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The Improvement of Physics Lesson Plan in Inquiry-Based Model of Static Fluid Material to Improve Student Metacognitive Skills

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Abstract:- This study aims to create an inquiry physics lesson plan (valid, practical, and effective) which is used to train the metacognitive skills of the students of Muhammadiyah 2 Senior High School in Sidoarjo. The improvement of lesson plan used the ADDIE model and tested in the XI MIPA class of SMA Muhammadiyah 2 Sidoarjo Muhammadiyah 2 Senior High School in Sidoarjo on the first semester of the academic year 2017/2018 with One-Group Pretest-Posttest Design. The Data collection used validation, observation, tests, and questionnaires. The Data analysis techniques used quantitative descriptive analysis. The results of this study indicate: 1) The development of lesson plans ,which is improved, are valid; 2) The learning process based on the improvement of lesson plan and implemted to the students run well; and 3) The effectiveness of lesson plan are:

(a) Improvement of student learning outcomes aspects of knowledge seen from n-gain are in high category (b) Student responses to lesson plan and the implementation of learning are very positive (c) The results of metacognitive skills of students who are trained are very well. It was concluded that the inquiry learning model which is improved here was feasible (valid, practical, and effective) and was used to improve the metacognitive skills of the students of Muhammadiyah 2 Senior High School in Sidoarjo.

Keyword:- *The Improvement of Lesson Plan, Inquiry Learning Model, Metacognitive Skills.*

I. INTRODUCTION

Education Philosophy stated that learing process must be done and has specific purpose. The learning process must be able to create fun thmosphere and planned well so that the students have active motivation in improving self-potential of spriritual, self- control, personality, intelegency, good attitude, and the skills needed in community, nation and state life (National Education System Law No. 20 of 2003). In the 2013 curriculum of standart graduation competency, there is metacognition competency. Minister of Education and Culture Regulation No. 20 of 2016 concerning in graduation standard Competency of primary and secondary education, in which it is stated that for competency the ability of lukusan is to have factual knowledge, conceptual knowledge, procedural knowledge and metacognitive knowledge (Kemendikbud, 2016).

The success of a child in the future is determined by how the development of all aspects of individual children, namely physical, intellectual, emotional, and spiritual development that develops optimally. Someone must have an awareness of his own thinking ability and be able to manage it. Experts say this ability is called metacognitive. As in the study of Azizah (2014) states metacognitive knowledge regarding knowledge of how to understand one's own abilities and how to use them to respond to all situations and conditions.

Students will know what the benefits of learning are being learned for their daily life and future. The learning process carried out is related to the cognitive, affective, and psychomotor domains and accompanied by metacognitive learning will enable students to increase awareness of what will, are and have been learned (Sanjaya, 2006).

Hartman (2002) states that educational research is very important to emphasize attention on higher-level thinking, which includes problem solving, metacognition, and critical thinking. Learning is categorized as good if it is active, meaningful, provides some context. Some students pay less attention to their thought processes, learning strategies used, and their attitudes to develop. Eggen & Kauchak (1996) state that one of the types of critical thinking skills and higher order thinking is metacognition abilities. An individual's ability to organize his thoughts. This ability is called metacognitive, namely an awareness of someone who has own cognitive, how cognitive works and how to manage it. Children 3 years have this ability is very important especially for the purposes of efficient use of students' cognitive use in solving problems. In summary, metacognitive can be termed as "thinking about thinking". Students can use metacognitive strategies in learning including the following three stages, namely: design what you want to learn; monitor self-development in learning; and assess what is learned. Metacognitive strategies can be used for any learning in any field of study. This is important to direct them so that they can consciously control the thinking process in learning. Flavel (1976).

The 2013 curriculum mandates the essence of a scientific approach of learning process. The scientific

approach is believed to be a golden bridge for the development and development of students' attitudes, skills and knowledge. The scientific method refers to investigative techniques for phenomena or symptoms, gaining new knowledge, or correcting and integrating prior knowledge. Inquiry can be applied in the curriculum through reflection while in learning activities based on inquiry, students are given the opportunity to search for and understand the cognitive and affective domains of learning how to learn (Alberta, 2004). Building inquiry culture also means recognizing, supporting, and teaching the rules of metacognition. Metacognitive skills are part of "learning how to learn" skills that can be channeled / applied in new learning situations, in the school environment or outside of school (Alberta, 2004).

