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Development of Learning Devices Oriented Model Eliciting Activities to Improve Mathematical Problem Solving Ability Junior High School Students

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Abstract

This study aims to develop a learning device-oriented model of eliciting activities (MEA) tested the validity and effectiveness to improve mathematical problem solving ability junior high school students of class VII. This type of research is the development of learning devices with 4-D models of Thiagarajan which consists of four phases: 1) define; 2) design; 3) develop; and 4) disseminate. The subjects were students of SMPN 17 Medan. The results showed that the learning device classified both criteria that meets the requirements of validity and effective. MEA implementation-oriented learning device can improve students' mathematical problem solving ability SMPN 17.

Keywords: Devices Development; Model eliciting Activities; Mathematical Problem Solving Ability.

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1. Introduction

Along with the development of science and technology, people are required to have the ability to think critically, systematic, logical, creative, reason and cooperate effectively so that it can develop forward in the age of globalization. According to [1] that "the development of mathematics education today is directed to development". Development which is meant in this case is the process of producing learning materials.

In this case the formal education has an important role in the development of which is to hold a quality learning with the creation of appropriate learning tools. According [2] that "the learning device is one manifestation of the preparations made by the teacher before making the learning process".

In line with that according to [3] argues that "the learning device is a device that is needed and used for managing the learning process". So it can be said that the learning device is prepared by the teacher before implementing the learning process and become the handle of teachers in implementing good learning.

But the reality of the field that there are still many teachers who have not designed the learning tool well. Often found learning devices only limited to the terms only for administrative completeness. Based on the observations that have been done in SMP Negeri 17 Medan, the design of the implementation of learning that is still not designed in accordance with the provisions of the criteria. Then based on information from one of the teachers of class VII said that in the implementation of learning is not used student activity sheets as a learning tool. The teacher only uses the exercises in the student manual only.

From the observation, the textbook used in SMP Negeri 17 Medan still has some weaknesses where the example of the problem does not show the steps that can measure the ability of problem solving mathematically. So it is necessary to develop a good textbook in accordance with the criteria. According to [4] that "the textbook is a textbook used as a standard reference on a particular subject. Development of good textbooks must meet valid, practical and effective criteria ". According to [4] good textbooks are: (1) accurate (accuracy); (2) appropriate (relevance); (3) communicative; (4) complete and systematic; (5) oriented to the Student Centered; (6) in favor of the ideology of the nation and the State; (7) correct language rules, textbooks written using spelling, precise terms and structures; (8) is readable, textbooks with high legibility contain sentence length and sentence structure according to reader's comprehension. On the implementation of mathematics teachers often have difficulty in presenting the material so that students acquire concepts correctly. It is necessary for teachers or researchers choose the right learning in learning. According to [5] that: "The development of learning device should be prepared based on appropriate learning models as well. Use of learning models that are not in accordance with the development of students will affect the development of student learning. Lessons are always focused on the teacher will lead the students knowledge about developing States. Teacher-centered learning make students passive, only receiving material. Learning activity will make students only remember and memorize ". Based on the above, the learning model that is expected to enable the students to construct knowledge, can make students independent in learning, can enhance student interaction, can train students to communicate ideas and to enhance the knowledge of students solve problems. With the characteristics possessed the expected learning model that will result in increased student learning outcomes. One of the learning that

begins with an introduction to the problem is through approach Model Eliciting Activities (MEA). "The model eliciting activities (MEA) are complex, open, non-routine problems in a variety of real-world Contexts that can be approached by learners at different entry levels and then solved through the interaction between Reviews their informal and more formal mathematical knowledge " according [5]. Meanwhile, according to [5] states that: “Model Eliciting Activities (MEA): The modeling approach has become increasingly popular in mathematics education in recent decades. A MEA is designed to a reflect real-life situation, containing incomplete, ambiguous, or undefined information regarding a problem that requires solving. Students must interpret and make sense of the situation in a meaningful way, the challenge encouraging them to elicit conceptual tools which function as mathematical models. This is not a linear process, the givensbeing tested and iteratively revised through multiple cycles of translation, description, data prediction, and deliverables. This is known as mathematizing the situation”. MEA is designed to reflect real-life situations, it contains information that is incomplete, ambiguous, or undefined on issues that require settlement. Students must interpret and understand the real situation, the challenge of encouraging them to acquire a conceptual tool that serves as a mathematical model. One of MEA learning objectives is to give students the chance to control their own learning with the briefing process. In this study, the learning step MEA are used as follows:

