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The Influence of the Realistic Mathematics Education Approach and Early Mathematical Ability to Mathematical Literacy

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Abstract

This research is based on the low level of Indonesian students mathematical literacy test released by PISA in 2015. The purpose of this research is to examine the influence of Realistic Mathematics Education Approach and the early mathematical ability to mathematical literacy in statistical materials. This research uses group design by level 2 x 2. This study was conducted in students of class VIII. The result of this research shows that there is influence of Realistic Mathematics Education Approach and early mathematical ability to mathematical literacy on statistical matter. Beside that, the Realistic Mathematics Education Approach not only increases mathematical literacy in students with high early mathematical skills, but also in students with low early mathematical abilities.

Keywords: *Early mathematical abilities, Mathematical Literacy, Realistic Mathematics Education*

1. Introduction

In the current era of globalization, people are needed not just those who are able to understand certain knowledge. This day, humans are required to be more applicable to utilize his knowledge in daily life. Organization for Economic Co-operation and Developmentor OECD (2014) explains that modern societies are more appreciated to those who have the knowledge and earned to use it. Its case is very important to solve the more complex problem this time.

Since 1994, TIMSS (Trend in International Mathematics and Science Study) has conducted research in fourth and eighth class in mathematics and science. TIMSS focuses on the existing material on the curriculum that is about numbers, algebra, measurement, data, and geometry. In addition to TIMSS, there is also PISA (Program for International Student Assessment) which is conduct research since 2000 to know the literature ability of 15 years old studentsin math, science, and reading. The difference, PISA more focus on the student skills to apply their knowledge in the everyday environment (Stacey, 2011). From those two institutions that examine the mathematical ability, the focus of discussion on the ability of mathematical literacy released by PISA.

PISA (2010, p. 4) defines mathematical literacy as an individual's ability to formulate, use, and interpret mathematics in various contexts. It includes reasoning mathematically and using concepts, procedures, facts, and mathematical tools in explaining and predicting phenomena. Mathematical literacy helps one to recognize the role of mathematics in the world and to make judgments and decisions needed as citizens. Mathematical literacy is very interesting for research because Indonesia is always in the top ten from below for every PISA test, especially mathematical literacy. Indonesia is below the international average. Not only that, the majority of students can only solve the problem below level 2. Looking at the facts mentioned, the ability of students' mathematical literacy in Indonesia still needs to be improved. In order to improve the ability of this mathematical literacy; first of all, teachers, government and educational observers needed to understand what is math literacy. Not only that, it is necessary to realize why maths literacy needs to be a concern in mathematics learning.

Mathematical literacy is widely considered to indicate the ability of students in achieving mathematics skills in the curriculum, but it is wrong. This is because the mathematical literacy focuses on sharpening the skills of solving real-life problems compared to the concepts and axioms of the math lesson itself. But to be able to achieve the mathematical literacy requires understanding and skills in the school curriculum.

PISA 2012 test results revealed that most Indonesian students have low levels of mathematical literacy. In a test followed by 65 countries, Indonesian students ranked second from bottom after Peru (OECD, 2013, p. 19). The

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results are not much different from PISA in previous years (2000, 2003, 2006, and 2009) which put Indonesia in the bottom position. However, the facts on the ground based on the preliminary study conducted by the researcher on the five students of VII grade of Junior High School, give the result that there is one student is at level 1, one student is in level 2, and three students are on the level 3. This gives a little idea that not all of the Indonesian students have low levels of mathematical literacy. This result is also reinforced by the research of Widodo *et al* (2015) on the level of mathematical literacy of students of grade XI-A 4 SMA Negeri 01 Ambulu. Widodo *et al*'s research give results that 8.57% of students are at level 2, 60% of students are at level 3, 20% of students are at level 4, and 11.43% of students are at level 5.

Mathematical literacy problem in PISA consists of 6 levels. Level 1 and 2 questions include a group of questions with a lower scale that measures reproductive competence. Level 3 and 4 questions include a medium-scale problem group that measures the competency of connections. Meanwhile, the level 5 and 6 questions include a high-scaling group that measures the competence of reflection (Johar, 2012, pp. 7). From the results of PISA tests in 2012 is known that the average score of Indonesian mathematics literacy is 375, while the average score of international mathematics literacy is 500 which is at level 3. This result illustrates that the ability of Indonesian students mathematics is at level 1 is still limited to reproductive ability. Students are only able to operate mathematics in a simple context.