Metacognitive skills involve knowledge and awareness of one's own cognitive activity or everything related to cognitive activity (Livingston, 1997; Schoenfeld, 1992; and Sukarnan, 2005), thus, someone's cognitive activities such as planning, monitoring, and evaluating the completion of a certain task are naturally metacognitive skills. Metacognitive skills train students to become independent learners, because students can manage their own learning and become assessors of their thoughts. Thus metacognitive skills are needed to develop the learning abilities of other students (Elsina, 2010).

Some of the previous studies reinforced by research by Irawati (2015) suggest that inquiry learning models are effective for improving metacognitive skills; Azizah (2014) states the inquiry learning model is able to train metacognitive skills well on stoichiometry material; Garret and Alman (2007) state that the diagnostic test provided a measure of a limited number of skills related to metacognition, and preliminary data suggest that such skills are especially important in retaining information; and Aswadi (2014) Guided inquiry-based Student Worksheets are very effective in increasing students' metacognitive abilities..

Based on the constructivist theory of learning activities in general are complex activities in other words, the learning process is not just an activity to recall the knowledge that has been given previously. A learning process can be said to be successful if students are able to work hard to get the various knowledge and the knowledge that teachers provide in the classroom. Teachers as instructors who have an important role, teachers are not only required to transfer knowledge, but also play a role to make information and knowledge as one of the things that have meaning through providing opportunities for students to express ideas with independent learning strategies (Nur, 2008, p: 2). The theory explains that a student must be independent in finding and applying complex information to conduct transfering information activities.

Related to the improvement of thinking skills, one interesting strategy to develop is that when students solve a problem, a cognitive process must occur within themselves. The existence of cognitive abilities that are directed and developed effectively, it will improve thinking skills, with increasing thinking skills it is expected that students' metacognitive skills will increase.

Based on the description of these thoughts the author is interested in conducting research under the title " The Improvement of Physics Lesson Plan in Inquiry-Based Model of Static Fluid Material to Improve Student Metacognitive Skills."

II. RESEARCH METHOD

The subjects of this study are learning devices to support the implementation of inquiry learning models on Static Fluid material (Hydrostatic Pressure and Archimedes' Law). The quality of learning devices is determined from three aspects, namely: aspects of validity, aspects of practicality and aspects of effectiveness. Sources of practicality and effectiveness data come from limited trials in 15 students of eleventh grade of science program in Muhammadiyah 2 Senoir high school Sidoarjo in the fists semester of academic year 2017/2018.

The trial of this study used the One Group Pretest - Post Test Design. with the trial design as follows:

U1 X U2

Information:
U_1 = Preliminary Test, to determine the level of student mastery of learning material before treatment (pretest)
X = Provide treatment to the students, namely learning with guided inquiry models to train students' science process skills.
U_2 = Final Test, to find out the learning outcomes and the level of mastery of learning material after treatment (posttest).

A. Practical Instruments of Learning Devices

The instrument of practicality in learning consists of:

- *Lesson Plan Implementation Sheet*

The observation sheet for the implementation of the lesson plan by using the inquiry model is used by the observer to observe the ability of the teacher to manage learning globally including the introduction, core activities, closing, time management, and classroom management that is adjusted to the implementation of the inquiry learning syntax in the lesson plan.

- *Students Response of the Questionair Sheet.*

This student response of questionnaires sheet was used to determine student responses to the subject matter of Static Fluids (Hydrostatic Pressure and Archimedes' Law). The instrument form of student response questionnaire was used to measure students' opinions and responses to each component of learning activities using the inquiry learning model.

➢ *The Obstacle of Observation Sheet in Learning Process (Integrated with Assessment of Metacognitive Skills: Evaluation)*

The instrument is used to obtain observational data about constraints and solutions that will be used to overcome obstacles while following the study of the subject of Static Fluid. The obastacle Observation in this field is integrated in the instrument to train the evaluation phase metacognitive skills written by each student.

B. Instruments of Effectiveness of Learning Devices.

➢ *Knowledge Aspect*

The Knowledge Learning Outcomes Test Sheet is used to measure the level of achievement of the indicator translation. Data on the learning outcomes of the aspects of knowledge were obtained from ten knowledge tests of multiple choice questions referring to Bloom's revised taxonomy. To find out whether there are differences in learning outcomes obtained from the pretest or posttest are the result of the influence of learning process which is done, then it is necessary to do sensitivity to the questions.

