Can the problem-based learning model affect students’ mathematical literacy ability and emotional intelligence?

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Abstract. This research aims to determine does the Problem-Based Learning (PBL) model affect to mathematical literacy ability and emotional intelligence of students in Senior High School grade VIII in Mataram City, province of Nusa Tenggara Barat. This research is a quasi experimental with population of all students of grade VIII SMP Negeri 2 Mataram. The sample selection was done randomly so that 1 experimental class was selected. Data were collected by tests and questionnaires. The results of this research indicate that the PBL model affect students’ mathematical literacy and emotional intelligence ability.

1. Introduction

The need of society today is not just to understand certain knowledge, but more than that. People are required to utilize their knowledge optimally to be more intelligent and critical in receiving and processing information. To be able to understand math then every student is required to have literacy ability [1]. Mathematical literacy can predict, interpret data, solve everyday problems, raise reasons in numerical, graphic, and geometric situations, and communicate using mathematics [2]. Moreover, mathematical literacy can also help individuals to recognize the role of mathematics in the real world and as a basis for consideration and decision-making needed by society [3]. In addition, mathematical literacy can also create awareness of the role of mathematics itself in the modern world [4].

Mathematical literacy refers to the ability of mathematical reasoning and uses mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena in everyday life [5]. The most important thing of mathematical literacy is the ability to use, perform, and recognize mathematics in real life situations [2]. Literacy is an important part of learning mathematics [4].

However, given the facts, Indonesian students’ test results in PISA and TIMSS have not shown satisfactory results. Based on the results of a survey conducted by PISA in 2000, 2003, 2006, 2009, and 2012 Indonesia always lies in 10 lower states [6]. In 2012, Indonesia ranks 64 out of 65 countries with a score of 375, while the international score is 494 [5]. Then the last is in 2015 and then, Indonesia ranked 63 of 72 countries, with a score of 386, while the international score is 490 [1]. This shows that the ability of Indonesian mathematics literacy is still low. In the period of 2003 to 2012 almost 80% of Indonesian students are only able to reach below the level 2 border of the six levels of questions tested [1]. The factors that make the ability of students’ mathematical literacy is still low that there is no effort of teachers to provide practice questions related to the ability of mathematical literacy.
Based on interviews with several math teachers in the city of Mataram obtained the result that there are still many mathematics teachers have never made efforts to improve the ability of students' mathematical literacy. This will certainly have an impact on the ability of low student math literacy. This can be seen from the low components of mathematical literacy such as communication skills, representation, reasoning, and skills in solving mathematical problems both routine and non-routine.

Beside the ability of mathematical literacy, teachers also need to hone and develop the emotional intelligence of students. As Cohen puts it, "goal of education needs to be reframe to prioritize not only academic learning but also social, emotional and ethical competencies" [1]. Even mentioned that the purpose of education such as academic development, vocational development, personal development, and social development [4]. In addition, in Permendikbud Number 23 of 2016 on the Standards of Education Assessment also states that the assessment of the learning outcomes of primary and secondary education students not only focuses on the assessment of knowledge, but includes aspects (1) attitudes, (2) knowledge, and (3) skills.

However, seeing the current state of education, especially in the city of Mataram, most teachers focus only on cognitive aspects only. As some math teachers in the city of Mataram say, not a few teachers refer only to the improvement of cognitive aspects without training and developing the affective aspects of students, especially the students' emotional intelligence. This, of course, affects the lack of emotional intelligence of students who are characterized by less motivated students in learning mathematics, especially when studying difficult material.

In Permendikbud No. 65 Year 2013 on the standard process of primary and secondary education implies the need for a learning process guided by the principles of the scientific approach [6]. The scientific approach is a thinking and doing approach consisting of five discovery skills, associating, questioning, observing, networking, and experimenting [6]. Scientific learning prepares students for more frequent performing skills of questioning, observing, networking and conducting experiments [6]. Another effort that can be done to be able to train the ability of students' mathematical literacy and emotional intelligence is by applying model problem-based learning (PBL) [7]. The problem-solving process in problem-based learning will help students develop their emotional intelligence [4].

