MATHEMATIC LEARNING BASED ON DOUBLE LOOP LEARNING TO IMPROVE CRITICAL THINKING AND PROBLEM SOLVING SKILL STUDENT

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Abstract: The purpose of this study is to describe Lesson Plan (RPP) that integrates one character of 21st century skills, critical thinking skills and problem solving, using mathematics learning based on double loop learning. This study uses a research and development approach. Research and development, which is a process to develop existing and accountable products. Data collection techniques, observation, interviews, and documentation are the methods used in this study. The subject of the study consisted of mathematics teachers, school principals, and eighth grade junior high school (SMP) students in Sukoharjo Regency, Central Java. The results of the study show that the development of RPP that integrates critical thinking skills and problem solving can be done by 1) including the skill into the development of RPP in accordance with Basic Competencies (KD) 2) developing indicators to achieve KD 3) formulating learning objectives clearly so that students can improve skill 4) developing learning materials related to skills 5) developing learning activities according to the skill that will be carried out 6) developing assessment tools as a measure of quality skill. Including literacy planning into the learning process can also improving critical thinking skill and problem solving to students.

Keywords: Critical Thinking, Problem Solving, Mathematic Learning, double-loop learning.

INTRODUCTION

The 2013 curriculum is designed with characteristics such as developing a balance between spiritual and social attitudes, knowledge and skills, and applying them in various situations in schools and communities. Teachers are required to prepare students to be individuals of character facing 21st Century proficiency demands. According to Sutama (2017), teachers have a very important role in minimizing mathematical phobia, instilling and developing the independence spirit of students. Likewise, learning innovation depends on what the teacher thinks and does. Learning quality mathematics can be seen as one of the social forces that contribute to the shape, style and direction to the lives of intelligent future students (Sutama, Narimo, & Haryoto, 2013). Means that the performance of teacher both in the thinking and the action that is intelligent, is expected to develop students with character.

To form students with character in accordance with 21st century skills and the 2013 curriculum, one of them by "innovation in developing critical thinking skills and problem solving in mathematics learning based on double loop learning". In the Regulation of the Minister of Education and Culture No. 22 of 2016 concerning the

Standard Process for Primary and Secondary Education, it stated that one of the important learning principles in 2013 curriculum is students find out not to be told. In finding out, students must get quality services, and have the opportunity to express themselves freely, dynamically and pleasantly. Therefore, before the teaching and learning process is made a Learning Implementation Plan is prepared in a Learning Implementation Plan or RPP. RPP is a plan for face-to-face learning activities for one meeting or more. RPP is developed from syllabus to direct learning activities of students in an effort to achieve basic competencies (KD). Every educator in the education unit is obliged to compile a complete and systematic RPP, so learning takes place in an interactive, inspirational, fun, challenging, efficient manner, motivates students to actively participate, and provides sufficient space for initiative, creativity and independence in accordance with their talents, interests and physical development and psychology of students.

Mathematical learning tends to only suppress results (Aldemir, 2018). Such learning, ignoring the characteristics and nature of mathematics and in turn students will experience difficulties in working on other forms of questions. Another effect of learning that only emphasizes possible results is that the results achieved are not durable (single loop learning). In this article, the authors propose double loop learning based maternal learning in planting critical thinking skills and problem solving.

Double loop learning is a learning method introduced by Chris Argyris and Donald Schon (Cartwright, 2002). Students are asked to think more deeply about their own assumptions. Double loop learning has a destructive aspect that always questions the current norms, values and assumptions. Unlike single loop learning, double loop learning always questions goals and has variation techniques to deal with problems. So the same problem might have a different treatment.

In double loop learning the assumptions underlying the current view are questioned and hypotheses about behavior are publicly tested (Cartwright, 2002). The final results of double loop learning must improve efficiency, effectiveness, and robustness in decision making and acceptance of better failures and errors. Efficient can be measured by comparison between input and output, which refers to the Minimax concept (minimum input and maximum output). Effectiveness is a level of learning achievement in achieving its objectives, meaning that the learning objectives that have been set can be achieved. Robustness of learning is a function of the nature and quality of relationship between learners and teachers, namely dynamic and adaptability relationships.