Table 1: Steps of Model Eliciting Activities (MEA)

Teachers’ Activity	**Students’ Activity**
Step 1: Defining	
Teacher gives a problem as early as the introduction for students to understand and then be able to resolve the problems well	Students observe, understand and define the problems
Step 2: Descriptioning	
Teachers give problems related to contextual issues	Students build knowledge based on existing problems with their knowledge
Step 3: Manipulating	
Teachers monitor and guide the students to be able to model the problem in mathematical form for the purpose of demonstrating	Students create a mathematical model based on issues that have been given
Step 4: Translating	
Teachers lead students to solve problems	Students solve problems based on a mathematical model that they have made at the stage of manipulation
Step 5: Verificating and Predicting	
Teachers urge students to check back answers to problems that have diselesikan so that there are no mistakes.	Students check their work one by one
Step 6: Presenting	
Teachers lead students to present their work and then discussed together with other students	Students present the work that has been completed

So with MEA, students are more engaged during the learning process with given contextual problem so that students better understand what they are learning and making them more active in learning.

One of math skills need to be improved is the ability of problem solving. This is because the math does not escape from the challenges and mathematical problems. Problem solving is an important component of mathematics education because it is easy to use individually or in groups. Accourding to [6] argues that "solving the problem is the process of applying the knowledge that has been acquired previously to new situations and different". Although problem solving is an unseparate part of the mathematical problems, many students are still difficult to resolve mathematical problems. Accourding [7] “Ability to solve word problems falls far below their ability to compute because children do not know how to choose the correct operation to apply to the problem”.

From the above it can be concluded that the mathematical problem solving plays an important and needs to be improved in learning. But the facts on the ground show that the problem solving ability of students is still low. PISA 2009 survey results [8] states: "only half the students in Indonesia (56.6%) who can solve the simplest PISA problem. About one-third of students (33.1%) who did the contextual matter if the question and the required data is given explicitly turn. Approximately 0.1% of Indonesian students who are able to develop and work on math modeling skill to think and reason. When referring to the PISA objectives to determine the ability of 15-year-old child in applying the knowledge gained in school, it can be said that the ability of Indonesian students in solving mathematical problems is the application of knowledge gained in school is still low ".

Things like this should be solved by familiarizing students and training students to answer the questions by implementing measures problem-solving ability, this is a provision for students in solving mathematical problems as well as problems that he finds in his daily life. Stages proposed mathematical problem solving that Polya pointed [9] can be seen as aspects of mathematical problem solving ability. Thus, to measure the ability of mathematical problem solving can be seen from the four indicators, namely: 1) Understanding the problem; 2) Devising a plan; 3) Carrying out the plan; 4) Looking back.

Thus, the core of solving the problem, so that students used to work on the problems that do not just rely on a good memory, but the student is expected to associate with the real situation ever experienced or ever thinks about. Then students explore with concrete objects, then students will study mathematical ideas informally, then formally study mathematics.

Based on the problems described above, this study aims to 1) develop oriented devices MEA to enhance the problem solving mathematical student class VII, 2) describe the validity of the learning device oriented MEA to enhance mathematical problem solving of student class VII, and 3) describe the effectiveness of learning devices that developed to improve students' mathematical problem solving class VII.

2. Research Method

2.1. Types of research

This research is the development of devices that used Thiagarajan development model, and Semmel Semmel, which is the 4-D models (define, design, develop, disseminate). This study was conducted to produce learning tools and instruments are needed which will then be tested in the classroom.

