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Development of Mathematical Learning Tools to Improve Representation Ability Based on Think Pair Share Models Assisted Virtual Manipulative

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***Abstract*—This study aims to: (1) Determine whether Think Pair Share (TPS) learning tools developed in grade VII of SMP Negeri 11 Medan are valid, practical, and effective. (2) Knowing whether students' mathematical representation ability through the use of learning tools can be improved. This type of research is a research development using the 4D model. The subject in this study was a Learning Kit that was developed consisting of student books, lesson plans, Student Activity Sheets, mathematical representation tests. The research subject is class VII. Data was collected in the form of instruments, namely validity sheets, questionnaire sheets, and tests. The results of the study obtained a valid, practical and effective learning device. (1) validation indicate that the device developed is suitable for use. Practicality can be seen from the response of the expert team or validator who stated that the learning tools can be used with minor revisions. The effectiveness seen from the classical completeness has met the minimum completeness criteria; (2) The trial shows that the mathematical representation ability increases as indicated by the n-Gain value.**

Keywords—Learning Tools, 4D Development Model, Representation Ability

I. INTRODUCTION

Mathematics is a tool to develop ways of thinking because it is needed for daily life and to face the progress of science and technology [1].Learning tools are needed to support the process of learning mathematics in the 2013 curriculum. Learning tools is an alternative for effective mathematics learning [2]. Learning tools can function as real concept models so that students can learn them using their senses. Learning tools can be used optimally so that students are encouraged to think and learn to build their own knowledge. This is in accordance with the principles of constructivism that knowledge is built by students themselves, both personally and socially. One of the teaching aids that can stimulate student knowledge is virtual manipulative.

Virtual manipulative according to Moyer [3] is an interactive visual representation of dynamic and web-based objects that aim to build student knowledge. According to the definition, it identifies that virtual manipulative is a learning tool based on web, which is a java or flash applet. One of the virtual manipulatives is NVLM (National Library of Virtual Manipulatives).

The National Council of Teacher Mathematics (2000) stipulates that there are 5 standard processes that students need to have through mathematics learning that is covered by the standard processes, namely: 1) problem solving; 2) reasoning; 3) communication; 4) connection; 5) representation.The ability of representation is a configuration of shapes or structures that can describe, represent or symbolize something in a way, thus mathematical representation needs to be emphasized and raised in the process of learning mathematics in schools. In line with this Arends [4] states students think, solve problems and become autonomous students is not a new goal for education.

Based on the results of observations made student representation ability is still low, this can be seen from the students' answers to the questions given that all students are able to rewrite what is known and asked of the problem; there are 20 students who are unable to write a mathematical representation model, students who write representations but are still wrong still don't understand there are as many as 8 students and students' calculation problems are still wrong in completing the work.

Learning process efforts to achieve the expected learning goals, it is necessary to develop learning tools that are in accordance with the model and approach applied. In the development of learning tools, in the preparation of devices, it is expected to be in accordance with the process standards set by NCTM to facilitate student's understanding of learning material.

Teachers are required to be creative in developing learning tools by using an approach to learning models that can motivate students to actively participate in learning. Learning tools are important components that must be possessed by the teacher before starting the learning process. These learning tools must have indicators that students want to achieve, these indicators are contained in the lesson plan (RPP), student activity sheet (LAS), and Student Book (BS).

According to Permendiknas number 41 of 2007 [5] that RPP is a learning plan developed in more detail referring to the syllabus to direct student learning activities in an effort to achieve basic competencies. LAS or student activity sheet is one that supports the teaching-learning process. Akbar [6] defines student books as textbooks used for standard reference on certain subjects. Trianto[7] said the

student book is a guide for students in learning activities that contain subject matter, inquiry activities based on concepts, scientific activities, information and examples of application in daily life.

Based on the results of interviews with teachers in the field of study at SMPN 11 Medan, there are still shortcomings in learning tools such as Student Books, Student Activity Sheets, and Learning Implementation Plans. The learning tools used have not been validated so that the lesson plans used are still centered on the teacher and student activities are only listening. Teacher-centered activities cause students to learn memorization that does not result in an understanding or understanding of learning, so students don't have the opportunity to develop their own potential and the goals of learning are not reached to the full. Student books are used in the form of textbooks that function as teacher's books and student books. Textbooks used by teachers and students are textbooks originating from schools obtained from one of the book publishers. Student Activity Sheets that are used tend to be ready for use which is widely traded, which contains more content at the conclusion of the material rather than on student activities.

