Realistic Mathematics Education (RME) Approach to Enhance Mathematical Cognition of Elementary School Students

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Abstract. Mathematical cognition is a fundamental skill in studying mathematics at the elementary school level. Teaching mathematics at school must aim to enhance mathematics cognition and can be used to solve real-life problems. This study observed the increase in students' mathematics cognition after implementing RME approach in the classroom. This study used a quasi-experimental design. The subject is 58 elementary school students at Agam and Bukittinggi. Data analyzed using SPSS statistic program. The research showed that there is a significant difference in students' mathematics cognition after learning with the Realistic Mathematics approach. It can be assumed that the use of Realistic Mathematics Education approach enhanced students' mathematics cognition and encourage students to engage actively in the teaching and learning of mathematics. Thus, Realistic Mathematics Education approach is an appropriate method to enhance the quality of teaching and learning process.

1. Introduction

One of the subjects taught in elementary school is mathematics. Mathematics as a field of science is a tool of thought, communication, logic and intuition, analysis and construction, generality and individuality, and has branches including arithmetic, algebra, geometry, and analysis. Characteristics of mathematics are deductive, logical, formal number symbol system, abstract structure, symbolism, and collection of human reasoning or basic inspiration as well as thinking activities [1]; [2]. Mathematics as a study starts from the study of very well-known parts to unknown directions. Directions are known to be structurally arranged in a complex (complex) direction, from integers to fractions, real numbers to complex numbers, from addition and multiplication to differential and integral, and to higher mathematics [3]; [4]; [5].

Mathematics needs to be taught at every level of school education starting from the elementary, secondary, and tertiary levels. Cockroft [6] points out why mathematics is taught. This is because mathematics is very much needed and useful in everyday life, for science, commerce and industry, and because mathematics provides a power, a communication tool that is short and unambiguous and serves as a tool to describe and predict in a way of critical thinking [7]; [8]; [9]. In fact, mathematics is a subject that is considered difficult by students at every level of education [10]; [11]; [12]; [13]. The cause of these difficulties can be sourced from outside the student and from within the student [14]; [15]; [16]. One of the factors that comes from within students is a cognitive factor that can be seen from students' attitudes towards mathematics, as known as mathematical cognition. The students face some difficult situations in critical and logical thinking, it is really important to also consider their mathematical cognition [7]; [17]; [18]. At the school where the writer taught, SDN 01 Matua, found a phenomenon where students were not able to absorb the concepts correctly. Students have not yet

reached the process of abstraction and are still a concrete stage. Students have not reached the stage of understanding and only know some examples. They cannot describe clearly about the concepts. Students do not understand the meaning of symbols. Students only write or say without being able to use it properly. As a result, mathematical sentences become meaningless to students. Students cannot understand the origin of a formula. In other case, students know the formula and use it, but don't know when or in what context the formula is used. Some students are not fluent in explaining mathematical procedures. Inequality using previous operations and procedures affects the understanding of the next procedure [19]; [20]; [21]. There also appears to be incomplete knowledge in students. The incompleteness of knowledge will hinder students' ability to solve mathematical problems, while learning continues in stages. These problems indicate students' low mathematical cognition. As a result, the learning process at school is still low.

One interesting innovation to be implemented is learning mathematics with the RME approach [2]; [7]; [22]. RME is one of the learning that began to be developed in Indonesia today is learning by using a real world context-based approach [2]; [23]; [24]. At this time, RME received attention from various parties, such as teachers and students, parents, lecturers, and the government. Realistic Mathematic Education (RME) was developed based on the thought of Hans Freudenthal who argued that mathematics is a human activity and must be associated with reality [2] [25]; [26]. The use of RME in the teaching and learning process is expected to create pleasant learning situations so that it can involve students thinking actively and help students improve their mathematical cognition. Freudenthal stated that students cannot be passive receiver of ready-made mathematics. Mathematics instruction has to be directed to the use of situation and possibility that allow students to reinvent mathematics by their own strategies. Students need to get accustomed to the concrete tasks [27]; [28]. It means that in solving mathematics problem, they have to be given realistic problems that related to their reality. RME is a teaching approach that starts from the real things for students [27], emphasizes the process of doing mathematics skills [29], discussions and collaborations, argues with classmates so that they can find their own strategies or ways to solve problems [23]; [30], and ultimately use mathematics to solve problems, both individually and in groups [24].

