International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

The Effectiveness of Realistic Mathematics Education Approach on Ability of Students' Mathematical Concept Understanding

Laras Lestari[a]*, Edy Surya[b]

[a,b]*Mathematics Education Post Graduate Program Study, State University of Medan, Jl. Willem Iskandar Pasar V, Medan 20221, Indonesia*

[a]*Email: laraslestari777@gmail.com*

[b]*Email: edy_surya71@yahoo.com*

Abstract

This research is an experimental research which aim is to know whether Realistic Mathematics Education approach is effective on ability of students' mathematical concept understanding or not. The population in this research is all the students of class VIII SMP Negeri 20 Medan, North Sumatera. The sample is the students of class VIII-1 as experimental group and the students of class VIII-2 as control group. The instruments which are used consist of the ability of mathematical concept understanding test, teacher's observation notes, and student's observation notes. Data analysis is done with *t* test. The results of this research proves that Realistic Mathematics Education approach is effective on the ability of students' mathematical concept understanding.

Keywords: Realistic Mathematics Education; ability of mathematical concept understanding.

1. Introduction

In accordance to the regulation of the minister of national education of the Republic of Indonesia, it is stated that the aim of mathematics in school are: the students have the ability to understand mathematics concept, to explain the relationship inter-concept and to apply the concept or algorithm in problem solving flexibly, accurately, efficiently, and appropriately [1].

---

* Corresponding author.

According to the Principles and Standards for School Mathematics NCTM [2], a combination of "factual knowledge, procedural facility, and conceptual understanding" is necessary for students to use mathematics.

It means that the ability of conceptual understanding is the main ability which should be possessed by the student to have other abilities such as the ability of problem solving, the ability of communication, and the ability of mathematic representation.

Based on the result of observation and the interview with mathematics teacher of class VIII SMP Negeri 20 Medan, it is concluded that in reality, there are so many students who have difficulty to understand the topic in mathematics subject which has been explained by the teacher. When the teacher asks about the new concept that has been described, only 10% of students can re-explain the concept. It shows that the students' ability of mathematics concept understanding is low.

Furthermore, many teachers continue to approach new concepts as if they were simply addons to their students' existing knowledge a subject of memorization and recall. This practice may well be one of the causes of misconceptions in mathematics [3].

Mathematics is one of the basic sciences to the human development and civilization. But in learning mathematics, there are some students who consider that mathematics is a science which is very difficult to be learned. So, the teacher's ability and accuracy in choosing and applying approach to teaching and learning which is matching the material taught in future is needed. The learning approach which is used in this research is Realistic Mathematics Education (RME).

Realistic Mathematics Education (RME) is learning and teaching theory in mathematics education which is firstly presented and developed by Freudenthal Institute in Netherland. This theory has been adopted by most countries in the world such as England, Germany, Denmark, Spain, Portugal, South Africa, Brazil, United States of America, Japan, and Malaysia [4]. For example, the RME-based textbook series "Mathematics in Context" has a considerable market share in the United States of America. The second example is the RME based "Pendidikan Matematika Realistik Indonesia" in Indonesia [5]. Realistic Mathematics Education (RME) seems to be a promising instructional approach that meets the Indonesia need for improving mathematics teaching. In the concept of RME, mathematics is a human activity and should be connected to reality. The concept of RME is characterized by students' activity to reinvent mathematics under the guidance of an adult [6], and the reinvention should start from exposure to a variety of "real-world" problems and situations [7].

The form of RME nowadays is mostly defined by Freudenthal's point of view about mathematics [8]. The most important point is mathematics must be related to the reality and mathematics as human activity. It means that mathematics must be close to child and relevant to daily situation. But, the word "realistic" does not only refer to the relationship with real world, but also refer to the real problem situation in student's mind. For the problem which will be represented to student, it means that the context can be a real world context. De Lange stated that problem situation can be also seen as application or modeling [9].

The instructional sequence of RME is understood as "learning line" where problem context is used as the start

point to gain the informal reasoning of student. RME integrates point of view about what is mathematics, how student learns mathematics, and how mathematics should be taught. Freudenthal believes that student cannot be seen as passive receiver of ready-made mathematics. Education must direct the students to the using of any situations and chance to reinvent mathematics by their own way. There are so many questions which can be appointed from various situations (context), which is considered have meaning so it can be a source of learning. Furthermore, RME has five characteristics, namely (i) use real life context, (ii) use mathematizing models, (iii) use production and construction, (iv) use interactions, and (v) use intertwinement [10]. Trefers also describes five characteristic of RME [11]: (i) using context, (ii) using model, (iii) using construction and the result purely from student, (iv) interactive character from the teaching process, and (v) the connection of various learning plot.