According to Stacey (2011), statistics is a topic that is usually used as a matter of tests in mathematical literacy, almost about 33% or 26 of 85 items are used as a test of mathematical literacy. Therefore statistical material should be concerned because PISA itself considers that literacy skills in statistics are very important. Thus if Indonesian students want to achieve level 3 or 4 values in mathematical literacy, it is necessary to have competence in solving problems related to statistical literacy.

Apart from mathematical abilities, there are other abilities that are often forgotten to be a part of mathematical literacy research materials,the named is early mathematical abilities. Early mathematical ability is the level of ability of learners in solving problems by analyzing using logic and logical, analytical, systematic, critical, creative and innovative thinking in school. In other words, students' early mathematical abilities can be learned from the student achievement scores obtained from mathematics lessons. Then, it shows the ability of each student early mathematics.

2. Methods

The research was conducted by using the experimental method involving two groups of samples ie students using learning with RME and conventional approaches. In addition, each of the divided groups is also grouped based on their initial mathematical abilities.

This research uses design *by level 2 x 2*. With due regard to the possibility of moderator variables that will affect the mathematical literacy. The variable of this study consisted of three research variables, including independent variables or also called experimental variables, namely the approach RME (A_1) and conventional approach (A_2). The moderate variables used in this study are high early mathematical ability (B_1) and early mathematical ability of red (B_2). While for the dependent variable is the mathematical literacy. To obtain an appropriate analysis result, all of these variables are incorporated into the research design. Correlation of research variables can be seen in the design *by level 2 x 2* in the table below.

Table 1 Design Treatment by Level 2 x 2

Early Mathematical Ability (B_1)	Learning Approach (A)	
	RME (A_1)	Conventional (A_2)
Height (B_1)	A_1B_1	A_2B_1
Low (B_2)	A_1B_2	A_2B_2

The research design design used is *posttes only control group design* which means that all groups to be studied are given postes after learning. Learning does not begin with pretes, but ends with postes. Instruments used in this study are the test of mathematical early ability and mathematical literacy. An early mathematical ability test that divides student groups with high and low early mathematical abilities. While the test of mathematical literacy which will be calculated influence.

Data obtained in this study were obtained from quantitative data. The quantitative data obtained will be tested for normality and homogeneity with variance analysis, and if the research meets the condition of significance will be tested further. All these steps will be processed using *Microsoft Excel 2007* and SPSS 16.0 *for windows* which are then analyzed and interpreted in accordance with the procedures that have been determined.

3. Results and Discussion

The data of mathematical literacy ability is obtained after the teacher performs the learning process by applying the predetermined approach. Mathematical literacy tests are tailored to indicators that have been prepared based on questions made by PISA and modified so that the content and context are appropriate to the students. The following is the descriptions of data calculation results and research results.

Table 2 Data Description

Early Mathematical Ability (B1)	Learning Approach (A)			
	RME (A1)		Conventional (A_2)	
Height (B_1)	Sample	= 20	Sample	= 20
	Mean	= 41.11	Mean	= 23.24
	Median	= 39.87	Median	= 21.57
	Std. Dev.	= 8.64	Std. Dev.	= 4.88
	Skewness	= 0.62	Skewness	= 0.74
Low (B_2)	Sample	= 20	Sample	= 20
	Mean	= 30.26	Mean	= 20.13
	Median	= 20.09	Median	= 20.59
	Std. Dev.	= 8.46	Std. Dev.	= 2,82
	Skewness	= 0.37	Skewness	= 0.139

The results of this study indicate that there is a difference in mathematical literacy ability of elementary school students between students studying with RME approach with students studying with conventional approach. In addition, the students 'early mathematical abilities have an effect on students' mathematical literacy skills. The results of data analysis have been done, put forward some things as follows:

1) Student Mathematical Literacy Differences with RME and Conventional Approach

Findings obtained in this hypothesis are the existence the difference of students' mathematical literacy that carried out the learning with the RME and conventional approach significantly. This is seen from test *Mann-Whitney* with *sig. 2 tailed* by 0,000 <0,05 so that $H_{0\ is}$ rejected Even if viewed implicitly without a one-way test, indicating that the RME approach is better than the conventional approach to mathematical literacy seen from its mean value. The average value of the students' mathematical literacy with RME is 35.69, while the students with the conventional approach is 21.68. So, the average difference of 14.01.