Based on the problems described and the theories of experts, as well as the limited research on the effectiveness of problem-based learning on the ability of mathematical literacy and emotional intelligence of students, the question arose from the researcher is "can the problem-based learning model affect students’ mathematical literacy ability and emotional intelligence?"

2. Research Methods

2.1 Research Design
This type of research is quasi experimental research (quasi experiment). The research design used is pre-test post-test control group design. Schematically, the design in this study is presented in Figure 1 as follows.

![Figure 1. Research Design](image-url)

2.2 Research Subject
The population in this study is all students of class VIII SMP Negeri 2 Mataram year lesson 2017/2018. The sample in this research use random sampling method. The sample used in this research is class VIII E as experimental class using problem-based learning model. There are two types of variables in this study are independent variables and dependent variable. The independent
variables in this study is problem-based learning model, while the dependent variable includes the ability of mathematical literacy and emotional intelligence of students.

2.3 Data Analysis Technique
The analytical techniques used in this study are: (1) descriptive statistical analysis which aims to find out the general description of the achievement of literacy ability of mathematics and emotional intelligence of students to pre-test score and post-test in experiment and control class; (2) Inferential statistical analysis comprising (i) a normality test which aims to determine whether the sample data is from a normally distributed population. This test is performed using the distance of the mahalanobis (ii) the homogeneity test, conducted to see whether the experimental class and the control class have a homogeneous covariance variance matrix. This test is done through Box’s M test using SPSS program; (iii) test the effectiveness of learning in both classes. In this research, problem-based learning model is said to be effective in terms of the ability of mathematical literacy if the average student score reaches high category that is more than 75. Furthermore, problem-based learning model is said to be effective in terms of students’ emotional intelligence if the average score of students’ emotional intelligence questionnaire reaches the high category of more than 81.6.

Data on the students’ mathematical literacy skills were obtained through a test in the form of a description. Then the data about students’ emotional intelligence is obtained by using questionnaire instrument in the form of checklist with Likert scale. Based on the calculations based on [8] the categories of literacy ability of mathematics and students’ emotional intelligence are as follows.

| Table 1. Category ability of mathematical literacy. |
|-----------------------------------------------|
| Interval | Category |
| = 80 | Very high |
| < = 80 | High |
| < = 60 | Medium |
| < = 40 | Low |
| < = 20 | Very Low |

| Table 2. Emotional intelligence category. |
|------------------------------------------|
| Interval | Category |
| > 10,8 | Very high |
| < = 100,8 | High |
| < = 81,6 | Medium |
| < = 62,4 | Low |
| < = 43,2 | Very Low |

3 Result and Discussion
Data analysis for the variables of mathematical literacy ability was obtained from the students' pre-test and post-test results. The data analysis for emotional intelligence variables was obtained from the initial and final questionnaire scores. Before testing the hypothesis, asums test was first carried out which included multivariate normality test, univariate normality test, multivariate homogeneity test and univariate homogeneity test.

After the assumption test proved that the experiment data was normally distributed and homogeneous, then the effect test was carried out. To analyze the effect of the problem-based learning model in terms of mathematics literacy skills and emotional intelligence of students in mathematics
learning is the result of one-sample t-test with the help of IBM SPSS Satistic 21 software on the data obtained after treatment (post-test). The results of the one-sample t-test in detail can be seen in Table 3 below.

**Table 3. Test results of one sample t-test class experiment.**

| Variables                  | T    | Sig  |
|----------------------------|------|------|
| Mathematical Literacy Ability | 5.132 | 0.000 |
| Emotional Intelligence    | 18.730 | 0.000 |

Based on Table 3 above, it can be seen that significance value for variables of mathematical literacy ability and emotional intelligence of students is smaller than 0.05. This shows that \( H_0 \) is rejected, meaning that the problem-based learning model is influential in terms of mathematics literacy ability and emotional intelligence of students in mathematics learning.

