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Development of Learning Devices Based on Problems with Metacognition Approach to Improve the Capacity of the Problem Mathematic Students SMK Kesehatan Haji Sumut

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Abstract —**This study aims to determine: 1) the effectiveness of the learning process by using teaching materials based on problem-based learning model with metacognition approach, and improvement of problem solving ability of students by using the developed teaching materials. Subjects in this study were students of class XI Analyst and XI Pharmacy SMK Haji Sumut as many as 28 people and the object of this study is to see the effectiveness of the learning process undertaken. Instruments used consisted of student activity observation sheets, teacher capacity observation sheets, student response questionnaires and problem solving skills tests. Teaching materials were developed ie RPP, teacher manuals, student books, and LAS that have met the level of validity, where the respective values are 4.05; 4.17; 4.18; and 4.03 as well as for the problem-solving test with the reliability coefficient for posttest of 0.911. Based on the data obtained from the experiments on the teaching materials, it is known that: 1) the instructional material developed has been able to fulfill the effectiveness of the learning process, where: (a) the student activity level has met the ideal time tolerance limit by utilizing the good LAS in learning on test I (b) the ability of the teacher (NKG) in the test I of 2.96 and the test II of 3.38, (c) the student's response to the teaching materials and the learning process has been positive in both trial I and trial II, (d) the percentage of learning mastery at the time of posttest has reached the minimum thoroughness, that is 82.00% of students get more than 2.66 (B-); 2) there is an increase in problem solving ability of students from posttest I and posttest II, ie from score 70.50 to be 82.00.**

Keywords— Teaching materials, problem based learning models, and problem solving skills

I. INTRODUCTION

The role of mathematics as a basic science has strategic values in develop how to think logically, to be critical and act rationally. The role of mathematics in accordance with the general objective of the learning of mathematics in learning mathematics competencies listed in the curriculum unit level education, is so that students are able to: (1) trained in reason way of thinking and draw conclusions; (2) develop a creative activity that involves imagination, instuisi and divergent thinking by developing inventions, original, curiosity, make predictions and conjectures and try; (3) develop problem-solving abilities and; (4) develop the ability to convey information or communicate ideas among others through verbal conversation, notes. Charts, maps, diagrams to explain the idea of (Balitbang Depdiknas in Siregar, 2013:2).

To be able to grow the mathematical problem solving ability needed a device that supports learning. In Permendikbud No. 65 Year 2013 on standard process of elementary and secondary education said that drafting a learning device is part of a planning study. Such learning devices in the form of lesson plan (RPP), the teacher's guide book (BPG), student textbooks (BS), student activity sheets (LAS), an instrument of evaluation or test the results of the study as well as the media of instruction. Furthermore, according to Permendikbud number 81A year 2013 page IV about the implementation of the curriculum guidelines of the Study, the first stage in the learning process by the standards was realized by making RPP. RPP was developed learning plans in detail from a subject matter based on the syllabus.

Basides the RPP, the textbook is one device that supports learning. Akbar (2013:33) defines the textbook as a text book used as a reference standard on certain subjects. The student textbook is a guidebook for students in learning activities that contains subject matter, based on the concept of investigation activities, science activities, information and examples of the application of science in everyday life (Trianto, 2011:227). The development of a good textbook should meet the criteria of valid and effective. According to Akbar (2013:34) a good textbook are: (1) accurate (accuracy); (2) appropriate (relevance); (3) the communicative; (4) complete and systematic; (5) oriented student centered; (6) favors the ideology of nation and State; (7) the rule language is correct, textbook that was written using the spelling, terminology and proper sentence structure; (8) read, textbook which contains high readability long sentences and sentence structure according the understanding of the reader.

Textbook used in Vocational High School Health (SMK Kesehatan) Haji SUMUT still has some weakness: first, the material presented in the student textbook does not match the learning objectives to be achieved. The second, directly providing the next formula used in problem solving, textbook does not contain steps in finding a formula so that students just memorize that led to easy to forget in its use. Third, there is the matter of the example does not show the steps that can measure the mathematical problem solving ability.

Development of learning device such as RPP, BS, BPG, LAS should refer to a model of learning in order for a developed of learning device into one Model is the problem-based learning approach to learning in which learners working on problems of authentic (real) so that learners can devise their own knowledge, develop skills and inquiry, independent learning student, and increase her confidence (Trianto, 2009:92).