This study is divided into two stages: the first stage is the development of learning tools. Development of learning tools that includes (i) Validity Learning Implementation Plan; (ii) The validity of Teacher Book; (iii) The validity of the Student Book; (iv) The validity of the Student Activity Sheet; and (v) The validity of the instrument test students' mathematical problem solving ability. While the second stage is the implementation of learning tools that are considered eligible based on the test results. Model development in this study is schematically illustrated in figure 1 below:

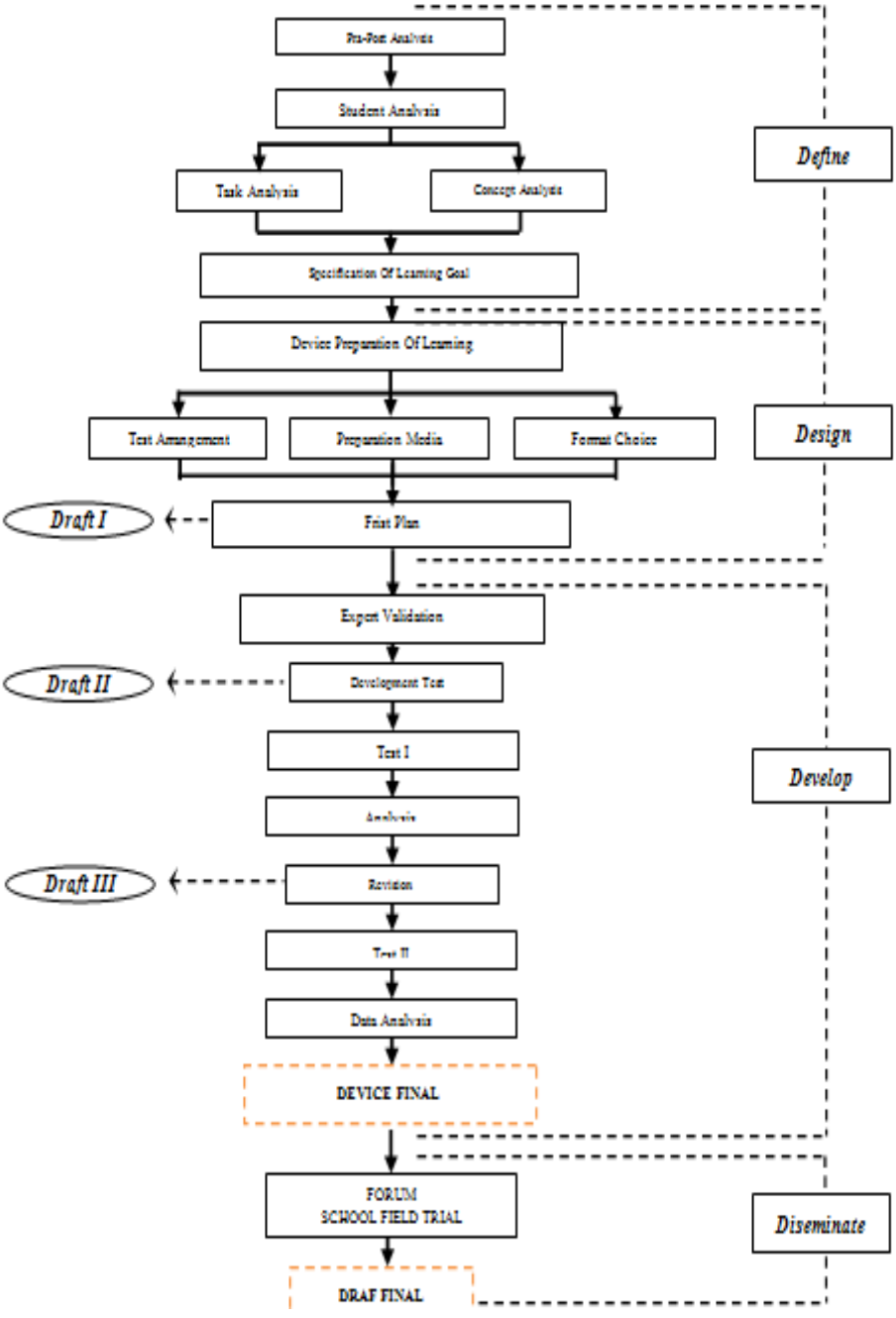

Figure 1 : Development Procedure of 4-D Model (*modified* from [3])

Learning device that is developed in mathematic learning is social arithmetic. The development of learning device in the form of learning design ranging from Learning Implementation Plan, Books Teacher, Student

Book, Student Activity Sheet and the Mathematical Problem Solving Ability Test.

