sample point for the event.

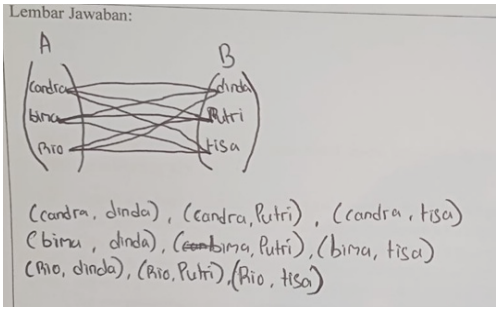



**Figure 3: Work Results of Problem 2**

Test class students use the same method to solve problem number 2.It can be seen that students use arrow diagrams and a set of ordered pairs to solve the problem.

At the completion of LKS 2, each group immediately writes down the results by mentioning the number of answers to the question.Students no longer do data collection or re-calculation, because the questions on LKS 2 are developments from the questions on LKS 1.

**Description of the Learning Process and Test Results for Research Class Students**

*Learning Process*

Learning with PBM consists of 5 phases that must be carried out, with the following details:

1. Provide Orientation on The Problem to Students

   In this phase, the researcher conveys the learning objectives to the students, then the researcher reviews the relations and functions material that has been studied.After that, the researcher gave examples of problems related to opportunities that occur in everyday life, such as throwing dice when playing snakes and ladders.Then the researcher asked students to mention other problems, students still had difficulty giving other examples.At the second meeting, the researcher reminded students of the material that had been learned at the previous meeting. Students already understand what a sample space and sample points are.

   There are no indicators of mathematical literacy ability achieved in this phase.
2. Organizing Students to Research

   In this phase, the researcher did what was done in the trial class. When the researcher walked around, it was seen that all groups worked using arrow

diagrams.Most of the students in the class already understood what had to be done so they didn't ask many questions.(Prahmana et al., 2016)

At the second meeting, the researcher reminded students about the previous meeting.Students are able to work on part a and on the problem. But students are still confused about working on the next part.Then the researcher gave several supporting questions related to everyday life. "For example, the teacher gives money to all of you in class. There were 10 children who received 5 thousand each and there were 5 children who received 2 thousand each.The question is how many children get 5 thousand money"the students answered "there were 10 people", then the researcher again asked "the total of 5 thousand children got from how many children" the students returned to answer "10 children out of a total of 15 children". The researcher then gave other supporting questions so students could write "$\frac{10}{15}$". Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 2.

3. Helping Investigative Research Groups

   The researcher walked around and saw the work results of two groups. It can be seen that the second group uses the arrow diagram and the set of ordered pairs, while the first group immediately uses the set of ordered pairs to list the members that appear.

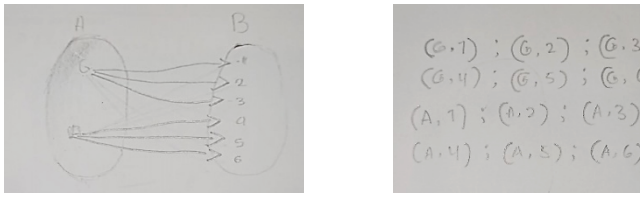



**Figure 4: The Work Results of Group 1 on Problem Number 1**

When making arrow diagrams, it can be seen that the group is still confused.The researcher then gave several supporting questions related to the relationship material, students gave good responses and were able to collect data correctly.

At the second meeting, students still had difficulty solving questions c and d.The researcher then gave a number of supporting questions as was done in the trial class to lead students to write down the mathematical form of the answer to the question. Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 2.

4. Develop and Present The Results of Group Work

   In this phase, the researcher selects representatives from each group to explain the completion of their work.It can be seen that each group was able to explain the solution process in general and clearly to their friends.

   The indicators achieved in this phase are indicators 1, 2 and 3.

5. Analyze and Evaluate The Problem Solving Process

   In this phase, the researcher does the same thing as was done in the trial class.The researcher provides supporting questions that guide students to conclude what they have learned today. Indicators of mathematical literacy skills achieved in this phase are indicators 1 and 3.