Problem-based learning involves the presentation of authentic situations and means that serves as the Foundation for the investigation and inquiry students (Arends, 2008:41). Problem-based learning approach to metacognition according to Nurasyidah (2014:117) is learning that instill the awareness of how to design, monitor, and control about what they know; what it takes to work on, it focuses on learning activities; assist and guide students when experiencing difficulty; and assist students in developing a concept of themselves while learning math.

The application of models of learning are expected to develop mathematical problem solving abilities students start working from a given problem, hooking problem that will be investigated by reviewing the problem of many perception, do authentic investigation to find the real resolution to the problem is real, making products in the form of reports for demonstrated to other friends, cooperate with each other to develop social skills and thinking skills.

Exposure learning models and weaknesses learning devices in SMK Kesehatan Haji SUMUT indicates that the quality of learning available devices have not been classified as either . For that, it needs to be done learning development quality, in accordance with the conditions and characteristics of student SMK Hajj Health of North Sumatra. The quality of learning devices being developed will meet the criteria for a valid, practical and effective and in accordance with the applicable curriculum. Learning developed devices will refer to the model-based learning approach issues with Metacognition, among them: RPP, BS, BPG, LAS as well as the learning ability test (TKB). It encouraged research focusing on " development of learning devices based on problems with metacognition approach to improve the capacity of the problem mathematic students Smk Kesehatan Haji SUMUT ".

II. REVIEW OF THE LITERATURE

A. Mathematical Problem Solving Ability

Problem solving plays an important role in the education of mathematics students ranging from elementary to intermediate level. NCTM (2010:1) Problem solving is an important component in the process of learning mathematics, as well as the solution. Students may gain experience using the knowledge and skills that are already owned to apply problem solving. In line with that, Polya (1973: 5) mention there are 4 problem resolution process include the following: First, we have to understand the problem; we have to see clearly what is required. Second, we have to see how the various items are connected, how the unknown is linked to the data, in order to obtain the idea of the solution, to make a plan. Third, we carry out our plan. Fourth, we look back at the completed solution, we review and discuss it.

B. Problem-Based Learning Model

Arends (2008: 41) States that model problem-based learning is a model of learning where students work on authentic problems with a view to drawing up their own knowledge, develop inquiry and higher level thinking skills, develop independence and confidence. Thus the conclusion can be drawn is the problem-based learning is the students in understanding the concept and principles of a material starts from work and study towards a situation or a real problem given, through investigation, inquiry, modeling and problem solving students construct concept or principle with its own merits that integrates the skills and knowledge that are already well understood before.

C. The Approach Of Metacognition

The general understanding of Metacognition is thinking about how to think. Metacognition according to Flavell, as cited by Sastawati, E dkk (2011:4) States that: "Metacognition refers to higher order thinking which involves active control over the cognitive processes engaged in learning. Activities such as planning how to approach a given learning tasks, monitoring comprehension, and evaluating progress toward the completion of a task are metacognitive in nature". Activities such as planning how to approach learning tasks given understanding, monitoring, and evaluating the progress of task completion is metacognition.

D. Learning Devices

Learning Device is a collection of learning resources that are compiled in such a way where students and teachers learning activities (Subanindro, 2012:811). Meanwhile, according to Ibrahim (Trianto, 2011:112) learning device is a device that is used in the learning process. Thus the development of learning is a process that is done to produce a series of instructional devices used by teachers and students in the learning process in the classroom.

A group learning devices that must be prepared in the face of a teacher in a classroom learning in this study include: RPP, BS, BPG, LAS, TKB (mathematical problem solving ability).

E. The Quality Of Learning Devices

It is a learning Device products resulting from the research development. A learning product into this learning device used later by students should be qualified and meets certain criteria. Nieveen (2007:93) States "First of all, it is necessary to make clear the type of value judgement that the evaluation needs to result in. In this respect, we distinguish for quality criteria that are applicable to a wide array of educational interventions". The fourth criterion, among others; (1) Relevant (*Relevance);*

(2) Valid (*Consistency)*; (3) the practicality*;* and (4) Effectiveness.

III. RESEARCH METHODS

This type of research is research development (R & D) i.e. the process used to develop and validate product education combined with a develop learning device using Model Thiagarajan is the 4-D model, which consists of 4 stages of development, that is, define, design, develop, and dessimenate. This research was carried out in class XI SMK Kesehatan Haji SUMUT on odd semester academic year 2017/2018 material linear programs.