2.2. Subject of Research

Subjects in this study were students of class VII SMP Negeri 17 Medan 2016/2017 school year, while the object of this research is a learning tool that was developed using the learning model eliciting Activities (MEA) in the matter of social arithmetic.

3. Result And Discussion

Based on observations and interviews with teachers in the field of study of mathematics class VII SMP Negeri 17 Medan, showed that during the learning is still using lecture, discussion and question and answer. So it is necessary for teachers or researchers to choose appropriate learning in learning. According to [5] that: "Development of learning tools should be structured according to the appropriate learning model as well. The use of learning models that are not in accordance with the development of students will have an impact on student learning development. Learning that is always focused on the teacher will cause the students' knowledge less developed. Teacher-centered learning leads to passive students receiving material only. Learning activities will make students only remember and memorize ".

Learning theories related to learning mathematics is a guide for teachers to assist students in developing cognition, emotion, social, and spiritual. The guidelines are the clarity of information that describes the purpose, the required knowledge, the process and the performance. Vygotsky's learning theories emphasizes the stages of giving direction, encouragement and helping them in times of congestion thinking. For the next process is more emphasized to the liveliness of students so that learning is not centered on the teacher but the students actively learn, explore their knowledge independently.

Based on research conducted by [5] explained that learning tools developed in his research are teacher book, student book, RPP, LAS, mathematical problem solving test and self efficacy questionnaire. The result of data analysis that have been obtained shows that the quality of learning device developed with the problem-based learning model on the material of equation and linear inequality one variable in class VII SMP Negeri 12 Pematangsiantar is good review from valid, practical and effective. Improved mathematical problem-solving and student self-efficacy skills by using developed learning tools.

Based on the analysis and discussion in this study, presented the results of learning tools that have been developed and has been tested otherwise been valid and effective.

3.1. Analysis of Data Validity Learning Device

Validation of the contents of RPP, Teacher Books, Student Books and LAS is based on the opinion of five experts in the field of mathematics education. Based on the opinion of experts will be determined the level of agreement between observers (experts) were analyzed using a statistical test by the formula:

$$r = \frac{RJK_b - RJK_e}{RJK_t} \text{ ; [12]}$$

Where :

r = the level of agreement between observers / experts

RJKb = variance sum of squares grains

RJKe = variance sum of squares error

RJKt = variance sum of squares total

The criteria stated MEA learning device having a good degree of validity, if the validity of the minimum level achieved was moderate ($r \leq 0.400 \leq 0.600$). If the level of achievement of the validity under valid (very low), then it should be revised based on input (correction) experts. Furthermore, the re-validation activities. And so on, in order to obtain an ideal learning device of the size of the content and construct validity.

The results of the overall validation of the developed learning tools are presented in table 3.1 below:

Table 2: Summary of Results Validation Learning Device

No	Device developed	The average value of total validity	Category
1	Learning Implementation Plan	4.47	Valid
2	Student Activity Sheet	4.05	
3	Teacher Book	4.53	
4	Student Book	4.48	

3.2. Effectiveness Data Analysis Learning Devices

Learning devices that developed otherwise meet the criteria of effectiveness if they meet some of the following:

a. Active Activity Data Analysis Students

Active activity of students is the percentage of time spent on students to be active in the learning process and achieve the ideal time. To calculate the percentage of active activity of students used the following formula:

Percentage of agreement = $100\%\left[1-\frac{A-B}{A+B}\right]$; [13]

Information:

A = Frequency aspects of behavior observed by observers give high frequency.

B = Frequency aspects of behavior observed by an observer who provides low frequency.

The instrument is said to be good if it has a reliability coefficient of ≥ 0.75 or ≥ 75%.