From the results of the pre-test of mathematical literacy ability in the experimental class, there were no students who reached the specified minimum completeness criteria of 75. This was naturally the case because students did not have the competencies they had learned. Meanwhile, if you see the results of the initial questionnaire from students' emotional intelligence, the average achievement of the experiment class reaches the medium category, with a percentage of 64.29%. Although there are students who reach the high category in the experimental class, but the number is not much, that is 6 people.

Problem-based learning model is closely related to giving real world problems as a source of student learning. The percentage of learning achievement measured from the observation sheet of teacher activities and students in the experimental class showed an increasing value at each meeting, even reaching 100% at several meetings. This increase in learning effectiveness supports the results of research from [9] that teaching practices with problem-based learning approaches enable students to be actively involved in classroom learning activities. In addition to providing real-world problems can help students in building the ability to think critically, solve problems, and intellectually, and develop the ability to solve with new knowledge of students.

Improvement in the implementation of learning, especially in the experimental class is also supported by [10] which states that problem-based learning has the aim that students can develop students’ skills to learn independently, develop research skills, and problem-solving skills, and shape behavior and skills social. Increased implementation of learning can also be indicated from problem-based learning steps that require students to solve real-world problems that have been given by the teacher. This was also revealed by [11] that in the problem solving process students are required to think critically, creatively and monitor their understanding. In addition, problem-based learning is able to develop thinking skills and problem solving skills, learn the role of authentic adults and become independent learners. All of these things because in essence, mathematical literacy is the ability to help students in solving real life problems related to mathematical concepts [12].

The increased activity of student learning in the classroom has a positive impact on mathematics literacy skills and emotional intelligence of students. In this study, mathematical literacy skills in both experimental classes were declared effective after the results of one sample t-test on post-test data with a significance value of less than 0.05. Overall, the results of the study indicate that the problem-based learning model has a significant influence on students’ mathematical literacy abilities. This result is supported by [13] study which concluded that problem-based learning is effective in terms of students' mathematical literacy abilities. This can happen because heterogeneous grouping determined by the teacher provides new experiences and contributes to improving student learning because with this model students are encouraged to be active physically, mentally and emotionally in learning and students interact socially through student activities in solving problems by sharing and discussing with friends of group members [14].
Based on [12], mathematics literacy is the ability of students to solve problems, so that the problem-based learning model is considered appropriate to develop students' mathematical literacy skills. Furthermore, Maudsley and Strivens explained that the goal of problem-based learning is to help students think, solve problems and to improve their high-level thinking skills by building real situations or connecting concepts to be studied [15]. The problem solving process, which is the core of PBL, requires students to learn to systematically explore and analyze problems. This allows students to be proactive and expand their knowledge. Students also use various sources of information from textbooks and others in informal discussions with peers allowing students to integrate their knowledge. In addition, PBL also provides solutions for students who experience authentic problems [16]. By having authentic problems that must be solved, students are more involved in the learning process. Therefore, students are usually more innovative and creative in their problem solving approaches [17].

In addition to the academic ability, problem-based learning is also effective in terms of students' emotional intelligence, as in the research of [18] which concluded that problem-based learning in STAD and GI cooperative learning settings in mathematics learning is effective in terms of learning achievement and intelligence emotional student. As the steps in problem-based learning are giving contextual problems and making temporary hypotheses about the given problems, problem-based learning can improve students' emotional intelligence. This is because the process of solving problems and making decisions using thoughts and feelings or logic and intuition is part of emotional intelligence [19].

Increasing the implementation of learning especially in the experimental class is also supported by [20] which states that the problem-based learning class shows better mathematical communication skills and shows stronger teamwork. This is reinforced by research conducted by [21] which concluded that there is a positive relationship between interpersonal intelligence and problem-based learning. In addition, according to [21] states that with small group discussions as a step in the problem-based learning can help students develop interpersonal intelligence.

4 Conclusion
Based on the analysis, research results, and discussions that have been disclosed previously, obtained the following conclusions: the average score of mathematical literacy ability and emotional intelligence of students in the classroom using problem-based learning model reached the high category.

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