

Effectiveness of Developing Mathematical Learning Device Based On Open Ended Approach To Improve Mathematical Creative Thinking Ability Of Junior High School Students

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Abstract—*The purpose of this study is produces learning tools that valid, practical, and impact on the ability of creative thinking mathematical students with approaches of open-ended. Flow the development of used is development model Plomp. Devices that will be developed is Lesson Plan and Student Worksheet. In this paper will be focused on test the effectiveness of learning tool made to see the effectiveness of learning tool on the ability o fcreative thinking mathematical students used tests in accordance with the indicator ability creative thinking. The result of this study is produces the development of learning tool to improve the ability of creative thinking.*

Keywords—*Creative Thinking Ability, Effectiveness, Model Plomp, Open Ended Approach*

I. INTRODUCTION

In today's technological era the competition in the world of work is very fierce. Everyone is competing to create new and sophisticated innovations. Only creative people are able to survive in the competition, because creative people are able to give different ideas so as to create new innovations.

Indonesia is one of the country emerging develop technology. It was supported by the natural resources abundant. However, Indonesia do not have a good human resources quality yet that able to manage the natural resources it. To be a good quality human, one should have the creativity or or have the ability to think creatively.

Creative thinking is one of the abilities that need to be developed in education. It is written in UUNo. 20 of 2003, one of the goals of education in Indonesia is to develop the creative thinking ability of learners. In addition, Permendiknas No.17 of 2010 in Curriculum 2013, one of the primary and secondary education objectives is to develop the potential of students to become creative human beings. This shows that the ability of creative thinking is one of important ability, especially in learning mathematics.

Creative thinking is a thought process for finding new ideas, views, ways or connecting relationships to find new connections in understanding things. According to Haylock, creative thinking is defined as the scope of the ability to see new connections between engineering and the

field of application engineering to make associations between ideas that may not be related [1]. In addition, Pehkonen states that creative thinking as a combination of logical thinking and divergent thinking is based on intuition in consciousness [2]. Guildford states that creative thinking is the ability to see the various possible solutions to a problem [3]. Based on that, the ability to think creatively can be defined as the ability to solve a problem with various solutions by combining various ideas that are related or not. According to Munandar, the characteristics of the ability to think creatively that is; fluency, flexibility, originality (original thinking), and elaboration (detailing) [3].

But in fact the ability to think creatively mathematically students in Indonesia is still low. This can be seen based on observations made at SMPN 1 Nan Sabaris on August 23, 2017, it appears that the process of learning mathematics is still centered on the teacher. Students are treated only as objects in learning. This treatment resulted in students not being given the opportunity to develop creative ideas in understanding a given problem. Students in learning math are encouraged to memorize formulas or concepts without knowing their meaning and are not encouraged to look for alternatives that may be effective in solving problems. Students are still not familiar with non-routine questions. In learning, students only use printed books as a source of learning. This makes the students have less knowledge, because there is no other learning resources. This makes the ability of students is still low, especially the ability of mathematical creative think.

One of approach that can improve students' creative thinking ability is the open ended approach. The open ended approach was developed in Japan since the 1970s. The open ended approach is a students approach by providing open issues to students. This approach encourages students to solve problems in various ways or many answers. Designing lessons that can provide students with more opportunities to explore problems that provide many solutions can enhance the ability of students in creative thinking [4]

According to Shimada, an open ended approach is a learning approach that begins by introducing or confronting

students on open-ended problems[5]. In addition, Nohda states that the open ended approach is a flexible and students-centered method [6]. This means that an open ended approach is not focused on one answer or one way, but with many answers or many possible ways. The open ended approach provides students with the freedom to solve their own problems to improve their abilities. This is consistent with Bruner's learning theory, that "learning must give the students freedom to learn by themselves through discovery". Learning process will work well if students are given the freedom to find a concept or understanding through the examples encountered in life [7]. This will give them experience in finding something new based on their skills and mathematical thinking.