Active activity of students during the learning process using learning device oriented MEA in the first trials have not all the indicators meet the ideal time while in the second all the indicators already in the ideal time.

b. Data Analysis Capability Teachers Manage Learning

The ability of teachers to manage the learning process is the ability to develop intimate learning environment and positive. To analyze the ability of teachers to manage learning taken from the average score assesses the ability of teachers [13] are converted as follows:

$$RSP = \frac{\sum x}{n}$$

Information :

RSP = average score ratings

x = score ratings

n = number of aspects of assessment

Table 3: Conversion Value Average Capability Teachers

Average	Category
1,00-1,49	Less Active
1,50-2,49	Active Enough
2,50-3,49	Active
3,50-4,00	Very Active

Category assigned to measure the ability of teachers to manage learning when reaching active enough category (1,50 to 2,49).

In the first trial is concluded that the ability of teachers to manage learning in the category active enough, to the second trial teacher's ability to manage learning are in the active category. This can be seen by the average teacher's ability to manage learning in the first test of 2.3 with a fairly active category while the average in the second trial amounted to 3.17 with the active category.

c. Completeness Student Data Analysis

According to [14] determine the level of student success is determined by how many percentage of students learning completeness. To determine the percentage of each student's learning can be used the following equation: $KB = \frac{T}{T_t} x100\%$

Where: KB = learning completeness

T = Sum of scores obtained by students

Tt = Total score total

Criteria: 0% ≤ KB <80%

80% ≤ KB <100%

Based on the test results of students' mathematical problem solving ability in the first trial, the number of students who take the test as many as 36 students.

There are 2 (5.56%) were scored 90-100, 18 students (50%) were scored between 80-89, 9 students (25.00%) were scored between 65-79, while seven other students (19.44%) obtained a value of 55-64.

The average value of the class is still in an incomplete criterion that is equal to 65.83%.

Based on the test results of students' mathematical problem solving ability in the experiment I, level of completeness of students is as follows:

Table 4: Completeness level Mathematical Problem Solving Ability Test First Trial

Completeness level	**Criteria**	**Students**	**Percentage of students**
0% ≤ KB < 80%	Not Completed	16	44,44%
80% ≤ KB < 100%	Completed	20	55,56%

While the test results of mathematical problem solving ability of students in the second trial, there were 13

(36.11%) who scored 90-100, 19 (52.78%) who received grades 80-89, 2 students (5.56 %) scored between 65-79, while 1 students (2.78%) obtained a value of between 55-64. The average value of 80% grade with complete criteria.

Based on the test results of students' mathematical problem solving ability in the second trial, the level of completeness of students is as follows:

Table 5: Completeness level Mathematical Problem Solving Ability Test Second Trial

Completeness level	**Criteria**	**Students**	**Percentage of Students**
0% ≤ KB < 80%	Not Completed	4	11,11%
80% ≤ KB < 100%	Completed	32	88,89%

This demonstrates the ability of students' mathematical problem solving using oriented learning device MEA has increased from the first trial of 55.56% to 88.89% for the second trial. This can be seen in the following diagram:

Figure 2: Increasing Number of Students Completeness Learning On First Trial and Second Trial

Some students are still experiencing difficulties in completing mathematical problem solving ability test, but the number of students who have difficulty in testing I've seen the changes in the second trial.

4. Conclusions

Based on the analysis and discussion in this study, a number of conclusions as follows:

1. The level of validity of the learning device comprising (i) a lesson plan (RPP), (ii) the student activity sheet (LAS), (iii) teachers book (BG), (iv) the student book includes in the category of valid student team validator with the understanding that the learning device can be used with little revision.
2. Effectiveness of learning device developed oriented the model eliciting activities (MEA), inferred based on: (i) the activity levels of active student meets the criteria specified tolerances ideal time, (ii) the ability of teachers to manage learning are at the criteria "quite active" on trial I and criteria "active"

in the experiment II, and (iii) the achievement of classical completeness students' mathematical problem solving in the experiment II with a percentage of 88.89%.

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