➢ *Skills Aspect*

The aspect of student skills which is observed in this study is metacognitive skills. The metacognitive assesment skills are the planning stage, namely planning the learning strategies that will be used, the monitoring stage evaluating each learning progress in each step that is adjusted to the objectives and the Evaluating stage to evaluate and it can understand the subject matter in learning, then constraints in learning and the solutions that students will do. Giving a score of metecognitive skills based on the assessment rubric made by researchers. This assessment rubric is intended to measure the metacognitive skills of students who are first validated by the validator. The instrument for measuring skills consists of test questions and metacognitive skills rubrics. The method used is the written test method. The test questions used are metacognitive skills tests. The metacognitive skills rubric used is the adoption and adaptation of the metacognitive skills rubric developed by Corebima (2006).

❖ *Data Collection Technique*

To get the data of data collection technique is needed, the technique in question is a method used by a researcher to obtain research data. The data collection process in this study is:

➢ *Validation devices*

Data about the validity test of learning device development, namely the development of Student Teaching Materials and Student Worksheet, is a requirement of this research. Existing learning devices were developed and revised by researchers on the direction and guidance of the supervisor and validated by two validators before a limited trial of learning devices was conducted.

➢ *Learning Outcome Test*

Data about learning outcomes is obtained through written tests contained in product assessment sheets that pay attention to cognitive skills, so that it is integrated with the question description.

➢ *Giving Test*

This test is used to obtain information about the completeness of student learning in the Static Fluid teaching material sub- discussion of Hydrostatic Pressure and Archimedes' Law. The test is given in 2 stages, namely the first initial test (pre-test) and secondly the final test (post-test) the final test that is tested after learning activities aims to determine student understanding of the learning material provided.

➢ *Observation*

- *Observation*

Observation was carried out by two observers who observed and recorded the stages of learning when the teacher conducted the learning process. This observation produces data about the implementation of learning syntax.

- *Questionaire*

The completion of this questionnaire aims to collect research data on students' responses to the learning process that has already been carried out. The filling out of the questionnaire by students is done honestly and objectively without any pressure after teaching learning process has been finished.

❖ *Data Analysis Technique*

This data analysis technique describes the activities of teachers and students during the teaching and learning process takes place, based on the inquiry learning model in this study are as follows:

➢ *Data Analysis of the Validity on Learning Devices*

Validitas perangkat pembelajaran yang sudah disusun terdiri atas RPP, BAS, LKS, dan LP, Analisis data hasil validasi perangkat pembelajaran tersebut dianalisis menggunakan analisis deskriptif kuantitatif, menurut Ratumanan dan Laurens (2011), yaitu dengan cara menghitung rerata skor masing-masing komponen yang telah diberikan oleh dua validator baik validitas format, validitas isi maupun validitas format. Pada pelaksanaan observasi masing-masing pengamat memberikan penilaian (4: Sangat valid, 3: valid, 2: Kurang Valid, dan 1: Tidak Valid).

The validity of the learning devices that have been compiled consists of lesson plan, student worksheet, and rubric. Data analysis of the results on learning device validation is analyzed by using quantitative descriptive analysis, according to Ratumanan and Laurens (2011), by calculating the average score of each component that has been provided by two validators in format validity, content validity and format validity. During the observation each observer gives an evaluation (4: Very valid, 3: valid, 2: Invalid, and 1: Invalid).

➢ *Practical Data Analysis Learning devices.*

- *The Implementation of Lesson plan*

Observation of the implementation of the lesson plan is carried out by two observer teachers who have been entrusted and trained to provide observations and assessments. The performance of the assessment is then analyzed descriptively qualitatively. The value of learning achievement is obtained from the assessment conducted by two observer teachers who have studied and understood the observation sheet rubric properly.

During the observation each observer gives an evaluation (4: Very Good, 3: Good, 2: Poor, and 1: Not Good). The assessment criteria are obtained by comparing the average rating scale given by the two observers. The calculation is carried out on the two values given by each observer. The value given is a maximum of 4 and a minimum of 3. The criteria for carrying out the lesson plan is based on the value of the two observers, if the value given is at least 3 by both observers.

- *Analysis of Research Constraints.*

Data constraints that arise during the implementation of learning are obtained from evaluation sheets as students' personal journals during the learning process, then the data obtained is then analyzed descriptively qualitatively.

- *Analysis of Students' Response*

Data from student response data are then analyzed using quantitative descriptive statistics to determine student responses or assessments of the learning tools used and the situation during the learning process using the formula:

$$\frac{\sum}{\sum}$$

Information:
ΣR = Number of responses for each aspect that appears
ΣN = Number of all students who filled out the questionnaire

➢ *Data Analysis of the Effectiveness of Learning Devices.*

- *Analysis of Learning Outcomes Aspects of Knowledge*

✓ Analysis of Problem Sensitivity Index of Problems

The sensitivity index of an item is basically a measurement that states the ability of items to distinguish students' abilities before and after learning by using the inquiry learning model. Benchmark sensitivity of items to learning is if S ≥ 0.30. Item sensitivity index is calculated by the following formula:

$$S = \frac{Ra - Rb}{N}$$

(Gronlund & Linn, 1995)

Information:
S : sensitivity index Item s
N : The number of students who have taken the test.
Ra : Number of students who have answered correctly at the end of the test
Rb : Number of students who have answered correctly at the beginning of the test.