21st Century competency skill, namely a) critical thinking and problem solving skill, namely the ability to solve complex problems by gathering various information so solutions can be obtained with different points of view (Rubric, Paul, & Elder, 2007) , b) communication skills, namely the ability to express opinions clearly both verbally and non-verbally, c) creativity and innovation, namely the ability of different ways of thinking from others and productive, and d) collaboration that is the ability to work with others by helping or completing so that goals are achieved.

Critical thinking skills and problem solving are one of the most important subjects in the field of education (Minister of Education and Culture, 2017). The teacher strives to improve student's critical thinking and problem solving abilities because this ability can be utilized in everyday life. Critical thinking is the ability of a person to solve problems by collecting information from various sources so that the results can be accounted for and not side by side. The description of critical thinking must be functional, which can lead to useful methods for predicting performance. Indicators of critical thinking skills and problem solving in students are 1) Students are able to formulate problems 2) Students gather various information for problem solving from those already formulated 3) Students compile a number of alternative problem solving 4) Students set the best solution with smallest risk to think of origin of the concept of mathematical formulas.

APPROACH & RESEARCH METHOD

This research as a whole uses a research and development approach. Research and development is a process to develop existing products and can be accounted for in terms of efficiency, effectiveness and robustness (Sutama, 2010). The research design carried out, namely qualitative. Qualitative research design is a research method used to examine the condition of natural objects, where researchers are key instruments, data collection techniques are carried out jointly, data analysis is inductive and the results of qualitative research emphasize the meaning rather than generalization (Denzin & Lincoln, 1994) Research subjects, namely mathematics teachers, principals, and students from 65 Junior High Schools in Sukoharjo Regency, Central Java.

Data collection methods in this research, using observation, interview, documentation, test, and questionnaire (Denzin & Lincoln, 1994). Data collection methods in development are added using Focus Group Discussion (FGD). Data analysis techniques in this research use a qualitative analysis of the flow model. The flow model is data collection, data reduction, data presentation, and cycle evaluation / conclusion, through the validity of source and method triangulation data.

RESULTS AND DISCUSSION

The learning process carried out by mathematics teachers in reseach subjects through three stages, namely preliminary, core and closing activities. Variations of the actions of teachers in each learning step are very diverse, but all tend to be student-centered and not yet optimally created a dynamic and adaptability relationship.

Preliminary activities consist of conditioning, apperception and motivation activities, delivery of competencies and activity plans. Conditioning activities are activities that condition students to be ready to learn by greeting, praying, and checking student attendance. The activity of apperception and motivation is to relate the previous student experience to the subject matter to be discussed by giving questions. Competency delivery activities and activity plans, is the teacher gives an overview of

what competencies students will get. All preliminary activities are still dominated by teachers as a determinant of the course of learning process and the only source of learning for students (Sutama & Narimo, 2012).

Core activities in mathematics learning (Jazuli, La Ode, Anggo, Rahim, & Sahidin, 2017)

a. Read and understand contextual issues

The teacher gives contextual problems and asks students to understand the problem. If there are students who do not understand in certain parts then other students who understand are asked to explain to their friends who do not understand. If you still do not understand the explanation from his friend, the teacher will explain further by giving an overview of the problem situation.

b. Resolve contextual problems

One student is asked to solve a contextual problem with his own way of thinking. Different answers are recommended on this issue. The teacher motivates students to solve problems by giving questions that can help students find answers. At this stage, students are accompanied to repeat the concept or basis of mathematics through contextual problems given. Furthermore, students are also directed to use their own ways to find answers.

c. Compare and discuss answers

Students are asked to compare and discuss the answers in small groups. After that, the results of the discussion were compared in the teacher-led class discussions. At this stage it can be used to train students to express their opinions, even if their opinions are different from their friends or teachers.

d. Conclude

Based on the results of small group discussions or classes that have been conducted, the teacher directs students to make conclusions about concepts or definitions, theorems related to contextual problems that have been solved.

