

Research Article

Application of Problem-based Learning in Efforts to Build Mathematical Literacy Skills

Adelia Putri Liowardani¹, Hendro Permadi², Yuli Anita³¹Pascasarjana PPG Prajabatan Matematika, Universitas Negeri Malang²Universitas Negeri Malang³SMP Negeri 3 Malang**Abstract.**

Mathematical literacy ability is the ability that a person has in formulating, using, and interpreting mathematics in a variety of concepts. From the results of diagnostic tests conducted at the beginning of the 7.1 grade learning year at SMPN 3 Malang, it was found that more than 50% of students were not maximal in applying mathematical concepts in solving a mathematical problem. This can happen due to a misunderstanding of the problem or also a mathematical concept that is not used to being used. The use of learning by using problem-based learning, which is carried out in 2 cycles and discusses material regarding number operations (multiplication and division of integers) is applied to build students' mathematical literacy skills on number operations material. This study contains actions that are adapted to the syntax of problem-based learning and indicators at level 2-3 PISA mathematical literacy abilities. The results of this study applying the problem-based learning model adapted to the PISA mathematical literacy ability indicators obtained a very significant increase in score from 50.01 to 91.43 and at the evaluation stage, the results increased from 44% to 75.86%. It can be stated that the application of problem-based learning model if adapted to PISA's mathematical literacy ability indicators can build mathematical literacy skills.

Keywords: problem-based learning, mathematical literacy, operation of integers

Corresponding Author: George Smith; email: george.s@ox.ac.uk

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1. PENDAHULUAN

The Covid-19 pandemic that hit Indonesia in mid-January 2020 made the Government call on all Indonesian people to carry out activities from inside the house and keep their distance to suppress the spread of the virus that occurred. This is also related to the implementation of learning in schools at all levels in Indonesia. Distance learning that is carried out in schools can be done online using several electronic media such as gadgets, laptops, and others. Several applications are also used to support learning activities as a form of adaptation so that learning activities that were originally carried out face-to-face can be carried out remotely. Related to the new adaptation that they have to adjust, of course, it will also cause them to face several obstacles. Barriers that occur are not only from their skills in using electronic media and the applications

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they have to use but also in the way the material is given. In learning Mathematics in particular, several mathematical concepts cannot be given as a whole, and causing the knowledge absorbed by students is also not optimal. This mathematical knowledge includes the mathematical concepts they will use in solving a problem. In solving a mathematical problem, it requires the ability to understand the problem in advance to use of mathematical concepts in solving mathematical problems.

In learning mathematics in Indonesia, currently, problems related to everyday life are only used as a source of inspiration for inventions or concept formation due to the lack of students' literacy skills so students only apply existing concepts instead of studying and interpreting mathematical concepts themselves [1]. Mathematical literacy skills are very important because mathematics is very closely related to everyday life [2]. Besides that, mathematical literacy also emphasizes students' abilities to analyze, give reasons and communicate ideas effectively in solving mathematical problems they encounter [3]. According to [4] states that mathematical literacy does not only involve the use of procedures but requires basic knowledge and competence as well as the confidence to apply their knowledge in everyday life. This means that individuals who have good mathematical literacy skills will have an impact on the process of how these individuals solve mathematical problems in a structured manner according to their level and the mathematical concepts they have previously had. To find out how much an individual's mathematical literacy ability can be used several tests, one of which is a diagnostic test.

Diagnostic tests are a way to find out certain signs or symptoms in individuals towards understanding a particular concept. Based on the Diagnostic Test that was carried out at the beginning of the 2022/2023 school year with the subject matter of Numbers for grade 7 at SMPN 3 Malang, it was found that more than 50% of grade 7.1 students at SMPN 3 Malang still lacked understanding of mathematical concepts and the use of mathematical concepts in solving a problem. The knowledge or mathematical concepts that they received during their education in elementary schools still cannot be absorbed properly. This also underlies why students' mathematical literacy abilities cannot be applied optimally. There have been several studies that have been done previously to improve students' mathematical literacy abilities with several methods, one of which is the application of the Problem Based Learning learning model. From the results of research by [5], the Problem Based Learning Approach influences students' mathematical literacy abilities. It is clear that there are differences in how individuals in their research subjects solve problems and these individuals are accustomed to encountering problem-solving questions. Based on research conducted by [6] it is known that there is an increase in the mathematical literacy skills of individuals who do

learning with the Problem Based Learning model. According to this study, it is also said that improvement leads to better things when compared to individuals who carry out conventional learning.

