

THE DEVELOPMENT OF MATHEMATIC TEACHING MATERIAL THROUGH REALISTIC MATHEMATICS EDUCATION TO INCREASE MATHEMATICAL PROBLEM SOLVING OF JUNIOR HIGH SCHOOL STUDENTS

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ABSTRACT

Research Goal: To know (1) the teaching material effectiveness that is developed to the social arithmetic material through RME to improve students' mathematical problem solving ability (2) The students' respond to the teaching material that's developed. The research is done in Muhammadiyah 2 Junior High School Medan. The kind of research is device development through 4-D model ((Define, Design, Develop and Disseminate) which is stated by Thiagarajan, Semmel and Semmel. The teaching material test is done twice in VII Grade students. Research result: (1) Effective teaching material based on the achievement: classical completeness; TPK; students' learning and activities respond; (2) Students' ability in solving the mathematic problem is increased; and (3) Students positive respond.

Keyword: *Teaching Material, Realistic Mathematics Education, Problem Solving*

1. INTRODUCTION

Mathematic is one of science that's basically develops community's life and really needed in the development of science and technology. As Cornelius stated (in Abdurrahman, 2009) [1] that: " five reasons mathematic is important to learn is: (1) thinking medium's clear and logic; (2) the madium to solve daily life problem; (3) the mediu to know the relation forms and experience generalization; (4) the medium to develop the creativity; and (5) the medium to improve the awareness to the culture development.

One of general goal of mathematic education is having the ability which is related to the mathematic that can be used in solving mathematical problem. Polya (1945) [9] describes the process of problem solving at four stages, including the understanding the problem, determining the strategy, implementing the selected strategy and assessment. At the stage of understanding the problem, the student is expected to state what they understood from the problem and to determine what are given and unknown in the problem and also to suggest clearly the condition of the problem. At the stage of determining the strategy, the student is expected to determine which steps such as calculation, drawing, etc. to follow in order to reach the requested. The teacher, in this process, can promote the use of different problem solving strategies by writing the all strategies on the board and can enable the student to choose the suitable strategy (Miller in Ersoy, 2016) [3].

Thinking ability to mathematic problem solving is a very important and basic part. According Akinoglu (2007) [2], the model is a problem solving activity students to find information themselves, which these activities have become an educational program from teaching to learning. This model allows students to learn new knowledge to deal with problems that must be solved. By way of problem-based learning, some students' attitudes to increase them in areas

such as problem solving, thinking, group work, communication, information acquisition and sharing information with others has positive effects. Pehkonen (2007) [8], about the ability of problem solving in school mathematics in Finland said, there are lectures and demonstrations that will be used to solve different problems. Troubleshooting was first introduced in 1986 in its efforts to systematically fatherly improve math education. Then, The National Council of Teachers of Mathematics (NCTM, 2000) [6] mentions as a problem-solving teaching methods which can improve the quality of teaching mathematics in schools.

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Nut, the fact in field is the students' mathematic problem solving ability in Indonesia is still low. It can be seen the from four year survey result TIMSS which coordinated by IEA (The International Association for the Evaluation of Educational Achievement), where, one of cognitive indicator that's evaluated is the students' ability to solve the non-routine problem. The low of Indonesian students' mathematic problem solving ability can be seen from the PISA survey result (OECD, 2016) [7] ON 2015 which showed that Indonesia is in 63 grade of 69 countries that's survey with 386 mean from 500 which had firmed by PISA.

In mathematic learning process there are many students don't pass the basic competency that had assigned. It can be proved with the low learning result of Muhammadiyah 2 Junior High School Medan students in the final semester examination in mathematic test which did not reach the minimum criteria completeness. The fact shows that the learning process had not run well. One of the factors caused that case is the lessness of plan in learning process so the teaching learning process doesn't organized well, because in studying, the students are not only interract with the teacher as one of the learning result, but also interract with all the learning source that's use to achieve the learning goal.

Generally, the teachers is less in doing a agood preparation before teaching. It can be seen from the fact in field which is gotten from the interview and observation in Muhammadiyah 2 Junior High School Medan, the researcher got the data about the mathematic learning condition occured. Generally, at school there are 3 mathematic teachers. In learning process the teachers are only use the learning book. Next, in learning the teacher also put the students' answer sheet, but the answer sheet used is not suit yet with the students' understanding and can not invest mathematic problem solving abilty in social arithmetic concept. The answer sheet is usually bought from the printing shop which produces it. Ideally, the teachers are more understand the students' characters, so the teachers can develop students' answer sheet in order to match with the students' needs.