Implementation of learning activities based on an approach/model should be on a good plan. Learning tools are things that must be prepared by teachers before carrying out learning activities. Learning tool can be a learning implementation plan Lesson Plan and Student Worksheet. Lesson Plan is a teacher guide in implementing learning to fit the expected goals. Meanwhile, Student Worksheet is a guide for learners in learning activities. Based on the above description, then described open ended approach to the learning tools in the form of mathematics Lesson Plan and Student Worksheet. Learning tool designed is expected to have an impact on the creative thinking skills of students of grade VII Junior High School on learning mathematics.

II. METHOD

This research is a development research. In this research will be developed learning tools of mathematics covering Lesson Plan and Student Worksheet in grade VII semester 2nd semester material with open ended approach to improve creative thinking ability of learners. The device development model used is the plomp development model. This model consists of three developmental stages: preliminary research, development or prototyping phase, and assessment phase [8]. Learning devices are said to be effective if after the learning process with learning tools based on open ended approach, the value of students is complete classical, that is more than 75% of learners got value above standard of minimum completeness.

III. RESULTS AND DISCUSSION

I. Preliminary Research

Preliminary research aims to determine the basic problems that occur in the learning of mathematics in the classroom. It is necessary to develop a mathematical learning tool that will be created. Activities in the preliminary research begin with needs analysis and concepts as well as literature review. Description of initial investigation results are:

a. Needs and Concepts Analysis

The analysis of needs and concepts in this study is based on the rationality of the need for the development of learning tools based on open ended approach, analyzing the Core Competence, Basic Competence, and analyzing the characteristics of students (covering the cognitive and age levels), so that the learning devices produced in accordance with the characteristics of learners.

Based on the observations at SMPN 1 Nan Sabaris grade VII that has been done, the information obtained is the

learning process is still dominated by teachers (teacher centered). In addition, the students are less actively involved in learning. This is reinforced by the low value of the odd semester exam. Where there are still many students who have not completed.

Based on the results of interviews with teachers of mathematics, obtained information that teachers have not fully use the learning tool optimally. Teachers only use the textbook as a learning resource. Then, learners do the exercises in the textbook in accordance with what is taught by the teacher. If the practice questions given by different teachers, the learners are confused and can not solve the problem.

b. Literature Review

In the literature review, the analysis of theories and concepts related to the development of learning tools based on an open ended approach. Based on the results of the analysis of the literature review, compiled theory, concepts and materials needed in the learning process. Aspects are used as a reference for reconstructing learning tools based on an open ended approach, namely:

- a. Open ended approach
- b. Development style; Plomp model
- c. Learning Media; consists of Lesson Plan and Student Worksheet
- d. Learning materials; semester 2 math materials.

II. Phase of Development or Making of Prototype

a. Characteristics of Lesson Plan

Lesson plan is designed as a guide for teachers in classroom learning activities. Lesson plan components are designed based on Permendiknas No. 65 Year 2013. Lesson plan components include: (1) School identity, (2) Class / semester, (3) Main subject, (4) Time allocation, (5) Learning objectives, (6) Basic competencies and indicators of achievement of competencies, (8) Learning materials, (9) Learning methods, (10) Learning resources, (11) Learning steps are carried out through preliminary, core, and closing steps (12) Assessment of learning outcomes. Learning activities presented in the Lesson plan refers to an open ended learning approach that is integrated in student worksheet based on an open ended approach.

b. Characteristics of Student Worksheet

Student worksheet based on an open ended approach has several components that are titles on the cover page, sub-headings, Core Competence, Basic Competence, indicators, learning objectives, student worksheet instructions, problems, and exercises. Student worksheet has an interesting image according to the problem to be solved. Student worksheet is designed with a variety of colors and bright. The goal is to generate interest in students using Student worksheet, because in general students like bright colors.

Student worksheet begins with questions or problems that aim to help students to relate the observed phenomena to the concepts to be constructed. Student worksheet uses a simple and communicative language in accordance with the communication level of students, so that the presentation of the material on Student worksheet can be understood well. The sentences used by student worksheet are in accordance with the general Indonesian spelling guidelines (PUEBI).

The type of writing that is widely used in student worksheet is the Times New Roman font.