Closing is an activity carried out to end learning activities that can be done in the form of a summary or conclusion, assessment and reflection, feedback, and follow-up. In double loop learning, students are asked to evaluate and follow up on the learning that has been done.

Develop learning activities that in line with critical thinking skills and problem solving, namely observing the problems presented in relation to the two-variable linear equation system concept and its solution associated with contextual problems. Examples of observation material: One day at the stationery Afina and Andi shopping in the same place. Afina bought 5 pencils and 2 books for Rp. 45,000. Beni bought 2 pencils and 1 book for Rp. 20,000. How much money must Afina prepare to buy 1 pencil and 1 book in that place? This learning activity starts from what students experience in their daily

lives and trains students to learn to find out and apply interconnections between concepts in mathematics and everyday life (critical thinking) in accordance with the concept of double loop learning.

So far, teachers still apply the Lower Order Thinking Skills (LOTS) in learning. The level of one's thinking ability is divided into 1) remembering, 2) understanding, 3) applying, 4) analyzing, 5) evaluating, 6) creating. A person's thinking ability category in the LOTS category is 1,2,3 while the Higher Order Thinking Skills (HOTS) category 4,5,6. As another observation material that also applies critical thinking and problem solving, literacy, and HOTS skills: "Fina and Rina go shopping for the same clothes and skirts and in the same shop. They have the same money, which is Rp. 400,000.00 and plan to spend the money. Fina spent her money to buy one shirt and two skirts, while Rina spent her money to buy three clothes and one skirt. a) Without knowing the price of a dress or skirt, can you determine which item is more expensive? Explain your opinion. b) How much the price of a shirt? Explain your opinion. c) How much the price of a skirt? Explain your opinion. "The assessment instrument is equipped with a grid and an assessment rubric. Lattice is useful for controlling so problems are not separated from basic competencies and GPA and learning objectives. Assessment rubrics are useful so they are not subjective in giving scores.

In addition, literacy activities need to be encouraged. In general, literacy is the ability of individuals to process and understand information when writing or reading. Even so, the word literacy also refers to other language skills which include written and oral knowledge which actually requires a series of knowledge about genre, culture and cognitive abilities.

CONCLUSION

The results of the study show that the development of RPP that integrates critical thinking skills and problem solving can be done by 1) entering the character of skills into the development of RPP accordance with Basic Competencies (KD) 2) developing indicators to achieve KD 3) formulating learning objectives clearly so students can improve skills 4) develop learning materials related to skills 5) develop learning activities according to the skills that will be carried out 6) develop assessment tools as a measure of quality skills.

To achieve KD, Indicators of Achievement of Competence (GPA) and the character of 21st Century skills need to be developed, by working from the easy ones to the difficult ones. Learning will measure competencies with the Lower Order Thinking Skills (LOTS) order towards Higher Order Thinking Skills (HOTS).

The formulation of learning objectives should be made clear and include Audience, Behavior, Condition, and Degree (ABCD). Learning objectives are used as a reference in the selection of types of material, strategies, methods, and learning media that will be used in the learning process. Examples of the formulation of learning objectives that contain ABCD: C: Given the problem of two variable linear equations A:

Student B: can determine the variable values of linear equations of two variables in daily life D: within one minute.

Develop learning materials that relevant to KD characteristics and indicators, which include material that factual, conceptual, procedural, and metacognitive. Learning materials are sorted and selected in order to fulfill the development of 21st century skills that have been formulated according to KD's guidance.

Assessment of learning outcomes in the internalization of 21st century skills, must be able to measure student's mastery of character quality, competence, and literacy knowledge, and can develop a high-level thinking process. The assessment instruments are equipped with grading and assessment rubrics.

Literacy activities are carried out through discourse/text/non-text comprehension strategies in three activities. 1) Activities before reading are carried out in preliminary activities. 2) Activities when reading, carried out at the core activities. 3) Activities after reading can be done at the core or closing activities in the learning process.

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