5th ICRIEMS Proceedings
Published by Faculty Of Mathematics And Natural Sciences
Yogyakarta State University, ISBN 978-602-74529-3-0

Development of Teaching Materials Based on Constructivism Theory to Improve Problem Solving and Mathematics Communication Skills of 5th Grade

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Abstract. The objectives of this research are to develop a teaching material based on constructivism theory toward problem solving skills and mathematics communication of fifth grade. It was study and development (R&D) based on 10 major steps developed by Borg & Gall. The subject of the study were 84 students of class A, class B and class C, of 5th grade in Serayu elementary school of Yogyakarta. The data were collected using an interview, a questionnaire, and observation. The data were analyzed using by *paired sample* t-test with a significance (p) < 0,05. The results of this research is a included lesson plan, students work sheet, modul, and assesment based on problem solving and mathematics communication ability. The result of the assesment expert, media expert, and material expert get a minimum category of "good". Teaching material based on constructivism theory is efective to improve mathematic communication and problem solving skill, with significantly different between control class and experiment class.

Keywords : learning kit, constructivism theory, mathematics communications, problem solving skills.

INTRODUCTION

Constructivist view emphasizes learning centered on the student and the teacher as a facilitator. Cobern (1992) in Martin [2] says that knowledge cannot be transmitted intact from one person to another. But people must construct their own knowledge and their own understandings. Because learning does not occur by transmitting information from the teacher or the textbook to the pupils' brain. Instead, each pupil constructs his or her own meaning by combining prior information with new information such that the new knowledge provides personal meaning to the pupil. Because knowledge is not something ready-made, but a process that is evolving. Piaget, [1] stated the process of knowledge construction took place through the process of assimilation and accommodation. Assimilation is a cognitive process that classifies the stimulus of integrating new concepts, perceptions, and experiences into existing structures. This assimilation process develops an existing schema process or structure to adapt and build students' intellectual structures. [6] Because knowledge is not something that has become, but a process that develops. Thus, all knowledge is subjective and personal which is entirely the product of pupils cognitions.

The National Curriculum in Indonesia uses the Kurikulum 2013. This implementation, it uses thematic-Integrative learning as the theme linking network. The Device of learning is an important component in the learning process. The sections in the device of learning consist of the lesson plan, communication assessment and problem-solving ability, and modules. The national curriculum uses [5] the approach of a scientific approach, its application involves the skill of observing the process, classifying, measuring and forecasting, explaining and

concluding. In practice, this research uses a problem-based learning model. This learning model uses real-world problems as a context for learning about problem-solving skills and mathematical communication [9].

Mathematics lesson based on Permendikbud [3] number 22 and Mathematic Manualy on [4] number 21 on Standard content such as using thinking ability and reasoning in problem solving, communicating ideas with images and symbols to convey math ideas effectively, having attitudes and behaviors that fit the values in mathematics learning. The intended problem solving skills include the ability to understand the problem, design the mathematical model, complete the model and interpret the solutions obtained. The purpose of mathematics learning is not only to develop knowledge but also the attitudes and skills of students in life skills in the future [8]. Thus the learning of mathematics is a means that students need to reason, think logically and quickly in achieving the competition in the future.

Based on the factors causing student failure in learning mathematics among other factors students, teachers, and learning process [2]. In the student factor, on the observations made on the subject of the 5th graders of the elementary school of Serayu Yogyakarta. Students have difficulty symbolizing mathematical sentences, mis-interpreting tendencies, and difficulty in choosing and using the right formula. This is proven, when giving the story about an average of 30% of students mis-communication symbols. While 35% of students difficult to translate the story into the math symbol. Then in the teacher factor, based on observations made suggests the difficulty of teaching communication skills and problem solving. These two core mathematical abilities are difficult to develop in the ongoing thematic learning process. In addition to learning factors, students rarely get different problems than usual to train students' skills in translating and solving problems in the story. For that required the existence of learning devices that can improve communication skills and problem solving on students.

The Problem form a stable communication at least as a mathematical-pedagogical object. in NCTM [11] mathematical communication is more emphasized on the ability of students in terms of (1) reading and writing math ideas, (2) expressing the relationship of mathematical ideas, (3) using notation to present data, drawing relationships and mathematical models, (4) interpretasion ideas presented in writing, (5) organize mathematical thinking. Furthermore, Ontario Ministry of Education [12] conclude that categories of mathematical comunication are (1) expression and organization of ideas and mathematical thinking, (2) communication for different audiences, (3) Use of conventions, vocabulary and terminology of the discipline. Pupils needs is the most to learn a written language in order to convey their solution or ideas. They have to use correct and accurate syntax, grammar, and symbols of the mathematical language.

Whereas in Polya presented four phases or areas of problem-solving, which have become the frame work often recomended for teaching and assessing problem-solving skills. The four steps are : (1) understanding the problem, devising a plan to solve the problem,(3) implementing the plan, and (4) reflecting on the problem. Based on fundamental assumption of these approaches, that meaning is negotiated in interactions between several individuals and that social interaction in thus understood as constitutive of learning processes, communication can no longer be only understools as the medium in which meaning is constructed. They affect the cognitive process of the problem and help them reflect on their task of finding the solution. In this way, pupils begin to see that problem solving is more than applying strategies. That they approach a problem, execute a plan, and look back on the answer and the process after they reach a solution [13].