Teaching material is a batch of learning source which sustains the teacher and students to do the learning. Hamdani (2010) [5] stated that: "Teaching material is all kind of material that's arranged sistematically that's used to help the teacher or instructor in doing the teaching learning process so the confortable nuance is gotten to study. The teaching material can be reached printed material such as (hand out, students' answer sheet, module, brochure, leaflet, wallchart), audio-visual such as (video/film, VCD), Audio such as (radio, cassette, audio CD, PH), visual such as (photos, picture, model), multimedia such as (interractive CD, based computer, internet)

Interesting printed teaching material to use, in the making process is hoped to the learning process which is match with the students' needs so that the learning is more meaningful. One of the model that can be used is Realistic Mathematic Education (RME). The meaning of the mathematic concept is the main concept of RME. The students' learning process is only happened if the learned-knowledge is meaningful to students (Freudenthal in Wijaya, 2011) [13].

A knowledge will be meaningful if the learning process is held in a context (CORD In Wijaya) [13] a realistic process the learning uses realistic problem. A realistic problem is not just a real-world problem and can be found on students' daily activities. A problem called 'realistic' if the problem is imaginable or real in students mind. Webb et al (2011) [12] said that: "it is important to point out here that the realistic aspect of RME is not just because of its

connection with real-world context, but it is related to the emphasize that RME puts on offering students problem situations which are imaginable.

Treffers (1987) distinguished two kinds of mathematical horizontal mathematic refers to experientially real situations into mathematics and vice versa, where as vertical mathematization refers to process of attanting a higher level of abstraction within mathematics. Next, according to Freudenthal (1991) [4] stated it in the following way: “horizontal mathematization involves going from the world of life into the world of symbols, while vertical mathematization means moving within the world of symbols”.

2. METHOD

The research method is the development research to the teaching material through 4-D model by Thiagarajan, Semmel and Semmel. The researcher had developed the teaching material in social arithmetic material. The learning tools developed in this research is teaching material through RME model. The developed model which is stated by. Thiagarajan, Dorothy S. Semmel, dan Melvyn I. Semmel (1974:5) [10] include of four step called *define step, design step, develop step and the disseminate step*. The teaching material development can be seen int this following picture:

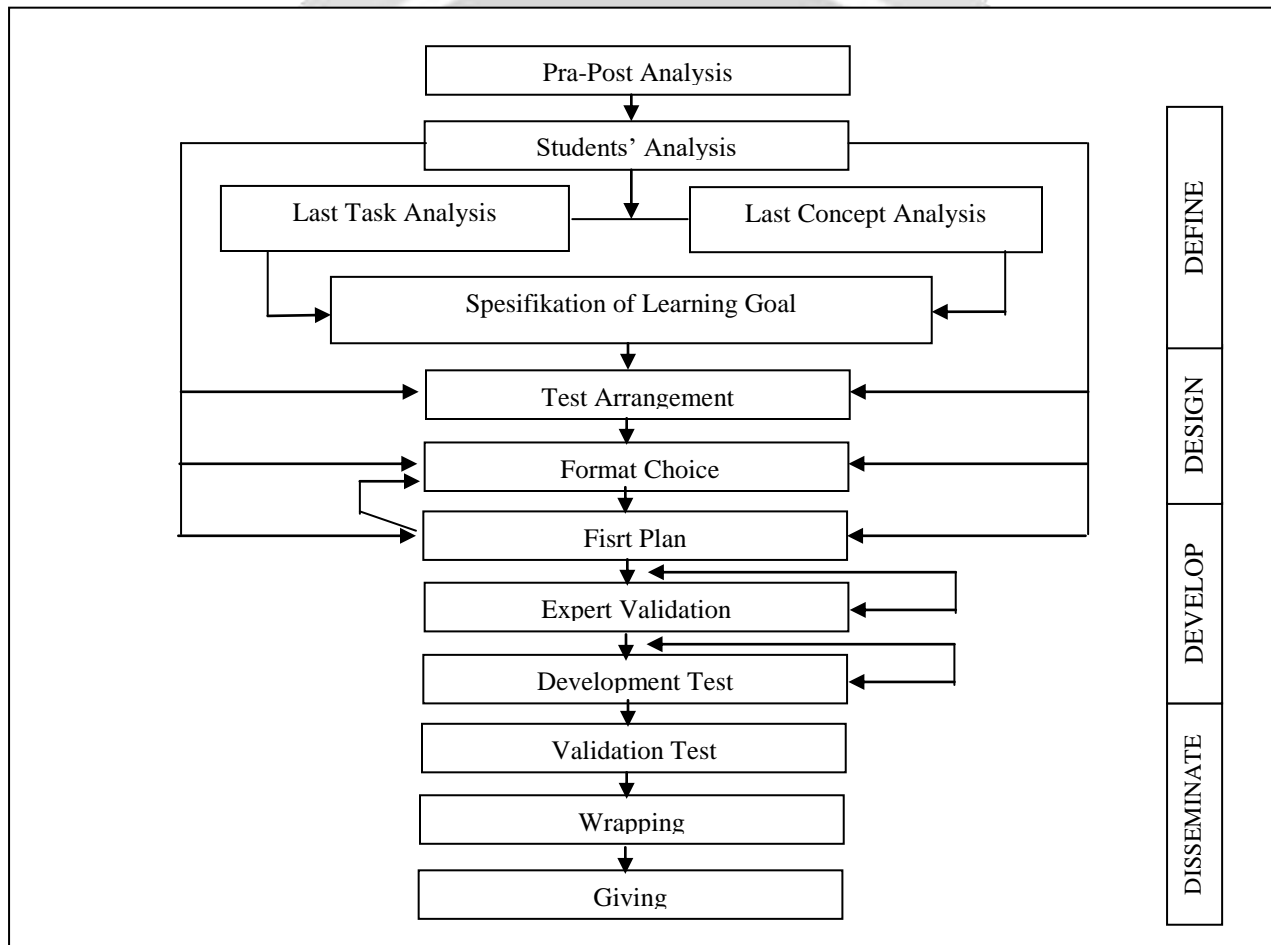


Fig -1: Development procedure of 4-D Model
(Source: Adapted from Thiagarajan 1974: 6-9) [10]

3. RESULTS AND DISCUSSION

According to the researcher’s observation in the mathematic learning in VII Grade of Muhammadiyah 2 Junior High School the teacher was less to include the students when the learning process was going on. The teacher still used the usual learning form, namely explain with a little interaction to give the example of question and than give the exercises. It could make the students become unusual to solve the problem with their own finishing.

If we have watched the students' age mean of VII Grade in that school is about 12-13 years old. If it's connected with the cognitive development step according to piaget, thus the VII Grade students are in the formal operational step. But, actually they are in operational transition step. They still need concret things in the mathematic learning, including their daily experience.

The interview result with one of the mathematic teacher in that school, knowing that the teachers haven't used the learning by using RME model and the arrangement of the students in studying by group at class. So, the RME model is still new for the students. The learning media that is needed in the learning implementation by using teaching material that's developed using PMR in the VII Grade of Junior High School involve: learning plan implementer, teaching material, test of mathematic problem solving and teachers' management sheet in learning.

TEST I

Achievement effectiveness of mathematic learning with teaching material by RME that is determined based on the teachers' ability to manage the learning, students' activity, students' studying completeness classically and the achievement completeness TPK to the teaching material that's developed can be seen in the following table:

Table 1 Effectiveness Achievement of Teaching Material

No	Aspect of Category	Description
1	Teachers' ability to manage the learning.	Effective
2	Students' activity	Non-effective
3	Classically students' learning completeness.	Not-passed
4	Students' completeness achievement.	Passed

From the table above, based on the criteria of achievement effectiveness mathematic teaching material that's developed through RME can be conclude that the mathematic learning by using RME is not effective, because the requirement of students' completeness learning result classically and the students' activities is not filled.

TEST II

Achievement effectiveness of mathematic learning by teaching material through RME that's determined based on the teachers' ability to manage the learning, students' activities, students' learning completeness classically and the completeness achievement TPK to the teaching material that can be developed can be seen in the following table.

