The Effect of Realistic Mathematics Education on High School Students' Mathematical Problem Solving Ability

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Abstract. *Realistic mathematics education (RME) has developed almost 20 years in Indonesia, yet has not taken place in the curriculum of mathematics education, while teachers and researchers have been using this method in learning. It is needed to develop RME for further achievement. The purpose of the present research is studying the effects of Information and Communication Technologies (ICT) assisted based RME on Students' Mathematical Problem Solving Ability. This research also develops the instrument of mathematical problem solving ability to improve students' mathematical problem solving ability*

1. Introduction

In realistic mathematics, learning is get started by the real world problem so that students could probably use their previous experience directly to solve the problem. Using real world context develops mathematical concepts such as numeric, geometric, algebraic, and statistic ability as part of core process in problem solving framework. According to the data of Trends in International Mathematics and Science Study (TIMSS) in 2015 which was organized by the International Association for Evaluation of Educational Achievement (IEA) indicates that Indonesia students' mathematical ability is still lags that should be improved for long term. It can be seen that Indonesia fourth-graders' average score in mathematics was 397, which was higher than the average scores of students in 4 education systems and lower than the average scores of students in 40 education systems [1].

It is well known that learning mathematics become problem for most students. Nevertheless, mathematics trains students to be familiar with the real world problem. According to Retman [2] problem is a situation where given a description of something but have not had anything that deal with the description. To learn mathematics, every single student has to have objectives which is varies for every student. Some are learning mathematics to improve skills in so that will help them in asking the jobs such as entrepreneurship. There are also learning mathematics due to responsibility, such as teachers, practitioners, and lecturers in order to have strong capability. Therefore, someone's motivation for learning mathematics can be grown due to trust and need in mathematical ability. In the United States, National Council of Teachers of Mathematics (NCTM) formulate mathematical power as a central goal of mathematics education, i.e [3] application of knowledge to solve real world problem using mathematics and others fields; 2) using mathematical language to communicate and transfer the ideas; 3) capabilities to give reason and analyze; 4) knowledge and understanding of mathematical concepts and procedures; 5) positive towards mathematics.

Similar to NCTM that points the problem solving ability in the first order from the central goals of mathematics education, [4] state in their paper entitled essential mathematics for the 21st century, NCSM also points that the problem solving ability in the first order for the 12 essential components of mathematics education. This paper states that learning to solve problem s is a reason of principle to learn mathematics. Further [5] also said that solving the problem is not just a goal of learning mathematics but it is a major tool to perform or work in mathematics. Related to this

work, [6] says that solving the problem is not just a skill to be taught and used in math but is also a skill that will be taken on the everyday problems of students or decision-making situations, thus solving ability helps a person well in his life. The use of models and production will improve students' ability in problem solving processes associated with the use of a comprehensive strategy to formulate the problem in terms of the use of diagrams, work slow, simplify the problem, looking for patterns, as well as make systematic lists. The ability to monitor the thought theirselves, examine alternative ways of showing tasks, and check out the plausibility of the solutions as a form of metacognition in problem solving will also appear. Students will also find the pleasure in doing mathematics, appreciates the beauty and power of mathematics, showed confidence in using mathematics, and diligent in resolving the problem.

In 2006 curriculum so-called KTSP said that an assessment of learning math covers 3 aspects [7] namely: 1) Understanding concept; 2) reasoning and communication; 3) problem solving. Matter of the story, although it is the most common form of matter found in the books of the primary school, but the finishes a difficult task for most students. One of the initial steps in completing a math problem is "understanding" [8]. Understand the problem requires the activation of three's schemata contextual scheme: first, relating to the situation of the problem; second, the scheme language to understand what is the problem of the question; and third, the mathematical schemes linked to the indirect action (implied action) of the problem. For example, the matter of the story about the concept of division demanded the students to read the story (the schema languages), accessing their contextual scheme for sharing (sharing), and then their schemes (i.e. Strategy Division of mathematics) for back resolving the situation of sharing (sharing) [8].

