The influence of realistic mathematics education (RME) approach in enhancing students' mathematical literacy skills

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Abstract. This study aims to find out the improvement of students’ mathematical literacy skills after they are provided a learning with Realistic Mathematics Education (RME) approach and to compare with students who only get regular learning approach. This study was a quasi-experimental with non-equivalent control group design. This study involved 64 grade VIII students of one of the Islamic junior high schools in Bandung. Sample of this research was two classes, which involved 32 students of one experimental class and 32 students of another control class, with using purposive sampling technique. The instrument used is a test of mathematical literacy skills. The results showed that there are differences in the enhancement of mathematical literacy skills between students who studied with Realistic Mathematics Education (RME) approach and students who studied using conventional learning.

1. Introduction

Students' understanding of mathematics is not only about understanding material but how students can use the knowledge they already have to apply in various contexts. The curriculum applied in Indonesia today, expected creating a process of learning mathematics can explore problem solving skills, reasoning, communication, connections, and student representation. These abilities are part of mathematical literacy. Mathematical literacy is the ability to apply and develop mathematical abilities in solving problems in everyday life [1]. Mathematical literacy is one of the aspects tested by the International Student Assessment Program (PISA) organized by the Organization for Economic Cooperation and Development (OECD).

Based on the 2015 PISA results, Indonesian mathematics literacy skills are still low and are ranked 61 out of 69 participating countries. Based on the results of several previous studies obtained from students' mistakes, that often appear in completing literacy questions is in carrying out mathematical processes in terms of modelling for mathematics and applying problem solving strategies [2]. The development of one's literacy is influenced by early mathematical knowledge and the way a person views mathematics. The way a person views mathematics will be formed if he understands mathematical procedures, understands how to formulate, and is able to apply various alternative problem solving [3]. Some important points that must be considered in the ability of mathematical literacy, namely being able to formulate context problems, able to apply, and able to interpret in various contexts [4]. Therefore it is necessary to develop mathematical literacy in order to be able to apply and develop mathematics in everyday life.
One approach that can be used in learning is the approach of realistic mathematics education abbreviated as RME [5,6,7]. In Indonesia, RME is known as Indonesian Realistic Mathematics Education (PMRI) and is often operationally called Realistic Mathematics Learning (PMR) [8,9] RME was first developed in the Netherlands [6]. Realistic interpretation in Dutch means "Zichrealiseren" which means "to imagine". Thus, realistic emphasizing everything that can be imagined by students' minds. Realistic has three meanings, namely: a) the problem presented comes from the real world; b) the world of formal mathematics; c) imaginary context that is not in reality but can be imagined [6][9]. The principle of learning RME is divided into six principles, namely the principle of activity, the principle of reality, the principle of level, the principle of intertwintement, the principle of interactivity, and the principle of guidance [6].

The principle of RME in terms of activity aspects treats students as active participants in the learning process. Mathematics is seen as human activity and learning mathematics means doing mathematics. Doing mathematics has a horizontal and vertical mathematization process. Horizontal mathematization processes are from contextual problems for students to form of mathematical models. The vertical mathematization process moves from the model that has been symbolized in mathematics to the concepts, principles, rules that will be used in solving these problems so that formal mathematical solutions are obtained[6].

Next, the reality principle of learning the RME approach is twofold Firstly, applying mathematics in solving real world problems. Secondly, mathematics begins with a problem situation that can be meaningful and being able to construct mathematics does not start by giving a formula. This is according to the concept of the didactical phenomenology that the mathematical context can come from real life, the formal world of mathematics or from the imagined context which can be imagined in the minds of students [6]. Giving contextual problems that are related to students' real life or which can be imagined in the minds of students will encourage students to learn. Thus, mathematical understanding is obtained by students through experience and not because of being told.

On the principle of the level of the RME approach, in mathematics learning students experience a level of understanding of the informal wayby using their own method “model of”. And then towards the “model for” and formal knowledge called self-developed models. The “model of” and “model for” it is very important to bridge between informal mathematics, contexts related to mathematics, and more formal mathematics. So that at the end of the process students will get a standard problem solving (for example, theorem and proposition) [6].Furthermore, the principle of intertwintement with the RME approach, mathematical content such as numbers, geometry, and measurement have relevance and are not considered as separate content [6]. Students are given a problem where they can associate their mathematical knowledge of various content. Learning with the RME approach provides an opportunity to improve and hone their skills in linking concepts with each other. If students can associate between concepts, it will make it easier to solve the problem given.

On the principle of interactivity, learning with the RME approach is not only an individual activity but also a social activity. The RME approach supports class discussion and group work to share strategies and findings [6]. Thus, it is expected that the level of achievement of students' understanding is higher and the interaction arouses student reflection. The interaction between students provides an opportunity to evaluate, renew construction of or constructed models to get the right model. While the interaction the teachers with students for guide students so that they can understand formal mathematics. Interactions are illustrated through learning observation which are seen as a tool for photographing classroom learning events.

The guidance principle for the RME approach refers to rediscovery of mathematical discoveries. Students are given the opportunity to rediscover concepts such as those that have been passed by previous mathematicians. This implies that the teacher must be proactive in guiding students in learning to find concepts that are in accordance with mathematical standards [6]. Based on the description above, the purpose of this study is to see the differences in the increase of students' mathematical literacy skills with RME approaches and regular learning.
2. Methods
This study was a quasi-experimental design with a non-equivalent control group design. In accordance with the developed design, the researcher took two classes, which are the experimental class and the control class. The population in this study were 64 8th grade students, aged 13-14 years in one of the Islamic junior high school in Bandung for the academic year 2018/2019. The sampling used is purposive sampling technique. Two classes were selected as the research samples. The experimental class was a class applied the RME approach and the control class was a group that used regular learning. The instrument used to collect data was a test of mathematical literacy skills that have previously been tested for its validity and reliability. Before testing hypotheses, test of normality and homogeneity were first performed, using the Mann Whitney test.