In developing learning tools, of course, the chosen approach model is appropriate to abilities students want to achieve. One learning model that can be used to improve mathematical representation is by using Think Pair Share models. According to Suyatno[8] said that "TPS is a cooperative learning model that has procedures that are set explicitly to give more time to students to think deeply about what is explained or experienced.

II. RESEARCH METHOD

This development research is carried out to produce learning tools (RPP, BS, LAS) which will then be tested in the classroom. This research was conducted at 11th grade SMP Negeri 11 Medan in the odd semester of the academic year 2017/2018 and was conducted for 7 (seven) hours of study or 3 (three) meetings for one trial. This research is divided into two stages namely the first stage is the development of learning tools. Development of learning tools that include 1) the validity of Student Books (BS); 2) the validity of the Learning Implementation Plan (RPP); 3) validity of Student Activity Sheets (LAS); 4) the validity of the mathematical representation ability test instrument. The second stage is testing the device that has been developed with a virtual manipulative assisted Think Pair Share approach in class VII of SMP 11 Medan.

The learning device development model that will be carried out is the Thiagarajan, Semmel, and Semmel Model[9], which is a 4-D Model consisting of four stages: define, design, develop, and disseminate. The purpose of data analysis in this study is used to answer the validity, practicality, and effectiveness of learning tools with virtual manipulative assisted think pair share approaches that were developed referring to the problem formulation and research questions. To see the validity of learning devices based on the average score of each learning device that has been validated. The practicality of learning tools based on validator/expert assessment and observation sheet of the implementation of learning tools starting from the teacher opening the lesson to closing the lesson. The effectiveness of learning is seen by the classical completeness of students while participating in learning by using the learning tools developed.

III. RESULT AND DISCUSSION

A. Development of Learning Tools for a Valid, Practical and Effective Think-Pair-Share Cooperative Approach

In developing learning tools using the Thiagarajan, Semmel, and Semmel development models, it is taken through 4 stages which are then better known as the 4D abbreviation namely define, design, develop, and disseminate. It's just that given that the purpose of learning is to create learning devices that are able to improve the ability of mathematical representation, the development of learning tools is carried out only until the development stage, where at this stage learning devices have been found in the final form. The learning tools produced in this development are the Learning Implementation Plan (RPP), Student Book (BS), Student Activity Sheet (LAS), Mathematical Representation Ability Test (TKRM).

A good learning tool is a learning device that meets the criteria of valid, practical and effective. For this reason, the development of these devices must also be tested for validity, practicality, and effectiveness. Thus, this learning tool is suitable for use in teaching and learning.

In the validity of the learning tool in terms of three aspects namely format, content, and language which are then assessed by a team of experts. The learning device is said to be valid if the minimum level of validity achieved is a valid level ($4 \leq Va < 5$). While the practicality of the learning kit is reviewed from three aspects, namely 1) the expert/validator states that the learning device is appropriate to be used without or little improvement (revision), 2) the results of the interview with the teacher as the user state it is practical, and 3) the results of the interview with students as the user stated practical. The effectiveness of learning tools seen from two aspects, namely 1) completeness of student learning classically, that is, at least 85% of students who take learning are able to achieve the minimum completeness criteria (KKM) of 50, and 2) at least 80% of students give positive responses to learning activities and learning tools.

In producing learning tools that meet these three aspects in this study, it was taken through two field trials. To determine the validity, practicality, and effectiveness of cooperative learning approaches Think-Pair-Share types can be explained as follows.

The Validity of Learning Tools with a Think Pair Share cooperative approach

The results of the validation for each component of the learning device developed by the cooperative approach of the Think-Pair-Share type are in the "valid" category with an average value of each component of BS (4.30), LAS (4.03), RPP (4.13). But even though the components of the learning tools developed have met the validity criteria, there are some things that need to be improved according to the notes provided by the expert team including the use of language, writing or typing and the use of colors to make it more interesting.

Thus, based on the results of the notes from the expert team that this learning device has fulfilled the validity criteria

with the category "valid" with a slightly revised note. Based on the description in CHAPTER III, because the learning device is in the valid category, then after repairs are made it is not necessary to re-validate the learning tool.

The practicality of Learning Tools with Think-Pair-Share approach

Based on the results of validity, it is known that experts claim the learning tools are valid. Then see the results of the interview with the teacher. Based on the results of the interview, in general the teacher stated that the learning tools were easy/practical to use. Next see the results of interviews with students. Interviews were conducted with several students who were considered capable of representing all students. Based on the results of this interview it is known that students find it easy/helped in learning by using this learning tool. Students stated that students liked the presentation of material on this learning tool because it was very interesting. Besides that, students also stated that students had no difficulty in using it. In other words, students state this learning tool is practical.