*Test Results of Research Class Student*

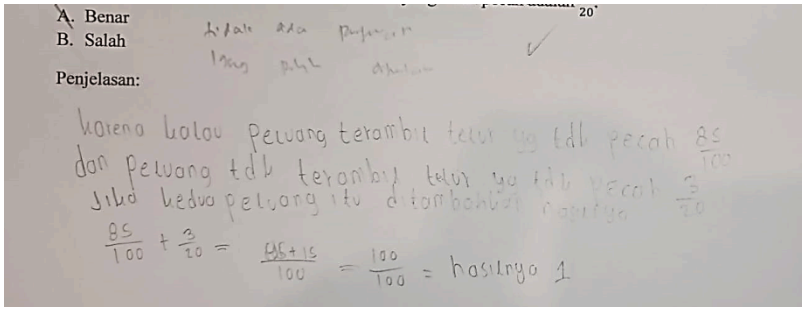



**Figure 5: Correct Answer**

Based on the results of the work above, it can be seen that students have been able to work on the questions given well.When solving problems, students also seem to be able to provide mathematical explanations related to completion.As for question no 2 above, it can be seen that to prove the statement is true or not, students do addition to see whether the total probability of its occurrence is 1 or not.

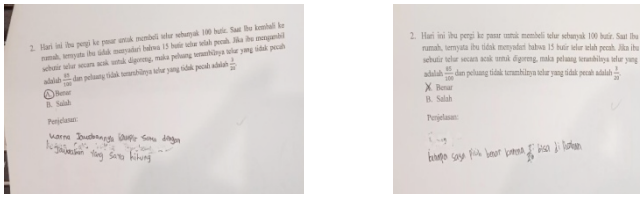


**Figure 6: Incorrect Answer**

There are some students who answered “correctly”, but have not been able to prove the answer they chose.As can be seen from the picture above, students only give opinions without proving their truth value.Based on the results of the interviews, students said that they chose answer A because the processing time was tight, so they were forced to choose answer A. Around 90% of students in the research class still had difficulty working on the test questions given.They are still confused about where to start and how to finish it.

Based on the results of work and interviews with research subjects for indicator 1, as many as 90% of students have understood the problems given.Students are able to understand the problem and mention the outline of the problem.For indicators 2 and 3, as many as 90% of students have not been able to solve the problem.Students have not been able to use the appropriate settlement steps to solve the given problem.So, as a whole it can be said that class VIII students of SMP YosuaTimika for the 2022/2023 school year have not fulfilled the 3 main competencies of mathematical literacy ability.

The novelty of this study is that it will focus on designing problem-based mathematics learning processes that are oriented towards students' mathematical literacy skills. This is an important area of research because mathematical literacy is essential for students to be successful in today's world. The study will also discuss how to teach these problem-based learning processes in teaching and learning activities in class, giving teachers a practical GUI.(Junita, 1967)

Additionally, the study will provide student learning objectives that are focused on students' mathematical literacy skills. This will make it easier to evaluate how well the problem-based learning techniques work. The Minimum Competency Assessment (AKM) was modified for the researchers' use in this study. This new regulation from the Ministry of Education and Culture is intended to evaluate students' proficiency in mathematical literacy.

The research will substantially advance the field of mathematics instruction. It will offer fresh perspectives on how problem-based mathematics learning processes are created, as well as helpful advice for instructors on how to adopt this kind of instruction in their classrooms. Additionally, the study will contribute to the evaluation of problem-based learning's efficiency in terms of student learning outcomes.

Specific points that could be discussed in the study:

- The benefits of problem-based learning for mathematical literacy
- The challenges of implementing problem-based learning in mathematics classrooms
- The design of problem-based learning processes that are oriented towards mathematical literacy
- The teaching and learning activities that can be used to implement problem-based learning in mathematics classrooms
- The student learning outcomes that can be achieved through problem-based learning

The study could also include a case study of a teacher who has successfully implemented problem-based learning in their mathematics classroom. This would provide a concrete example of how this type of learning can be implemented in practice.

## CONCLUSION

Based on the research results, it can be concluded that:

1. In general, the research steps carried out are: (1) provide real problems related to opportunity material on the topic of sample space and sample points, (2) provide problems related to opportunity material on the topic of opportunity events, (3) provide a final test in the form of real problems presented with the AKM type.
2. Learning outcomes after undergoing a problem-based mathematics learning process, namely, (1) Students can name the sample space and sample points of an event, (2) students can mention the formula for the probability of an event and the probability of not happening, (3) students have not fulfilled the 3 basic competencies math literacy.
3. It is advised that problem-based mathematics learning methods be further enhanced in order to enhance student learning outcomes in terms of mathematical literacy, according to the research findings. To help students develop their problem-solving abilities and their capacity to apply mathematical principles to real-world issues, problem-based learning procedures should be specifically created.

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