The instruments used in this research are sheet materials (RPP, BGP, BS and LAS) as well as a test mathematical learning ability problem solving of students. Data collection techniques used are test and question form. Data validation results analyzed criteria assessment by describing the mean score and statistical tests. Effectiveness materials as seen from the completeness of problem solving ability mathematical student, student response, learning objectives and learning time.

IV. RESEARCH RESULTS

A. Define stage

Based on the results of observation and analysis of materials at SMK Kesehatan Haji SUMUT, indicates that during this teacher does not yet have a good learning materials. Learning implementation plan (RPP) that there is not a description of the learning process that is implemented. The existing LAS used not synchronous with RPP, so that the desired learning goal in the RPP are not in there, and the textbook used did not contain questions that are contextual.

In terms of the characteristics of students of Class XI SMK Kesehatan Haji SUMUT year 2017/2018 who were investigated include the development of cognitive, academic ability, social background and ecomony. Then on the stage of the analysis concept, detailed and composed the social arithmetic concepts that will be taught. Next are arranged systematically and linked to other concepts that are relevant. Task analysis aimed at identifying the main skills required in learning social arithmetic and in accordance with the curriculum. Furthermore carried out an analysis of the main academic skills that will be developed in the learning. Then the formulation of learning objectives is a reference in designing learning materials based on problem based learning approach to metacognition.

B. Design stage

At the design stage a plan for implementing learning was produced for three meetings in field trials, BPG, BS, tests of students' mathematical problem solving skills and along with scoring guidelines. All results at this design stage are called the Initial Draft.

LAS in this study was 3 sets. Because, the meeting designed in accordance with the RPP is 3 meetings. LAS is given at each meeting on a different topic according to the linear program material at the meeting. Whereas in the BPG which was developed based on problem based learning the metacognition approach consisted of instructional instructions and alternative answers to problems in student textbooks.

The test developed in the form of a test of mathematical problem solving skills (TKB). Tests of mathematical problem solving skills in the form of a description consisting of 5 Post-Test questions from linear program material.

C. Development stage

- Validation Results of the Expert Team

Validators who validated the learning device developed (Initial Draft) consisted of 5 people including from three lecturers of UNIMED mathematics education, one teacher of High School N1Binjai and one teacher SMK Kesehatan Haji SUMUT. The following is a recapitulation of the results of the validation of learning tools by expertsn that is where:(1) Teacher's Book (BPG) average validation is 4.18 with category “Valid”, (2) Student Book (BS) average validation is 4.17 with category “Valid”, (3) Learning Implementation Plans (RPP) average validation is 4.05 with category “Valid”, (4) Student Activity Sheet (LAS) average validation is 4.03 with category “Valid”,

Based on the validity criteria, it can be said that the developed teaching materials can be used or in the "Valid" category.

- Trial I

Validity of Research Instruments

The test of students 'mathematical connection ability test aims to determine the validity and reliability of the test questions on students' mathematical problem solving skills. The following table presents the results of the validity of the research instrument.

TABLE 1. Validity of Post-test Item Ability to Solve Student Mathematical Problems

Number Reserved	t_{count}	t_{table}	Conclusion
1	0,904	0,361	Valid
2	0,938		Valid
3	0,699		Valid
4	0,903		Valid
5	0,846		Valid

Based on the data in the table above, the interpretation of each post-test item is in the category “Valid”. For the results of calculations using the alpha-Cronbach formula, the reliability for the post-test was 0.91.

Effectiveness of Learning Devices

As for the results of the trial results II for the ability to solve mathematical problems can be seen in the table below:

TABLE 2. Completeness of Students' Mathematical Problem Solving Ability In Trial I

Interval Value	Predicate	Frequency Students	Percentage
2.00 ≤ N < 2.33	C	10	25%
2.33 ≤ N < 2.66	C +	4	10%
2.66 ≤ N < 3.00	B-	5	12.5%
3.00 ≤ N < 3.33	B	13	32.5%
3.33 ≤ N < 3.66	B +	7	17.5%
3.66 ≤ N < 4.00	A-	1	2.5%
The total		40	100%
Average Score		70,5	
The total		40	
Average Score		70,5	

Based on the table 3, trial I is known that the average student score is 70.5 and the students' completeness in achieving learning goals is 52.5% of the 40 students. Based on the table above, it is known that the average score of students is 82.00 with the students' completeness in achieving learning goals is 82.50% of 40 students. The results of the trial results II for mathematical problem solving skills can be seen in the table below:

TABLE 3. Completeness Levels of Problem Solving Ability of Student Mathematics In Trial II

Interval Value	Predicate	Frequency Students	Percentage
2.00 ≤ N < 2.33	C	3	7.5%
2.33 ≤ N < 2.66	C +	4	10%
2.66 ≤ N < 3.00	B-	0	0%
3.00 ≤ N < 3.33	B	12	30%
3.33 ≤ N < 3.66	B +	12	30%
3.66 ≤ N < 4.00	A-	9	22.5%
Total		40	100%
Average Score		82.00	
Completeness (%)		82.50	

- Trial II

Based on the table 3, it is known that the average score of students is 82.00 with the students' completeness in achieving learning goals is 82.50% of 40 students.

D. Dissemination Stage

The next step is to do a limited distribution in the form of the distribution of final teaching materials to the MGMP forum in the SMK Kesehatan Haji SUMUT and submit the results of the development to the entire population in this study.

IV. Discussion of Research Results

Based on the formulation of the problems and research questions submitted in the previous section, based on the data obtained from the results of trial I and trial II, it will be known whether the formulation of the problem proposed has been answered or not. The results of the analysis of the data obtained from the results of the trial that is increasing the ability of mathematical connections using teaching materials with problem learning models based on the metacognition approach that has been developed seen in trial I of the classical completeness score of 52.5% while seen in trial II of the completeness value classical 82.5. There was an increase in trial I and trial II

Activities carried out by students at the time of the trial had met the ideal time tolerance limit, namely listening activity by 21.27% in the first trial and 20% in the second trial; reading activity was 15.46% in trial I and 13.34% in trial II; writing activity was 30.61% in trial I and 34.55% in trial II; discussion activities amounted to 30.30% in trial I and 30% in trial II; other irrelevant activities amounted to 2.12 in trials I and II. The activities of writing and discussing are mostly carried out by students to complete the LAS that has been provided (based on learning models, learning objectives, and scaffolding principles). Through LAS students practice solving problems through the stages of problem solving, both independently and with the help of other more competent students or teacher assistance so that they gradually experience increased grades in completing LAS.

The ability of the teacher to manage learning is in the poor category in the first phase of the trial, where the teacher's ability score (NKG) is 2.96 with the average score of the ability to apply learning syntax of 3.01 and the average value of the ability to manage time efficiently is 2.84; the average value of the ability to close the lesson and the value of class management ability is 3.00; experienced an increase during the phase II trial, where the teacher's ability score (NKG) was 3.38 with an average value of the ability to apply learning syntax of 3.49; the average value of the ability to manage time efficiently is 3.50; the average value of the ability to close the lesson is 3.17; and the average value of class management ability is 3.34.

The response given by students to the components (teaching materials) and the learning process is a positive response both in trials I and II, students who feel happy by 83.5% in the first trial and 88.5% in the second trial; students who stated that the teaching materials and processes carried out included a new category of 82% in tests I and II, students who were interested in following the learning process with problem-based learning models with a metacognition approach of 92.5% in trials I and II; and students who stated

that the instructional material developed was communicative and interesting at 81.25% in trials I and II.

V. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusion

Based on the discussion in the previous chapter, conclusions are obtained which are the answers to the questions raised in the formulation of the problem, the conclusions are as follows:

1) Students' activities after using teaching materials based on the problem-based learning model with higher developed metacognition approaches.
2) The ability of the teacher to manage learning after using teaching materials based on the mass learning model with the developed metacognition approach has increased.
3) An increase in students' mathematical problem solving skills using problem-based learning models with metacognition approaches has increased.

B. Suggestion

Based on the results of the research and conclusions above, it can be suggested as follows:

1. Problem-based learning with the metacognition approach should be an alternative learning model for teachers in high school, especially in an effort to improve problem solving skills and create effective learning.
2. Giving LAS to students should be accompanied by the provision of scaffolding as an alternative in activating students during the learning process and as an exercise to use the stages of problem solving, such as understanding the problem, planning a settlement strategy, implementing the plan made, and re-examining the solution through the interpretation of the problem .
3. To meet students' needs for valid and effective teaching resources/materials in accordance with the learning model, the teacher can develop his own teaching materials, namely by using the Thiagarajan development model/procedure consisting of 4 stages.

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