3. Result and Discussion
Research conducted to determine the improvement of literacy skills through learning with the RME approach and regular learning. Data on mathematical literacy ability was obtained through pre-test, post-test, and n-gain. The following Table 1 is a description of pre-test, post-test, and n-gain through RME approach and regular learning.

| Table 1. Description of data on students’ mathematical literacy abilities |
|---------------------------------------------------------------|
| **Experiment class** | **Control class** |
| N | Pre-test | Post-test | N-Gain | Pre-test | Post-test | N-Gain |
| 32 | 10.63 | 17.91 | 0.39 | 9.66 | 15.81 | 0.30 |
| s | 3.66 | 3.97 | 0.18 | 4.35 | 3.96 | 0.18 |

Based on the data in Table 1, mathematical literacy ability description can be seen from the average pre-test score the RME approach group experimental 10.63 and for the regular learning group 9.66. The average posttest score of mathematical literacy ability in the RME approach class is 17.91 and regular learning is 15.8 with a difference of 2.1 between the experimental class and the control class. Pretest scores on mathematical literacy skills of ordinary learning students have a higher standard deviation than learning with the RME approach. This shows that the pre-test scores of students in the control class are more varied than the experimental class with the RME approach learning.

The results in Table 1 explain that the average n-gain math score of students who get the RME approach learning is higher than students who get regular learning. The average n-gain of these two classes is classified as moderate. The average n-gain with learning approaches is RME 0.39 and learning is 0.30. After the descriptive analysis is done, the research data is analyzed inferentially. Based on the n-gain data obtained, learning with the RME approach is normally distributed and ordinary learning does not have a normal distribution. Because one group is not abnormally distributed, it will be followed by a non-parametric test using the Mann Whitney test.

The testing process at the significance level at the significance level α = 0.05. With conditions if the value of Sig. (2-tailed) <α then $H_0$ is rejected, and if Sig. (2-tailed) ≥α then $H_0$ is accepted. Test results of differences in N-gain mean mathematical literacy abilities are listed in Table 2.

| Table 2. Results of The Test Results for N-Gain Mathematical Literacy Abilities |
|---------------------------------------------------------------|
| **Mann-Whitney U** | **Z** | **Sig. (2-tailed)** | **Decision** |
| 363.500 | -1.995 | .046 | $H_0$ is rejected |

Table 2 shows that the Sig (2-tailed) value is 0.046 smaller than α, so statistically significant test results rejected $H_0$. In other words, there are differences in the increase of students’ mathematical literacy between those who learned using the RME approach and those who were in conventional teaching and learning process. Based on the principles of the RME approach can help students...
understand the material taught. Giving contextual problems that can be imagined in the minds of students will encourage students to learn. Therefore mathematical understanding is obtained by students through experience and not because of being told. During the learning process, students are given the opportunity to carry out activities to find concepts independently based on the knowledge that students already have. During the process of activities carried out by students, there will occur horizontal and vertical mathematization processes [6]. The horizontal mathematization process of students transforms realistic problems into mathematical models. Whereas, in the vertical mathematization process, mathematical models that have been symbolized towards concepts, principles, rules are used so that formal mathematical solutions are obtained. To go to the horizontal process to the vertical role of the teacher is very important. The teacher bridges the knowledge process that students have towards the formal standard stage in mathematics. With the scaffolding provided by the teacher will direct students in achieving formal completion in accordance with mathematical standards. Besides that, with interactivity through group formation during learning, helping students to exchange ideas about solving the problem. In accordance with the development of cognitive theory, students’ thought processes match their level of intellectual development. Intellectual development is formed from activities carried out during learning. The interaction between students and teachers will increase their mastery of the material being studied.

Besides that, with interactivity through group formation during learning, helping students to exchange ideas about solving the problem. In accordance with the development of cognitive theory, students’ thought processes match their level of intellectual development. Intellectual development is formed from activities carried out during learning. The interaction between students and teachers will increase their mastery of the material being studied. The RME approach takes place in the process of understanding students’ levels from informal to formal. In other words, the RME approach builds informal reasoning, pre-formal and formal mathematics [10]. To get the completion of mathematical standards, the role of the teacher is very important in giving direction to students. So, in the final results of learning, students can find the appropriate problem solving from the given context.

To measure the ability of mathematical literacy, researchers tested 6 questions.

Based on the results of the pre-test, one of the students’ answers do not understand the meaning of the questions given. This can be seen from the use of the concepts used from the problems given. In answering the questions given, students were seen to determine the size of the beam using the beam volume formula by multiplying all the beam elements $15 \times 12 \times 10$. Even though the question asked was that many blocks could be made using a piece of cardboard. The question should be using the beam surface area formula. This shows students cannot use the concepts from mathematical modelling that has been made[11].

Furthermore, based on the results of the post-test, students were seen starting the answers in accordance with the questions given. Students give answers by starting with the known, asked and make pictures in accordance with the illustrations provided. Then in answering the problem solving, students have used the appropriate concept rules. As seen by students in determining the beam size using the beam surface area formula $= 2((p \times l) + (p \times l) + (l \times l))$.

4. Conclusion
Based on the results obtained in this study, students who were learning using the RME approach can improve their mathematical literacy abilities. It is known that N-Gain data of the students’ mathematical literacy ability is in the moderate classification. It is concluded that if teaching-learning process with this RME approach can be practiced consistently on the appropriate material, the mathematical literacy skills can be maximized.

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