According to [12], based on the principal and characteristic of RME and observe the opinion about mathematics learning process with RME, so it has been set the steps in learning as follow:

- Understand the contextual problem
- Solve the contextual problem
- Compare and discuss the answer, and
- Conclude the answer

Based on those thoughts, RME has characteristics; that in learning process, student should be given a chance to reinvent mathematics through the guidance of teacher and that the reinvention of idea and that mathematics concept should be started from the exploration of various situations and issues in real world. This is appropriate with the ability of concept understanding indicator according to NCTM, they are:

- Give a mean of concept found, verbally and written
- Identify problem and make example or not-example
- Use diagram or symbols to present a concept
- Change a form of representation to another form
- Know various meaningful concepts and able to interpret concepts
- Identify given concepts and understand those concepts, and
- Compare and differentiate concepts.

Based on the problem background which has been explained before, the problem of this research is "Is *Realistic Mathematics Education* approach effective in increasing the student's ability of mathematics concept understanding?"

2. Materials and methods

This research is an experimental research. The populations in this research are all students of class VIII SMPN 20 Medan. The samples are students class VIII-1 who are counted as 34 students and class VIII-2 who are counted as 33 students. Research design which used is True Experimental Design. The research design is

explained as below:

R	X	O_1
R		O_2

That design is called "Posttest Only Control Design". According to [13], in this design there are two groups which each are chosen randomly (R). The first treated group is called experimental group and the untreated group is called control group.

The instrument which are used in this research are student's ability of mathematic concept understanding test in circle topic, teacher's observation notes, and student's observation notes. The ability of mathematic concept understanding test which is used in this research is written test. Teacher's observation notes are used to observe teacher's activity during learning process as well as to evaluate how well the plan of learning process is done. Student's observation notes are used to know how the development of student's learning activity which is subject to *Realistic Mathematics Education* approach. This observation notes are filled by an observer in experimental class by aim that the result of observation data is exactly same with the real condition. Then, a trial of instrument is done by giving a test to class or group which is not the research sample, but it is still the group which is integrate in one population. Trial test is done to know which question can be used as the question test in experimental class and control class through a set of instrument test, they are: validity, reliability, distinguishing capacity, and level of question's difficulty.

Data analysis is done by two steps; they are initial data analysis and final data analysis. Initial data analysis includes normality test and homogeneity test. Used data is notes of mathematics final test for first semester in class VIII SMPN 20 Medan.

Initial normality test data in this research aims to obtain an assumption whether the data which is obtained gives a normal distribution or not. If the data which is obtained gives a normal distribution, the further analysis will use parametric statistic, in this case it is t-test. If the data which is obtained does not give a normal distribution, the further analysis will use non parametric statistic.

Homogeneity test in this research aims to know whether the both samples have the same variant or not. If the class has the same variant, the group can be said as homogeny.

After getting the needed data in research, hypothesis test is done. Used data in this final data analysis is the posttest of circle topic notes after charged by RME in research sample. Final data analysis includes normality test, homogeneity test, hypothesis test I, hypothesis test II.

Hypothesis test I is done to know the learning with Realistic Mathematics Edcatioon approach has reached the mastery learning in ability of concept understanding by experimental group students. Individual mastery is

based on Minimal Mastery Criteria (MMC). Minimal Mastery Criteria (MMC) in SMPN 20 Medan for all mathematics subjects is 75. While classical mastery criteria is student's percentage in reaching minimal individual mastery is 75%. Hypothesis test of learning mastery for individual mastery uses the right side t-test while classical mastery test uses one side proportion test.

Hypothesis test II is done to know whether there is a different average between experimental group and control group which both of them are not related each other. Hypothesis test II uses t-test.

Data analysis observation is done in using observation notes. The observation is done in every learning activity. Student's observation notes only given to experimental class by sum the mark achieved in observation notes. Teacher's observation notes are also analyzed by sum the mark achieved in observation notes.

3. Results

The results which would be described in this chapter are the result of posttest in the ability of concept understanding by experimental group and control group in SMPN 20 Medan after they are given the different teaching. The experimental class, class VIII-1 SMPN 20 Medan uses Realistic Mathematics Education approach. The control class, class VIII-2 SMPN 20 Medan uses lecture method. The result of research which is described is final data analysis and observation result data analysis.

3.1. Final Data Analysis

After doing final data normality test to sample (the students of VIII-1 and VIII-2), it has been resulted like table 1 as follow.

Table 1: Analysis result of final data normality test

Class	χ^2 count	χ^2 table	Criteria
VIII-1	5.660	7.815	Normal
VIII-2	0.872	7.185	Normal

Based on that analysis result, it is obtained that χ^2 count for each sample class (class VIII-1 and VIII-2) is less than x^2 table. So it can be concluded that mark distribution for class VIII-1 and VIII-2 is normal. Final data homogeneity test is done to table 2 as follow.