Effectiveness of Learning Tools

In determining the effectiveness of a material developed can be seen from two aspects, namely the completeness of student learning outcomes and student responses to learning devices. In determining the completeness of student learning outcomes determined by a minimum of 85% of students gets a complete score of at least 50. While for student responses determined by a minimum of 80% students give a positive response to the learning tool.

Based on the results of the analysis of data previously stated that the classical completeness obtained during the first trial of 34 students amounted to 67.64%. This result is certainly not in accordance with the criteria for achieving classical completeness. Therefore, in the first trial the criteria for effective learning tools have not been fulfilled, so proceed to the second trial. With some improvements to the LAS and student books, in trial II with a subject of 34 students, classical completeness of 88.23% was obtained. This means that overall this achievement has met the classical completeness criteria of at least 85% of the total number of students completing with a minimum grade of 50. If seen from the results of student learning completeness individually and classically it can be concluded that the learning tool with the Think-Pair-Share type cooperative approach has met the specified effectiveness criteria.

Questionnaire students 'responses to learning that have been carried out are given at the end of learning trial I and trial II which aims to see or know the students' responses after applying to learn by using cooperative learning approaches Think-Pair-Share type. This questionnaire contains positive and negative statements consisting of 5 aspects. The results of student responses to the learning component questionnaire can also be illustrated in the following diagram.

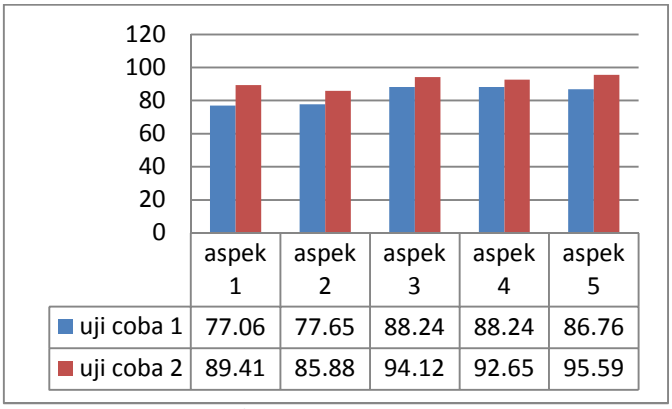

Fig 1. Percentage of Student Responses in Trial I and Trial II

If observed in Figure 1, it is known that the response of students to learning devices in trial II is better than the responses of students in trial I. This is in line with the completeness of learning outcomes that have better results in trial II than trial I.

Based on the results of trial I and trial II that have been outlined in the validity, practicality and effectiveness of the learning tools developed that have been outlined above, it can be concluded that the learning tools of the cooperative Think-Pair-Share type approach that have been developed are good learning tools because it has fulfilled valid, practical and effective criteria.

B. Improvement of Mathematical Representation Ability by Using Learning Tools

Based on the results of trial I and trial II, the average score obtained in the trial I was 53.48 and trial II was 82.90. This shows that the average score in the second trial is greater than the first trial, which means an increase in mathematical representation ability.

Improvements will be seen through the N-Gain from the results of the pre-test and post-test mathematical representation capabilities in trial II.Based on the results obtained that 24 students got a Gain score in the range> 0.7 or experienced an increase in the ability of mathematical representation in the "High" category. For students who have increased mathematical representation ability with the category "Medium" or get a gain score of 0.3 <g ≤ 0.7 totaling 4 people and 6 people who received a gain score of g ≤ 0.3 or have increased mathematical representation ability with the category " Low".

The average percentage acquisition of student scores on indicator I was 82.35%, indicator II was 82.35%, and indicator III was 83.09%. If compared with a study conducted by Simamora[10] with an average score ofindicators I of 66.67%, indicator II of 70.27, and indicator III of 65.49%. This shows that in this study, the average acquisition of student scores on each indicator is greater than the study conducted by Simamora.

Another study was conducted by Jenita, Sudaryati, and Lukita[11]with the results of the average percentage of student scores on indicator I at 80%, indicator II at 86.3%, and indicator III at 81.9%. This shows that in this study, the

acquisition of the average percentage score on indicators I and III is greater than the study conducted by Jenita et al. However, the average percentage score obtained in indicator II is smaller than the study conducted by Jenita.

The ability of representation can be increased due to the learning devices applied to students who have met the criteria of good learning quality, with the good learning devices used with the application of TPS have an impact on increasing the ability of student representation.

IV. CONCLUSION

Learning tools based on TPS learning to improve mathematical representation capabilities developed already meet the valid, practical, effective criteria and an increase in mathematical representation abilities using learning tools based on the Think Pair Share cooperative approach that has been developed.

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