The problem for someone is not necessary a problem for others, Schoenfeld [2] stated that the issue is always relative in nature for everyone. In the guide the development of the syllabus Subjects Mathematics Department of national education Ditjen management of primary and secondary education Directorate Coaching junior high school 2006 mentioned that the implication of the view of mathematics as a problem solving activity (problem solving) against learning mathematics is the teachers need: (1) provide a learning environment for mathematics that stimulate mathematical problems; (2) help students solve math problems using his own way; (3) help students know the information needed to solve the problems of mathematics; (4) encourage students to think logically consistent, systematic, and developed a system of documentation/records; (5) developing the ability and skills to solve problems; (6) assist students find out how and when to use various props/media education mathematics such as: period, rulers, calculators, etc. [9]

Realistic Mathematics Education (learning math in realistic) is a theory of teaching and learning in mathematics education, mathematical theory, discipline was first introduced and developed in the Netherlands in 1970 by Freudenthal Institute [10]. Lange claims that this theory has been adopted by a number of countries in the world such as the United Kingdom, Germany, Denmark, Spain, Portugal, South Africa, Brazil, the United States, Japan, and Malaysia [11]. This theory refers to the opinion of the Freudenthal says that mathematics should be associated with the reality and mathematics is a human activity. This means that mathematics should be close to the children and relevant to real life everyday. Mathematics as a human activity imply that people should be given the opportunity to rediscover the mathematical ideas and concepts with the guidance of adults [12]. This effort can be done through the exploration of a wide range of situations and issues of "realistic". Realistic in this case the meaning is not reality but in refers to something that can be imagined by students [13]. The principle of rediscovery can be inspired by the informal resolution procedures, whereas the process of re-discovery uses the concept of mathematization.

Two types of the mathematization formulated by Treffers [14] are the horizontal and mathematical vertical. Mathematical horizontal examples are the identification, formulation, and visualize problems in different ways, and real world problems transformation problems of mathematics. Vertical mathematization for example includes the

representation of relationships in formulas, repair and adjustment of mathematical models, the use of different models, and generalization. Based on mathematization, the horizontal and vertical approach in mathematics education can be differentiated into four types, namely mechanistic, emphiricist, stucturalistic, and realistic. The conventional approach is mechanistic approach and is based on what is known from his own experience (starting from simple to more complex). In this approach a human is considered as a machine, where both types of mathematization is not used. Emphiricist approach is an approach in which the concepts of mathematics are not taught, and students are expected to be found through the horizontal mathematization. Structuralistic approach is the approach of using formal systems, for example in teaching addition long ways need to be preceded by the value of the site, so that a concept is achieved through vertical mathematization. This realistic approach is an approach that uses realistic problems as the base of the bench learning. Through horizontal and vertical matematisasi activity it is expected students can find and construct mathematical concepts.

Basically, realistic math characteristic associated with Van Hiele level of learning math. In the Van Hiele [11] process learning to walk through three levels: (1) students are reaching the level of thinking of the first as soon as he can manipulate patterns of characteristics that have previously been known; (2) as soon as students learn to manipulate the characteristics of the interrelation he will reach the second level; (3) the student will reach the third level thinking when he started manipulating the intrinsic relationship characteristics. Realistic math characteristic is to use the context of the "real world", models, production and construction students, interactive, and connectedness (intertwinment) [14-15].

2. Method

This study used a Quasi Experiment design. Data sources in this study were students of VIII-6 class as the class were taught by a realistic mathematics education ICT assisted (experimental class), and students of VIII-8 class as a class taught without a realistic mathematics education ICT assisted (control class) in SMAN 4 Bekasi. Collecting data using a written test with a test item instrument description, which is to measure the ability of student's problem solving skills.

3. Results and Discussion

The mathematical problem solving ability of students taught using ICT-assisted learning realistic mathematics higher than that is not taught using ICT-assisted learning realistic mathematics.

Table 1: The result of mathematical problem solving ability between experimental and control class

Mathematical problem solving ability indicator	Items	Ideal score	Experimental class		Control class	
			Average score	Gain	Average score	Gain
understanding, planning, problem solving, revise and check.	1	10	5,3	53%	5,1	51%
	2	10	1,3	13%	2,8	28%
	3	10	3,8	38%	2,3	23%
	4	10	3,1	31%	2,6	26%
	5	10	4,2	42%	2,9	29%
	6	10	3,7	37%	2,6	26%
	7	10	4,6	46%	2,4	24%

Score data calculation results of mathematical problem solving ability experimental class students obtained an average score of 41.409 and a standard deviation is 9.061, while the control group gained an average score of 33.136 and a standard deviation is 10.409.

4. Conclusion

$t_{count} = 3.997 > 1.666 = t_{table}$ it can be concluded that the H0 is rejected. The conclusion is ICT-assisted learning Realistic Mathematics affect the ability of students' mathematical problem solving. The next step calculates how much influence the ICT-assisted learning realistic mathematics to students' mathematical problem solving ability. After doing the calculations obtained ES (effect size) = 0.795 or 79.5% is included in medium condition. Math teacher can be expected to pay more attention to mathematical problem solving skills as the ultimate goal of learning mathematics. The use of ICT in teaching and learning will allow students in the learning process, and can attract students to learn mathematics. Realistic mathematics education can be used as a mathematics teacher learning approaches in enhancing students' mathematical problem solving ability.

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