Table 2: Result of final data homogeneity test analysis

Data	F_{count}	F_{table}	Criteria
Posttest value of concept understanding ability	1.097	2.017	Homogeny

Based on that analysis result, it is obtained that $F_{count} < F_{table}$. So, it can be concluded that the variant of class VIII-1 and VIII-2 are same. In the other words, the sample class is homogeny.

Hypothesis test I for individual mastery uses one-side t test that is right side test, the submitted hypothesis is as follow.

$H_0 : \mu \leq 74.5$

$H_1 : \mu > 74.5$

The t_{table} value can be seen in *student t* distribution list with $dk = n - 1$ and probability $(1 - \alpha)$. The test criteria is H_0 is refused if $t_{count} > t_{table}$. The value of $t_{table} = 1.692$ with $\alpha = 5\%$ and $dk = 33$. Based on the result of learning mastery test summary, it is obtained that $t_{count} = 1.835$. Because $t_{count} > t_{table}$, H_0 is refused. It means experimental group which obtains learning topic in using Realistic Mathematics Education approach achieves learning mastery individually.

After that, one side proportion test is done in using right side test to know learning mastery classically. The submitted hypothesis is as follow.

$H_0 : \pi \leq 74.5$

$H_1 : \pi > 74.5$

The test criteria is H_0 is refused if $Z > Z_{0.5-\alpha}$ with $\alpha = 5\%$ can be obtained in using Z distribution table list ($Z_{0.45} = 1.64$). From the sum result, it is obtained that $Z = 1.84$ because $Z_{count} > Z_{0.45}$ $(1.84 > 1.64)$ so H_0 is refused and H_1 is accepted. It means that experimental group which obtains learning topic in using Realistic Mathematics Education approach achieves learning mastery classically.

Hypothesis test II is done with final data average differences test to sample class (class VIII-1 and VIII-2). The result is obtained as the table 3 shows below.

Table 3: Result of final data average differences test analysis

Data	t_{count}	t_{table}	Criteria
Posttest value of concept understanding ability	3.161	1.669	H_0 is refused if $t_{count} > t_{table}$

Based on the result of that analysis, it is obtained that $t_{count} > t_{table}$, the value of t_{table} in $\alpha = 5\%$ with $dk = 34 + 33 - 2 = 65$ so that the value of $t_{table} = 1.669$. So, it can be concluded that concept understanding ability of student who obtains learning topic with Realistic Mathematics Education approach is better than concept understanding ability of student who obtains learning topic in control group.

3.2. Observation Result Data Analysis

The observation of how active the student is done in using student's observation notes. The observation is done in every learning activity by experimental class; they are 1st meeting, 2nd meeting, and 3rd meeting which are shown in table 4 as follow.

Table 4: Result of student activity observation

Meeting	Percentage of how active the student in experimental group	Criteria
1st	81.18%	Active
2nd	84.71%	Active
3rd	87.06%	Active
Average	84.32%	Active

The observation of teacher is done in using teacher's observation notes. The observation is done in every leaning activity in experimental class and control class; they are 1st meeting, 2nd meeting, and 3rd meeting which are shown in table 5 as follow.

Table 4: Result of student activity observation

Meeting	Percentage of Teacher's Observation		Criteria
	Experimental Class	Control Class	
1st	89.71%	85.94%	Good
2nd	92.65%	79.69%	Good
3rd	89.71%	95.31%	Good
Total Average	90.69%	86.98%	Good

4. Discussion

Realistic Mathematics Education approach in this research is said to be effective on ability of students' mathematical concept understanding if:

- Realistic Mathematics Education approach has reached the mastery learning in ability of concept understanding by experimental group students.
- Ability of students' mathematical concept understanding who obtains learning topic using Realistic Mathematic Education approach is better than ability of students' mathematical concept understanding who obtains learning topic using lecture method.

According to the results, based on the result of learning mastery test summary, it is obtained that $t_{count} = 1.835$ and the value of $t_{table} = 1.692$ with $\alpha = 5\%$ and dk = 33. It means experimental group which obtains learning topic in using Realistic Mathematics Education approach achieves learning mastery individually. Furthermore, experimental group which obtains learning topic in using Realistic Mathematics Education approach achieves learning mastery classically. It is proven from the sum result, it is obtained that Z = 1.84 because $Z_{count} > Z_{0.45}$ (1.84 > 1.640). Then, result of final data average differences test analysis show that $t_{count} > t_{table}$, the value of t_{table} in $\alpha = 5\%$ with $dk = 34 + 33 - 2 = 65$ so that the value of $t_{table} = 1.669$. It means that concept understanding ability of student who obtains learning topic with Realistic Mathematics Education approach is better than concept understanding ability of student who obtains learning topic in control group.