Prototype 1

The results of designing learning tools in the early stages are called prototype 1. Furthermore the learning device is dived. Two things done in the validation of learning devices are; do self evaluation and discuss with experts. Below is description of validation result of prorotype 1 learning device that has been designed.

1) Self evaluation

Prior to validated experts, first self-evaluation of learning devices that have been designed with self evaluation instruments. .

a) Lesson Plan

Aspects evaluated are aspects of lesson plan components, open ended principles, and open ended learning approach components. after the evaluation is obtained the result that the designed lesson plan has met the aspects that have been set and fix the sentences that are still less good.

b) Student Worksheet

The aspects evaluated are the steps of the open ended approach, the use of language, the presentation of images, and the suitability of the problem to train the ability to think creatively. After evaluation, student worksheet is revised. Revisions were made to student worksheet, adding the questions according to the indicators of creative thinking ability and improving the layout of the writing and drawing on student worksheet. The revisions are then consulted and discussed with experts or experts.

2) The results of validation of learning devices by experts

Learning tools are then discussed with the tutor. Learning tools validated by 5 validators, consisting of lecturers of mathematics, lecturers of Indonesia, lecturers of educational technology.

After the validation process is completed, an improvement on prototype 1 is done according to the validator's suggestion. The revision of prototype 1 is called prototype. 2.

Prototype 2

Activities performed on prototype 2 are one person evaluation (one to one evaluation). Student worksheet was given to 3 students of class VII SMPN 1 Nan Sabaris Padang Pariaman District which comes from high ability, medium ability, and low ability. The three students are asked to read and understand the student worksheet given. After the learners read and understand the student worksheet given, then conducted an interview to determine the practicality of student worksheet. The results of interview analysis illustrates that the presentation of student worksheet has been interesting and easily understood by students. After the student worksheet revision process has been completed, an improvement on prototype 2 matches the result of one to one evaluation. The revised result of prototype 2 is called prototype 3.

Prototype 3

Activities undertaken on prototype 3 are small group evaluation (small group). Student worksheet was tested on 6

students of grade VII SMPN 1 Nan Sabaris Padang Pariaman Regency which is divided into two groups. Evaluation of this small group was conducted 6 times. At the end of the meeting, learners were given a response questionnaire to the mathematics learning device.

III. Field Test

After revised based on input from small group evaluation, then the device tested on the subject of grade VII.1 SMPN 1 Nan Sabaris consisting of 29 students. In learning, students are divided into groups of 2-3 students each. The study was conducted in 6 meetings.

Effectiveness of Mathematics Learning Tool

One indicator to see the effectiveness of learning devices is the test of learning outcomes. In this study, tests were conducted to examine the impact of using an open-ended learning tool based on an open ended approach to improving students' creative thinking skills. The subject matter that is tested is the material of grade VII of SMP in second semester which is titled quadrilateral and triangle. The tests provided are questions that are tailored to the indicators of creative thinking ability: fluency, flexibility, originality, and elaboration (detailing).

Before the test was done, it was first validated by two lecturers of mathematics to see the suitability of the problem with the indicator of creative thinking ability. After the test is valid, then the test is given to the learner upon completion of the field test. The test given amounted to 4 questions according to the indicator of creative thinking ability and the subject matter taught. The final result of the creative thinking ability test can be seen in the following Table I:

TABLE I. RESULT OF CREATIVE THINKING ABILITY TEST

The number of students	Completed	Unfinished
26	20	6

Standard of minimum completeness : 60

The test was given to 26 students of grade VII.1 SMPN 1 Nan Sabaris, because 3 students were not present. Based on the results of the test, 20 people are complete and 6 people are not complete. This means more than 75% of students get value above standard of minimum completeness. In addition, tests of instructional devices based on an open ended approach provide a positive effect for students. This is because many of the solutions raised by students on test answers. Based on these results, the tools of learning mathematics based on open ended approach is effective.

CONCLUSIONS AND RECOMMENDATIONS

Based on the data that has been done can be concluded that this research produce product development of learning tool based on open ended approach which is designed valid, practical, and have an impact to the ability of creative thinking of mathematical learners.

Based on the results of research, it is expected that the learning tools based on open ended approach can be used as a guide for teachers in implementing learning.

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