RESEARCH METHOD

This research is a development research. This research develops product of learning device based on constructivism theory to improve mathematic communication ability and problem solving of mathematics. The product developed in this research is student work sheet, lesson plan, module and assessment comunication mathematic and problem solving skill. The module product developed with Ecosystem theme for the subject of this research is Serayu elementary School, the development is done in class B of 5th grade and class C of 5th grade as development class while class A of 5th grade as control class.

The development prototype used in this study refers to the Borg & Gall model [7]. There are 10 steps in research and development of Borg & Gall models : research and information collecting; Planning; develop preliminary form of product ; preliminary field testing; main produst revision; Main field testing; operational product revision; operational field testing ; final product revision and dissemination and implementation.

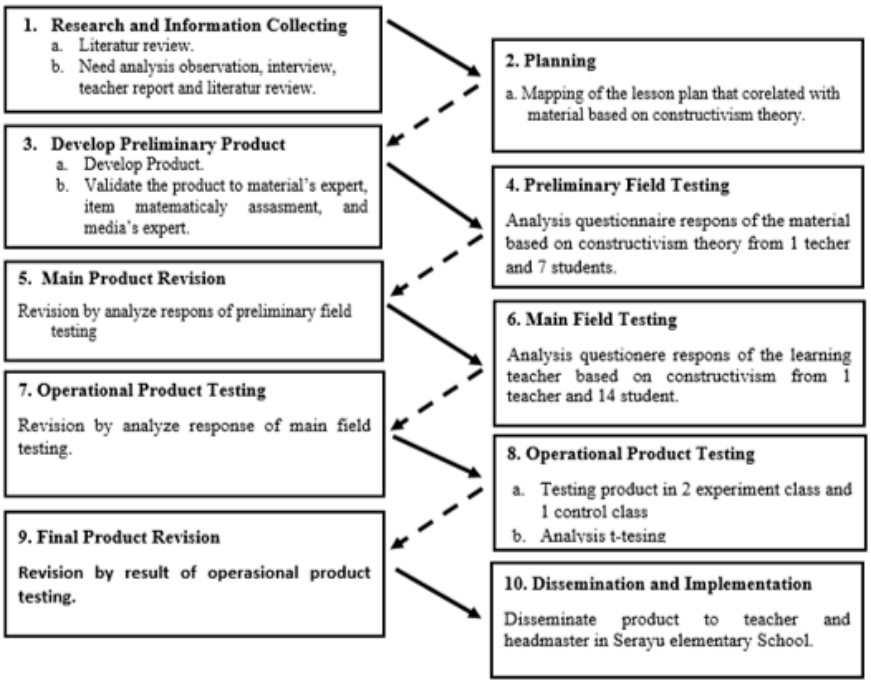

FIGURE I. stuctuture of the development prototype Brog & Gall

The data collection techniques used in this research are interview technique, observation, questionnaire and communication test and mathematical problem solving. Communication tests and problem solving were taken through the initial sample of the study and the study's aims. While the data analysis technique that is used is prerequisite test and t-test test. The prerequisite test used is the normality test and homogeneity test, used to prove the effectiveness of the product. The product is effective if there is a significant level <5% which states that Ho is rejected and H_1 accepted.

RESULT AND DISCUSSION

The results of this study are lesson plan, student work sheet, assesment comunnication mathematic and problem solving skills and modules. The developed module has ecosystem theme and sub theme 8.3 Maintaining Ecosystem containing one to sixth learning. The Student Work Sheet developed is also included in the module to help students complete the communication and problem-solving skills that occur. While the implementation plan of learning developed using Problem Based Learning method. Based on input judgments from media experts, instrument experts, assessment experts and material experts. The developed product gets a good minimum rating. With each score, the assessment of media experts got 89, with very good criteria. The material expert scores 132 with excellent criteria, and the assasment expert concludes that the questions given to the students are quite relevant to the communication skills and problem solving used.

As for assumption test used by test of Shapiro-Wilk sig normality p> 0,05. In this assumption test the mathematical communication in the experimental class B = 0.642 and C = 0.090. While problem solving B = 0.062 and C = 2.00. This shows that the data obtained is normal and homogeneous. As a prerequisite test for analyzing t-test. T-test on mathematical communication between control class and experiment class obtained class B = 13,680 and class C = 11,723, with significanse p= 0.000. While the t-test results obtained class B = 9,838 and C = 8.602, which mean t-test value with the two tails is significance p=0.000. This mean larning kit based on constructivism theory is efective to improve mathematic comunication and problem solving skill, with significantly different between control class and experiment class.

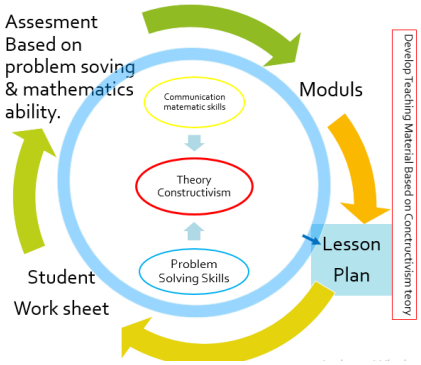

FIGURE 2. Stucture Models of Development Teaching Material Based on Conctructivism Teory

CONCLUSION

This study develops a learning device for the product sub theme 8.3. Keep the ecosystem. The use of the module is applied to students how students solve problems and communicate ideas which they have with colleagues. In addition, the use of student learning devices to suit the student's cognitive development is able to give good results. The conclusions of this study is the effectiveness of learning tools were developed to improve communication skills and problem solving in students.

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