This research is relevant to the research undertaken by [14], it was seen that self-reports of the students who were taught in accordance with the Realistic Mathematics Education were higher than the students who were taught by classical methods. Then, development of instruction theories as Realistic Mathematics Education was mostly integrated with the use of digital technology as investigated by [15] with respect to promoting students' understanding of algebraic concepts and operations.

5. Limitations

The limitations in this research are as follows:

- This research is limited to students of class VIII SMPN 20 Medan, North Sumatera in the academic year 2015-2016.
- This research was conducted during the learning activity of mathematics on the subject of circle.
- The approach used is Realistic Mathematics Education (RME) and limited to the ability of students' mathematical concept understanding**.**

6. Conclusion

Based on the result of research and discussions, it is obtained that:

- Ability of students' mathematical concept understanding who obtains learning topic using Realistic Mathematic Education approach achieves individual mastery and classical mastery.
- Ability of students' mathematical concept understanding who obtains learning topic using Realistic Mathematic Education approach is better than ability of students' mathematical concept understanding who obtains learning topic using lecture method.

So, it can be concluded that Realistic Mathematic Education approach is effective to ability of students' mathematical concept understanding.

7. Recommendations

Based on the results of research and discussion above, suggestions that can be given are as follows:

- Realistic Mathematic Education approach is expected to be applied and developed by teachers in learning so that ability of students' mathematical concept understanding is well achieved.
- Realistic Mathematic Education approach is expected to be applied with special attention in planning time and using learning media so as to minimize wasted time and students can understand the concept of learning materials well.

Acknowledgements

This work was supported by Mathematics Education Post Graduate Program Study, State University of Medan. So that, the authors would like to thank the Mathematics Education Post Graduate Program Study, State University of Medan.

References

[1] BSNP. Permendiknas No. 22 Tahun 2006 tentang Standar Isi untuk Satuan Pendidikan Dasar dan Menengah. Jakarta: Depdiknas, 2006, pp. 140.

[2] Wikipedia. "Principles and Standards for School Mathematics." Internet: https://en.wikipedia.org/wiki/Principles_and_Standards_for_School_Mathematics, April 13, 2017 [May 28, 2017].

[3] Meir Ben-Hur. "Concept-Rich Mathematics Instruction." Internet: http://www.ascd.org/publications/books/106008/chapters/Conceptual-Understanding.aspx, 2006 [May 26, 2017].

[4] Jan De Lange. "Using and Applying Mathematics in Education," in International Handbook of Mathematics Education, Part 1, volume 4. Alan J. Bishop et al. Ed., Netherlands: Springer Netherlands, 1996, pp. 49-97.

[5] Marja Van den Heuvel-Panhuizen and Paul Drijvers. "Realistic Mathematics Education," in Encyclopedia of Mathematics Education, 1st ed.. Steve Lerman, Ed. Netherlands: Springer Netherlands, 2014, pp. 521-525.

[6] K. P. E. Gravemeijer. Developing Realistic Mathematics Education. Utrecht: CD-β Press, 1994.

[7] Jan De Lange. "Assessment:: No Change Without Problems," in Reform in School Mathematics and Authentic Assesment, Thomas A. Romberg, Ed. Albany NY: State University of New York Press, 1995, pp. 87-72.

[8] Hans Preudenthal. Revising Mathematics Education. Utrecht: CD-β Press, 1991.

[9] Jan De Lange. "Using and Applying Mathematics in Education," in International Handbook of

Mathematics Education, Part 1, volume 4. Alan J. Bishop et al. Ed., Netherlands: Springer Netherlands, 1996, pp. 49-97.

[10] K. P. E. Gravemeijer. Developing Realistic Mathematics Education. Utrecht: CD-β Press, 1994.

[11] Adrian Treffers. Three dimensions: a model of goal and theory description in mathematics instruction – The Wiskobas project. Dordrecht: Kluwer Academic Publisher, 1987.

[12] Soedjadi. "Pembelajaran Matematika Berjiwa RME (Suatu Pemikiran Rintisan ke Arah Upaya Baru)"presented at the National Seminar of Realistic Mathematics Education (RME) in UNESA, Surabaya, Indonesia, 2001.

[13] Sugiyono. Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif, dan R&D). Bandung: CV. Alfabeta, 2011, pp. 112.

[14] Sebahat Yetim Karaca and Ali Ozkaya. 2017. "The Effect of Realistic Mathematics Education on Students' Math Self Reports in Fifth Grades Mathematics Course." International Journal of Curriculum and Instruction. [On-line]. 9 (1). Pp. 81-103. Available: ijci.wcci-international.org [May 30, 2017]

[15] Paul Drijvers. "Learning algebra in a computer algebra environment. Design research on the understanding of the concept of parameter." Dissertation. Freudenthal Institute, Utrecht, 2003.