Based on the description above, the application of the Problem Based Learning model can be used to improve or build students' mathematical literacy abilities. The learning model consists of several kinds. One of the learning models is the Problem Based Learning (PBL) learning model, which from the translation alone means that this learning is based on a problem. According to [7], PBL is a learning model that starts with giving a problem related to real everyday life. Furthermore, students solve the problem to find new knowledge. The PBL learning model is learning that focuses on students as learners and on authentic or relevant problems that will be solved using all the knowledge they have or from other sources [8]. According to [9] the PBL model uses real and authentic life problems to actualize knowledge which will help students make connections between abstract content knowledge and situations where they can apply the abstract content knowledge. Therefore the problems used in this learning model must be problems that are contextual and close to the environment of an individual or in other words the individual has recognized or even understood a condition in the problem. In the Problem Based Learning (PBL) learning model, the teacher plays a role in directing students to connect problems with the demands of a predetermined curriculum. However, in this case, students are also allowed to expand the problem of what they want to learn and want to know [10]. Usually a learning model, problem-based learning has learning steps or what is known as syntax. The following is the syntax for problem-based learning according to [11].

1. Student Orientation

on Problems In this stage, the teacher explains the learning objectives, explains the necessary logistics, poses problems, and motivates students to engage in problem-solving activities.

1. Organizing Students

In this stage, the teacher helps students define and organize learning tasks related to problem

1. Guiding Individual and Group Investigations

In this stage the teacher encourages students to collect appropriate information, and carry out experiments to get problem-solving

1. Develop and Present the Work

The teacher assists students in planning and preparing suitable works such as reports, videos, and models, and helps them with various assignments with their groups

1. Analyze and Evaluate the Problem-Solving

Process In this last stage the teacher helps students reflect or evaluate their investigations in the processes they use.

Based on a description of related research on the application of the Problem Based Learning model in improving mathematical literacy skills, a description of level 3 literacy skills for grade 7 students, and a description of learning achievement in number material for grade 7 which focuses on performing arithmetic operations on a variety of numbers in several ways and use it in solving a problem, for this study the following research indicators were compiled:

Based on the description above and related research, a class action research was appointed with the research subject being grade 7.1 students of SMPN 3 Malang with the title "Implementation of Problem Based Learning Models in Efforts to Build Mathematical Literacy". This study aims to determine the steps for applying the Problem Based Learning model to build mathematical literacy skills.

2. METHOD

This research was conducted at SMPN 3 Malang. As many as 30 grade 7.1 students of SMPN 3 Malang were the subjects of this study. In terms of gender, this class is a heterogeneous class with 14 male students and 16 female students. Furthermore, in terms of their mathematical literacy abilities, the research subjects had heterogeneous initial abilities but tended to be low. Information about the condition of the research subjects is used as a material consideration in planning to carry out research. This study was carried out in two cycles with the following details:

Description of the Implementation of Cycle I Actions

1. Planning This stage is carried out before taking action in each cycle.

This stage is used to prepare for everything that will be done, including:

1. Making teaching modules based on the consideration of the subject teacher concerned and related material

TABLE 1: Research Indicators.

Syntak Problem Based Learning	Learning Achievement Indicators		Mathematical Literacy Ability Indicators
	Cycle 1	Cycle 2	
Students Orientation	Describe information from an illustration of a problem related to the operation of multiplying integers	Describe information from an illustration of a problem related to the operation of integer division	Interpret and recognize situations in contexts that require immediate conclusions (Level 2)
Organizing Students	Plan a problem-solving process based on the information that has been described	Plan a problem-solving process based on the information that has been described	Choose and apply simple problem-solving strategies
Guiding Individual and Group Investigations	Perform the multiplication operation using the number line based on the sign of the number	Perform the multiplication operation using the number line based on the sign of the number	Interpret and use representations based on different sources of information
	Identify the properties of number operations that apply to integer multiplication operations	Identify the properties of number operations that apply to integer division operations	
Develop and Present the Work	Evaluating the results of group work including its suitability and completeness by communicating through presentations, asking questions, responding, and refuting in solving problems related to integer multiplication operations	Evaluating the results of group work including its suitability and completeness by communicating through presentations, asking questions, responding, and refuting in solving problems related to integer multiplication operations	Mengkomunikasikan dan melaporkan interpretasi, hasil, dan hujh
Analyze and Evaluate the Problem-Solving			

2. Determine the learning model that will be applied in improving students' mathematical literacy abilities
3. Making problem-based worksheets arranged according to the syntax in the learning model. These worksheets are used to guide students in discovering concepts and taking action in an effort to build mathematical literacy skills
4. Compile and prepare observation sheets for the implementation of actions in an effort to build mathematical literacy skills by applying the Problem Based Learning model
5. Compile problem-based Reflection test questions as a result of reflection on the actions that have been implemented

6. Implementation of Actions

At this stage, learning mathematics material multiplication of integers by applying the Problem Based Learning learning model with the following steps:

1. Orient students to the problem
2. Organizing students to study
3. Assist independent and group investigations
4. Develop and present work in the form of worksheets
5. Perform analysis and evaluation of worksheet results During the process of implementing the action there were two observers to observe the activities of researchers and students activities in the implementation of learning activities by applying Problem Based Learning.
6. Reflection

This stage is the final stage of the cycle. At this stage, students will work on a test with problem-based types of questions that contain material related to the multiplication of integers and the nature of the operations that apply to it. After the test was carried out, reflection was carried out based on the test results and the results of the observation sheets carried out by 2 observers. Then there is a discussion of the obstacles that occur, an evaluation of learning activities, and types of actions applied to build mathematical literacy skills to improve the next cycle.