A realistic mathematical approach is a mathematical learning approach that utilizes the student's activities in reality and the environment to transform problems in daily life into symbols of mathematical problem-solving models. As with Gravemeijer (1994, p. 3), *"Mathematics must be connected to reality and mathematics as human activity".* The realistic mathematical approach is relevant to mathematical literacy because it equally focuses on the ability to solve everyday problems. This commonality will eventually provide a way for RME to increase mathematical literacy.

Kwon (2014, p.7) research shows that "*students can readily adapt their well-developed manipulative skills to experiential real situations with the incorporation of the RME instructional design*." Students will readily adapt the manipulative capabilities that evolve into real-life situations by merging Intruksional RME. This suggests that the real problem-based mathematical skills will be in accordance with RME's learning steps.

Several studies also agree with the above statement, Budiono and Wardono (2014, pp. 211-220) conduct research on PBM PISA-oriented approach LMPD-based PMRI increase the mathematical literacy of junior high school students. Another study was conducted by Babys (2016, pp. 43-49) about the ability of mathematical literacy *space and shape* and the independence of high school students on *discovery learning by* RME-PISA approach. The research of Budiono and Wardono and Babys shows that the RME approach is highly relevant to mathematical literacy.

2) Differences in Mathematical Literacy between Highly Prior Mathematical Students Following RME Learning and Conventional Approach

Based on the results of the average difference test using the *Mann-Whitney* and *Post Hoc Test The* mathematical literacy value of the student group with the RME and conventional approach has *sig. 2 tailed* by 0,000 < 0,05 so that H_0 is rejected. Thus, it can be concluded that there is an average difference in the value of mathematical

literacy of students who have high early mathematical skills with the RME and conventional approach significantly. Even implicitly suggesting that the RME approach is highly relevant for students with early mathematical abilities to improve mathematical literacy skills. This can be seen from the difference in average score, on the mean mathematical literacy of the group of students who have high early mathematical ability with RME approach obtained on average 35.69. While the value of mathematical literacy students who have high early mathematical ability with conventional approach obtained an average of 21.68.Thus, the average difference of 14.01.

Based on Mathematics learning using RME requires a teacher to know the stages in the learning. Gravemeijer (Tarigan, 2006, p. 5) divides the five stages that must be passed by students in learning that uses a realistic mathematical approach that is the stage of problem solving, reasoning, communication, confidence, and representation. These five stages will accommodate students who have high initial mathematical abilities.

Students who have a high mathematical early ability will look more prepared to use their initial knowledge to deal with the contextual problems presented by RME learning. This is because RME will require students to master the skills in solving problems in the surrounding life with mathematical concepts (Zulkardi, 2002, p. 29). In line with one aspect of mathematical literacy that seeks to measure students' ability to solve problems of formulating, using, and interpreting mathematics in various contexts (OECD, p. 4).

While the conventional approach according to Freire in Sujarwo (2011, p. 2), build learning with paradigm *teaching* so that has put the students as objects alone. The teacher places the students as empty bottles to fill. This means that students who have high early mathematical skills will not be well managed. Even because conventional learning is not student-centered, the ability of mathematical literacy will not be visible. This is evidenced by there is no difference in the average group of students who have prior knowledge of mathematical low and high with the conventional approach (A_2B_2 and $A_2B_{2)}$ demonstrated the significant value of 0.460>α (0.05). Thus, the mathematical literature using the RME approach is higher than that of mathematical literature using a conventional approach for students with high early mathematical ability.

Conclusion

Based on the results of the analysis and discussion that has been described in this study can be obtained some findings, first the ability of students' mathematical literacy learning with RME approach is higher than those learning with conventional dictionary. Secondly, the mathematical literacy ability of students who have high early mathematical skills with RME approach is higher than using conventional approaches.

Based on the above findings, it can be concluded that the effect of the RME approach on mathematical literacy indicates that the RME approach is relevant to improve the ability of mathematical iteration.

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