The sensitivity index item is between 0.00 and 1.00. A larger index indicates a high sensitivity level, while a small value indicates a low sensitivity value. Arikunto (2009) item that is said to be sensitive or sensitive to learning is to have a sensitivity index ≥ 0.30.

✓ Analysis of learning outcomes scores aspects of student knowledge and N-Gain scores

Student's score after completing the pretest and posttest questions is calculated using the formula:

—

(Ratumanan dan Laurens, 2011)

Information :
J_B = the number of questions sheet has been answered
N = the number of questions.

Scores obtained by students are then converted into numbers with a range of 0 to 100 based on the 2013 curriculum assessment guide. Completeness of student learning outcomes is determined based on the completeness maximum criteria (KKM) which is determined by the level of the education unit, in this study the classical completeness maximum criteria (KKM) set is used by Muhammadiyah 2 Senior High School in Sidoarjo is 65. Student scores on aspects of knowledge are expressed on a scale of 0-100 and the predicate is determined as follows (Kemendikbud, 2015, p.43)

Very good (A) : 86 – 100
good (B) : 71 – 85
enough(C) : 56 – 70 poor (D) : ≤55

The improvement of student scores on knowledgea spects can be calculated by using the Normalized Gain analysis from Hake (1999). The formula from Hake is then adapted by researchers to be as follows:

———————

(Adapted from Hake, 1999)

Information:
N-gain = Gain Score S_{post} *= posttest Score*

S_{pre} *= pretest Score* S_{max} = maximum score

The results of the N-gain calculation are then converted using the Normalized Gain criteria as shown in Table 1.

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Skor *N-Gain*	Kriteria *Normalized Gain*
0,70<*N-Gain*	Tinggi
0,30⩽*N-Gain* ⩽0,70	Sedang
N-Gain ⩽0,30	Rendah

Table 1:- Criteria of *Normalized Gain* (Hake, 1999)

III. RESULT AND DISCUSSION

A. *Validity of Lesson Plan*

Learning devices in the form of lesson plans were developed by researchers with the guidance of a supervisor. The existing lesson plans were then validated by two expert lecturers, after an analysis of the results obtained was valid with a few revisions and the lesson plans were used as instruments for data collection.

B. *Validity of Students' Worksheet*

Student worksheets are arranged and developed by researchers at the direction of the supervisor. The worksheet formula is designed to improve students' metacognitive skills, which consists of the Planning, Monitoring and Evaluating phases.

The results of the validation of the worksheet are valid with a few revisions and the lesson plan is appropriate to be used as an instrument for data collection. There are a number of suggestions from the validator that researchers can use as positive suggestion and improvement.

C. *Validity of Methacognitive skills Metacognitive Assessment Skills*

Instruments consist of 10 multiple choice questions and 6 essay questions which are compiled and developed by researchers based on the direction and guidance of the supervisor. The results of data analysis construct validation and content validation of learning outcomes test instruments in the form of question sheets consisting of ten questions in the form concluded that the results of the learning device in the form of an assessment instrument learning outcomes stated to be very valid and fit for use in learning.

D. *The Implementation of Lesson Plan*

The syntax of inquiry learning models compiled and developed by researchers has been well implemented by researchers (teachers). There are five points of assessment in the implementation of the RPP of the incuri learning model to improve metacognitive skills, namely introduction, core, closing, learning atmosphere and time management.

The mean result of the two observers of the implementation of the lesson plan was 3.5 in the good category with a precentage of agrement of 96.43%. The results provide that teachers do all the syntax of inquiry learning models to improve students' metacognitive skills well, and students are actively involved.

E. *Students Response*

The results of student responses by 83% of students thought the inquiry learning model to increase the students' metecognitive skills was fun. The inquiry learning model implemented can train 93% students' metacognitive skills. 92% of students are interested in following the next learning with inquiry learning models to practice metacognitive skills.

The results of student responses in general are students giving a positive response to learning activities. This positive response is in line with this study reinforced by research by Irawati (2015) stating that the inquiry learning model is effective for improving metacognitive skills; Azizah (2014) states the inquiry learning model is able to train metacognitive skills well on stoichiometry material.