Table 2 Effectiveness Achievement of Teaching Material

No	Aspect of Category	Description
1	Teachers' ability to manage the learning.	Effective
2	Students' activity	Effective
3	Classically students' learning completeness.	Passed
4	Students' completeness achievement	Passed

From the table above based on the effectiveness achievement of mathematic teaching material that's developed through RME can be conclude that the mathematic teaching material is **effective** to be used.

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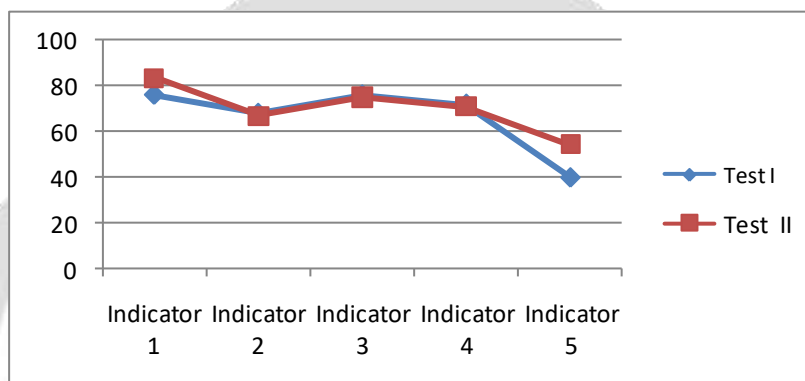
From the research process, we can got the result such as:

1. Teachers have been able to maintain and improve the teaching learning activity by using mathematic teaching material that is developed through RME. This is based on the observation result that shows the improvement with better teaching learning process that's held by the teachers based on the researcher's observation. The solidarity between the group members had been better so they're enthusiastic to do the teaching material is good enough. The question of the answer which showed when discussion and presentation is also getting better, the students have been brave to deliver the arguments in the discussion or presentation.
2. From the ability test to solve the problem in test I and from the test of problem solving ability in test II can be seen that the students' ability in solving the mathematic problem improved than before. The result explain in the following table:

Table 3 The Comparison of Research Result

	Test I	Test II
Class mean on TKPM	69,067	74,5
Classical completeness of TKPM	76% (19 students)	87,5% (21 students)
Completeness of TPK	80%	80%
Learning management	2,54	3,04
Students' activity (many aspects is fulfilled)	3	6
Respond	Positive	Positive

On the achievement of special learning goal in learning is able to maintain and improve the presentation of students' amount that's complete in reaching each indicator. The improvement of students' mean presentation that reached TPK in the learning can be seen in the following graphic:

**Chart -1** TPK Achievement in Learning on Test I and II

In teacher's ability in learning management activities, there is also an improvement. The class mean that's had by the teacher in learning management in test I is 2,45 while in the Test II the class mean that's gotten by the teacher in learning management in Test II is 3,04.

In the students' activity in learning there is also an improvement that's fulfilled. The tolerance criteria limit of achievement time effectiveness that is used is like the following table:

Table 4 presentation of Ideal Time and Tolerance Limit of Students' Activity

Observation Aspect of Students' Activity	The Percentage of Suitability (P)	
	Ideal Time	Tolerance 5 %
Listening/paying attention teacher's/friends' explanation	10 %	5 % ≤ P ≤ 15 %
Reading/understanding contextual problem in students' teaching material.	10 %	5 % ≤ P ≤ 15 %
Finishing the problem or finding the problem solving and problem answer.	35 %	30 % ≤ P ≤ 40 %
Compare the answer in group discussion or class discussion.	20 %	15 % ≤ P ≤ 25 %
Asking/giving the idea/argument to teacher or friends	15 %	10 % ≤ P ≤ 20 %
Taking the conclusion of a concept or procedure	10 %	5 % ≤ P ≤ 15 %
Unrelated behaviour to KBM	0 %	0 % ≤ P ≤ 5 %

The mean percentage of students' activity in learning on test I there are 3 criteria tolerance limit of achievement effectiveness time that's effective while the mean percentage of students' activity in learning on test II there are 6 criteria tolerance limit of achievement effectiveness time that's effective, there are improvement of tolerance limit effectivity on the aspect number 1,3, and 5. The improvement of mean percentage of students' activity in the learning can be seen in the following graphic:

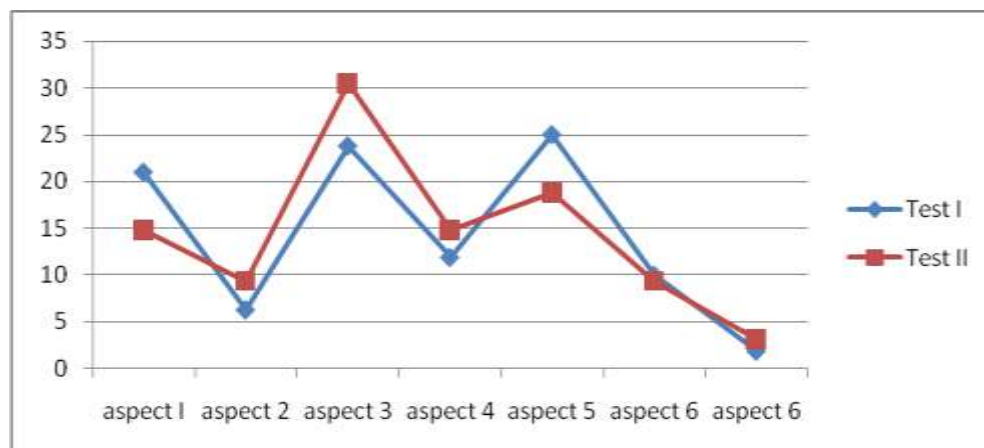


Chart -2 Students' Activity in Learning in Test I and II

The improvement of students' amount that's reach learning completeness in the problem solving ability test in the test I and II also have an improvement. Students' amount which is reached learning completeness in the test I is 19 students (76%) while the students' amount which is reached learning completeness in the test II is 21 students (87,5%). It can be seen in the following graphic:

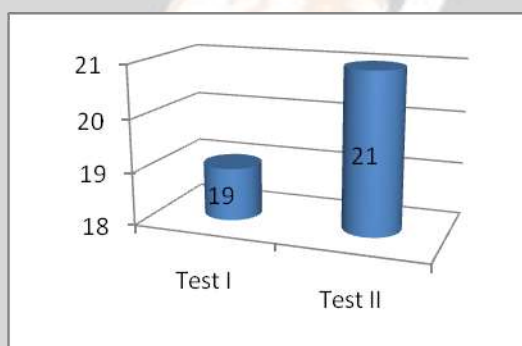


Chart -3 The Improvement of Students' Amount who Passed the Learning on Test I and II

Some students experience many difficulties in finishing the question given, but the amount of students who faced the difficultie is less than before. It can be known from the problem solving ability test in the test II. From the research result it's gotten that teacher had been able to maintain and improve the learning activity implementation with realistic learning.

Based on the data description, we can get the conclusion that the students' ability to solve the problem have an improvement and the students reached the completeness learning level as hoped. This shows that the success of mathematic teaching material development in the test II. Therefore, based on the problem solving ability test learning complet in the test II, it's gotten that the class mean is 74,5 with the learning completeness level reached 87,5%. The result had reached learning completeness level that have firmed and the students' ability to solve the problem is medium. Because of the learning completeness had reached so the teacher did bot continue to the next test (test III)

But in the research, the researcher found many weakness so with the implementation of the teaching material through RME does not make a whole students' get high score. The weakness of the researcher when the learning process is going on is:

- The short learning time to do some developments, many aspects realistic learning that can't be done well and fluent.
- The class environment which does not encourage especially from the students who did not understand the learning given by the researcher.
- Less-motivation and the direction from the researcher that caused the students are not focused to the things given by the researcher.

4. CONCLUSIONS

The conclusions of this research are:

1. The teaching material effectiveness that's developed by RME was gotten by twice test. in the test I the teaching material that had developed was only effective on: (1) the achievement of special learning goal and (2) teacher's ability to manage the learning is as big as 2,54, while the classical completeness was not filled 76% (under of 85%). From the test I there was analysis so there was a fixness that can be a basic in the test II, in the test II we could get the result as: (1) the classical completeness improved as big as 87,5%, (2) achievement of special learning goal, (3) teacher's ability to manage the learning is as big as 3,04 and (4) achievement effectiveness of students' activity. Caused by test II, four of the effectiveness requirement especially in the classical completeness and special learning goal, so we can conclude that a teaching material that has developed through RME has been effective to use.
2. Students' respond to the teaching material that has developed through RME is positif because more that 80 % students are intended to follow the teaching learning process by using the teaching material that has been developed.

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