2. Method

The research method used by the author is a quasi-experimental method. The research method is a way of solving problems research carried out in a planned and careful manner with the intent to get facts and conclusions in order to understand, explain, predict and control the situation [31]; [32]. We used a quantitative approach in carrying out this research. Quantitative approaches are usually used to test one theory, for presenting a fact or describing statistics, to show the relationship between variables, and there is also a nature that develops concepts [33]. In quantitative research it is divided into experimental research, descriptive correlational, evaluation, and so on. The population in this study were all students of Elementary School 01 Matua and SDN 06 Parit Antang Bukittinggi in semester 1 of the Academic Year 2018/2019. The research subjects were 4th grade students in both schools consisting of 58 students. Purposive sampling was used as the sampling technique. Students' daily test scores were used to determine the students' average score. Based on the scores, two classes which had relatively similar average score were chosen as participants. The two classes were selected as an experimental class and a control class. Each class consisted of 29 students; therefore, the total number of the participants was 58 students. We use analytical techniques to data obtained from research results. Prior to the hypothesis testing, some tests were conducted using SPSS 22.0 Program. It aims to get accurate data in accordance with the objectives of the study and to find out the difficulties faced by students in study mathematics using the RME approach. The hypothesis in this study is that there is a contribution of mathematics learning with the RME approach to students' mathematical cognition. Therefore, the use of RME in the classroom can improve their cognitive achievement. This research, thus, aimed to investigate the difference in cognitive achievement of students who learned with RME and of those who were engaged in conventional learning.

3. Result and Discussion

Pre-test Analysis Kolmogorov-Smirnov normality test was conducted to determine if two datasets differ significantly. The significance value of the pre-test scores for the control group is .58 (not significant) and significance value of the pre-test scores for the treatment group is .119 (not significant). This means that both groups are normally distributed. To determine the effects of RME approach on student's mathematical cognition, an analysis of students' post-test mean scores of achievement was carried out. This was to test hypothesis H_{01}. One-way ANOVA test was carried out to show there is a difference in mean score between the two groups. Significant value F = 8156 and p = .006. This means that there is a significant difference between mathematical cognition of students taught with RME approach and students taught with a traditional approach, where students who are taught by RME approach had a higher score compared with students who are taught by traditional approaches. Then it can be concluded that there are differences in post-test mean values on the ability of mathematical cognition between the experimental class and the control class. To investigate the homogeneity of the students' ability in both classes, the two-variable homogeneity test was conducted using Levene's test to compare variance from both classes. The result shows that $F_{calculated} = 2.014$ is smaller than $F_{table} = 4.25$ and the significant value is bigger than $\alpha = 0.05$ which is 0.162. It suggests that H_0 can be accepted so that it can be concluded that variance of both classes was homogeneous.

An observation was conducted before conducting any intervention. The result of the observation pointed out that the students got some challenges in explaining mathematical problems. This happened for some reasons related to the students themselves and to the teacher. It was clear that the students did not understand the material completely or only understood it somewhat. This incomplete understanding made the students incapable to employ mathematics in their daily lives. As a result, it was hard for them to connect the concept that they already knew with the concept they were studying and it delayed them from getting a new concept. Moreover, the knowledge was only stored in their short-term memory because there was no exercise after school. The learning process should be constant so that information can be stored in long-term memory. If it is not, only a few information will persist when a new one is received. Another element that influenced the students' mathematical cognition was the teacher who applied a few effective approaches or learning procedures. Mathematics learning mostly held transfer processes and also expressions of formulas and calculation schemes that are considered irritating for the students. Such methods only activated the students' left brain so that their brain was loaded with several formulas, symbols, logic, and calculation actions.

Quality of teaching is very dependent on what teachers do in the classroom. By using Realistic Mathematics approach students are more active during the process of teaching and learning, the teacher act only as a facilitator for them. Compare with the conventional teaching method where the mathematics teacher had not yet encountered fun and suitable strategies that can be practiced to learning, applying RME approach in learning moves learning beyond the expectation. Speech, asking issues, and presenting task only trouble students since they have to collect a lot of information. This situation was worsened by the fact that the teacher did not connect mathematical concepts to the students' daily experiences. Therefore, mathematics teacher needs to be aware of the condition and as a result, change his/her standard and learning models. RME is an approach which enables a teacher to deliver contextual problems into the classroom as a first step of learning. RME encourages students to identify concepts [2]; [23]; [27]. Moreover, it also helps students to be actively involved in learning activities. Students are challenged to have the initiative to resolve contextual problems presented by the teacher in their individual way. Besides, RME empowers students to learn individually or in groups. Students can work together in solving realistic contextual problems. RME is a way out to change students' idea, connecting what they receive and what they have already known, and constructing knowledge by themselves [34]. These research outcomes have proved that RME is effective in developing students' motivation, self-confidence, problem-solving ability, and argumentation which follows in an increase in their mathematical cognition.

4. Conclusion

The findings of this study have provided information that there are differences in mathematical cognition from students studying with RME and students learning with conventional learning. Mathematics teachers need to use concrete mathematical concepts more so students can understand them more easily. RME is proven to encourage teachers to simplify and realize mathematical concepts. Therefore, teachers need to be more creative in designing learning using the RME approach. Teachers must develop more appropriate learning resources, strategies that are more suitable for the real-world context of students. In addition, it is recommended for schools to make more contextual environments that are rich in information about how to solve real life problems. Future studies can explore how the contribution of RME to students' cognitive achievement in mathematics at various levels of education. The next study can also investigate the effect of RME on student's critical thinking abilities or other variables related to mathematics learning.

5. References

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