F. *Students Learning Outcomes*

➢ *Cognitive Learning Outcomes*

The learning process begins with a pretest. The results of the two tests were very low, 33 of the three classes average (XI MIPA5, XI MIPA6 and XI MIPA7), this was because the class had not yet received Static Fluid material. After the pre-test, the next activity is the implementation of learning devices that have been validated by experts and revised according to the suggestions and input of the validators. Learning activities carried out two meetings. The first meeting was about hydrostatic pressure and the second meeting was Archimedes' Law. After the learning process is complete, the next meeting is the posttest.

The results of this study are reinforced by research by Irawati (2015) which states that inquiry learning models are effective for improving metacognitive skills; Azizah (2014) states the inquiry learning model is able to train metacognitive skills well in stoikiometry; Garret dan Alman (2007) stated *The diagnostic test provided a measure of a limited number of skills related to metacognition, and preliminary data suggest that such skills are especially important in retaining information.*

➢ *Methacognitive Skills*

The results of the pre-test and post-test metacognitive skills of class XI MIPA 5, XI MIPA 6, and XI MIPA 7, in table 4.16 all of the sensitive questions are informed and all of the questions used have a sensitivity ≥0.30 which is 0.60, this shows that the questions developed are effective for research improving metacognitive skills in Static Fluid material. Problems that are sensitive to both categories of influence on the learning process carried out and the results of tests obtained by students.

There are six types of metacognitive skills tests in this research, namely Not Yet, At Risk, Not Really, Developing, Ok and Super. In this study, the results of the pre- test of metacognitive skills can be grouped into three categories namely At Risk, Not Really, and Developing. In three classes, there was an increase in the category of at risk, not really and developing into Ok and Super.

Complete can be observed in the following table:

Kategori	Jumlah			Kategori	Jumlah		
	XI M 5	XI M 6	XI M 7		XI M 5	XI M 6	XI M 7
At Risk	9	22	18	*Ok*	22	24	21
Not Really	21	3	5	*Super*	8	3	3
Developing	0	2	1				
TOTAL	30	27	24	TOTAL	30	27	24

Table 2

G. The Finding

Researchers in conducting education research by using the development of inquiry learning models in the field of physics studies of Static Fluid material (Hydrostatic Pressure and Archimedes Law) for class XI MIPA 5, XI MIPA 6 and XI MIPA 7 which were tested at Muhammadiyah 2 Senior High School Sidoarjo, found several findings including:

The physics learning device of the inquiry learning model to improve the metacognitive skills of the students of Muhammadiyah 2 Sidoarjo High School which has been developed is declared valid and is suitable for use in physics learning activities.

- The practicality of the learning devices developed through the trial implementation is seen from the implementation of first lesson plan and second lesson plan in XI MIPA 5, XI MIPA 6 and XI MIPA 7 in Muhammadiyah 2 Senior High Sschool Sidoarjo in the learning process with an average score of good implementation.
- The effectiveness of learning devices through implementation in the trial of the application of physics learning tools of inquiry learning models can improve student learning outcomes, namely the average N-gain of class XI MIPA 5, XI MIPA 6 and XI MIPA 7 is 0.70 with a high category. Students respond very positively to the results of the development of devices and the implementation of learning with inquiry models.
- The obstacles encountered that some students were still unfamiliar with metacognitive skills but also it had a low increase in learning outcomes and students were still not accustomed to the learning with inquiry models to practice metacognitive skills in practicum activities in the laboratory.
- Metacognitive skills test results are grouped into six categories, that is Not Yet, At Risk, Not Really, Developing, Ok and Super. In this study, the results of the pre-test of metacognitive skills can be grouped into three categories as at Risk, Not Really, and Developing. In the pre-test results three classes experienced an increase in the category of at risk, not really and developing into Ok and Super.

IV. CONCLUSION

Based on the results of the analysis and discussion, it can be concluded that the set of inquiry learning models to improve students' metacognitive skills, they have a decent rating (in terms of valid, practical and effective aspects) used in Physics subject.

V. SUGGESTION

Some suggestions given by researchers based on finding of this study that has been done are as follows:

- Researchers suggest that student worksheets and teaching materials (BAS) are used during learning, they are distributed to students before learning so that students have time to study about the student worksheets and teaching materials.
- The researcher suggests that the inquiry learning model be developed more in other subjects.
- The researcher suggests that the assessment of metacognitive skills be developed in the aspect of knowledge in the form of question.

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