Description of the Implementation of Cycle 2 Actions

The stages of activities that have been carried out in cycle I am repeated in cycle II activities. The action plan for cycle II was prepared based on the results of the reflection in cycle I by making several improvements according to the problems that arose. In the second cycle of action activities, it will be seen how the results of the actions carried out on the subject build mathematical literacy skills by applying the Problem Based Learning model based on indicators of mathematical literacy ability.

3. RESULT AND DISCUSSION

The results obtained in this study will be described in the description of the 2 cycles as follows.

A. Description of the implementation of the cycle I In the implementation of the first cycle of action, there were several syntaxes from the application of Problem Based Learning which were not carried out because students as research subjects were not by the time allocation that had been carried out. In the process of orienting the problem students are still not familiar with reading problems and describing them in information. This also resulted in the process of representing the problem as well as delays and finally, the communication process which should be carried out directly by students must be carried out by the teacher as a researcher.

TABLE 2: The Result of Cycle I.

Syntax of Problem Based Learning	Learning Achievement Indicators	Mathematical Literacy Ability Indicators	Score
Students Orientation	Describe information from an illustration of a problem related to the operation of multiplying integers	Interpret and recognize situations in contexts that require immediate conclusions (Level 2)	10,67
Organizing Students	Plan a problem-solving process based on the information that has been described	Choose and apply simple problem-solving strategies	10,67
Guiding Individual and Group Investigations	Perform the multiplication operation using the number line based on the sign of the number	Interpret and use representations based on different sources of information	8,67
	Identify the properties of number operations that apply to integer multiplication operations		
Develop and Present the Work	Evaluating the results of group work including its suitability and completeness by communicating through presentations, asking questions, responding, and refuting in solving problems related to integer multiplication operations	Communicating and reporting interpretations, results, and their reasons	0
Analyze and Evaluate the Problem-Solving			20
TOTAL SCORE			50,01

Based on the table above, it can be seen that the score obtained is only 50.01 out of a maximum of 100. This is because some syntax cannot be implemented properly. The poor implementation of the learning stages resulted in the process of building students' mathematical literacy skills. This becomes a reflection and material for improvement in the implementation of cycle II actions. From these results, it is also known that when

the subject has experienced problems when describing the problem it will result in the problem representation stage

B. Description of Implementation of Cycle II Actions Based on the implementation of the first cycle of actions, the implementation of the second cycle of the implementation of the problem orientation is carried out together. This has a good impact on the representations produced by students. This also resulted in the implementation of the presentation can be done directly by students.

TABLE 3: Result of Cycle 2

Syntax of Problem Based Learning	Learning Indicators	Achievement	Mathematical Ability Indicators	Literacy	Score
Students Orientation	Describe information from an illustration of a problem related to the operation of multiplying integers		Interpret and recognize situations in contexts that require immediate conclusions (Level 2)		20
Organizing Students	Plan a problem-solving process based on the information that has been described		Choose and apply simple problem-solving strategies		20
Guiding Individual and Group Investigations	Perform the multiplication operation using the number line based on the sign of the number		Interpret and use representations based on different sources of information		11,43
	Identify the properties of number operations that apply to integer multiplication operations				
Develop and Present the Work	Evaluating the results of group work including its suitability and completeness by communicating through presentations, asking questions, responding, and refuting in solving problems related to integer multiplication operations		Communicating and reporting interpretations, results, and their reasons		20
Analyze and Evaluate the Problem-Solving					20
TOTAL SCORE					91,43

Based on the table above, a significant increase was obtained from the actions in cycle I. The implementation of this research action ended in cycle II because it was appropriate. From the table above it is known that the score obtained is 91.43 out of a maximum score of 100.

4. CONCLUSION

Based on the results of the analysis and discussion above, it can be concluded that the application of Problem Based Learning steps can be used to build mathematical literacy skills. This can be seen from the changes in scores obtained from cycle I to cycle II from indicators that have been prepared according to the syntax in the Problem Based Learning learning model, number learning achievements for phase D related to performing number operations, and indicators at level 3 for mathematical literacy skills. To build mathematical literacy skills as outlined in worksheets that were worked on in groups using the application of Problem Based Learning, the score in cycle I was 50.01 and experienced a change for the better in cycle II with a score of 91.43

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