Development of Physical Learning Instrument with Process Skills Approach to Train Student's Critical Thinking Skills On the Concept of Dynamic Electricity

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Abstract- This research includes research and development (Research and Development). Research and development are research methods used to produce certain products and test the effectiveness of the product. To be able to produce certain products used research nature of needs analysis and to test the effectiveness of the product so can function in the wider community, research is needed to test the product. As the name implies, Research & Development is understood as a research activity that starts with research and continues with development. Research activities carried out to obtain information about user needs (needs assessment), while activities development is carried out to produce learning instrument. Research activities are not only carried out at the needs assessment stage but also in the product development process, which requires activities data collection and data analysis, that is at the expert validation process stage and the stage of empirical validation or testing. Whereas development refers to products produced in research projects. This research develops learning instrument with a process skill approach to train student's critical thinking skills. The device developed is a Lesson Learning Plan (RPP), Student Textbooks (BAS), Student's Activity Sheets (LKS), Assessment Sheet (LP). This research was conducted in odd semester, academic year 2018-2019 academic year in Al Hikmah High School Surabaya. As for who is the subject of research is learning instrument with a process skill approach to train student's critical thinking skills. And the object of research in this study is class of XII Al Hikmah Surabaya High School with 28 students. In this study, to obtain research data used some data collection techniques, namely as follows: test, observation, and provision of questionnaires. Based on the analysis of the results of research and discussion, obtained the conclusion as follows: The validity of the learning instruments includes lesson plans, student's book, LKS, LP are valid categories, readability of Student's Book and LKS shows that the contents and appearance are attractive and easy understood so that it can be applied in learning. The implementation of the lesson plan shows that the lesson plan can well-implemented and instrument of implementing RPP which used reliably, the most dominant activity is deep make observations, plan experiments, and do experiment or work with science process skills for practice critical thinking skills, student responses after application learning instrument are relevant to the results, the completeness of the results learning products, processes, psychomotor individually and classically has been achieved, the results of the sensitivity analysis of the items are sensitive. Based on the conclusions above, it is obtained a conclusion general that learning instrument with science process skills approach to practice critical thinking skills is worth using in learning.

Index Terms- Physical Learning Instruments, Process Skills Approach, Student's Critical Thinking Skills, Dynamic Electricity

I. INTRODUCTION

The development of science and technology in the current era requires human ability to compete in the process of globalization. The community must have the characteristics of creative, critical, innovative, flexible, agile, competitive to become quality [1]. Apart from that to be superior must also have mastery of information, be sensitive to problems, able to work with teams and cross fields. Humans must able to adjust to existing changes. Advances in science and technology marked the start of the era of globalization. Better mastery of science marks science and technology can be mastered. Physics is a part of science. If physics can be mastered well it will give a meaningful influence to master technology. Physics learning should be to pay attention to the empowerment aspects of thinking in learning. Learning Traditional deductive stresses that the teacher is the center of learning while learning that uses the process approach emphasizes that the role of students is very large in learning or usually referred to as the student-centered paradigm. Natural Sciences has several parts, one of which is physics. In physics, many skills can be performed such as: have a scientific attitude, able to communicate, work that can grown through the ability to think through physics learning scientific inquiry to support life skills. Based on these, high school students must have been trained to think at a high level according to his age level. Students can be trained to be skilled think at a high level by practicing topics that are inviting students think at the level of analysis, evaluation, and design or produce creation.

Critical thinking is constitutes a desire to get information, a tendency to looking for evidence, wanting to know both sides of the whole problem, the attitude of open-mindedness, the tendency not to expel opinion (expressing judgment), respecting the opinions of others, tolerant against ambiguity [2]. Learning that can empower critical thinking skills is the desired learning paradigm in the 21st century. Schools develop critical thinking activities are very important, schools expect teachers to realize learning that activates and develops

student's critical thinking skills. This was conveyed by Thompson and Melancon [3]. The teacher must plan science learning to develop critical thinking skills [4]. Citical thinking skills should be developed early on [5].

Based on observations at Al-Hikmah High School Surabaya, researchers found that learning physics in the classroom is still more advanced mathematical or calculation and have not practiced critical thinking skills to students. Learning emphasizes more on solving physics problems related to theory rather than linking the concepts of physics to analysis and solving real problems in everyday life. The teacher teaches physics is more dominant using the lecture and discussion method than demonstrations method and experiments to practice student's critical thinking skills. The teacher teaches critical thinking skills and still problem-solving as necessary at the time of the experiment because the measurement of this aspect is rarely implemented by the teacher. Consequently, the skills of students completing tests are oriented critical thinking skills namely the ability to analyze, evaluate and creativity students always get low scores. Based on student learning achievement data reached an average level of 69% quoted from archive vice principal of curriculum in the even semester of the academic year 2017/2018. The level of mastery learning individually set at 75% school and level 85% grade completeness.

By the Al-Hikmah Surabaya High School Curriculum, competency standards graduates who want to be achieved in physics include: developing experience to formulate problems, propose and test hypotheses through experiments, designing and assembling experimental instruments, collecting, process and interpret data and communicate experimental results oral and written. Achievement of SKL expected in physics learning should use more experimental methods to train science process skills in students, not just emphasizing understanding concept only. Based on the identification of the above problems, it is necessary learning that involves students actively in the learning process as well guide students discover their products and process skills itself, which in the end is expected to train the ability to think student's critical and student learning outcomes can be improved. Science process skills provide experience to students with learning through the process carried out in developing knowledge inductive. Learning approach oriented to the science process called the Science Process Skills Approach (KPS). In the approach, there are two KPS namely basic science process skills and integrated science process skill. Basic science process skills consist of making observations, classifying, communicating, measuring, doing predictions, provide conclusions and interpret. Integrated science process skills consists of identifying variables, determining variables operational, explain the relationship between variables, construct hypotheses, design procedures, carry out experiments for data collection and analyze data, present experimental results in the form of tables and graphs, conclude and communicate in writing or verbally. Through learning physics with the approach of science process skills then can be a means for students to practice their thinking skills and understanding of the concept to improve his critical thinking skills.

Science process skills on the concept of plant structure can empower critical thinking skills [6]. The science process skill approach will improve the ability to think critically, achievement and attitude to learning it [7]. Process skills can empower critical thinking skills. Through learning physics with an approach to science process skills is expected to be a vehicle for students to practice their critical thinking skills and understanding of the concept, because through this physics learning students trained to think critically, reason logically, and solve problems creatively [8]. One obstacle faced is the use of instruments tests that cannot measure students' critical thinking skills precisely. The recommendations of the National Science Foundation (NSF) to compile and implement evaluations with questions open, because such an assessment can improve student's thinking skills [9].

Based on the above view, it is necessary to design learning instrument that demand active student involvement in learning process as well as guiding students to find their products with the process skills themselves are ultimately expected to be able practice critical thinking skills and student concept learning achievement. For support this purpose, contextual learning instrument are designed physics concepts with a process skills approach. Based on the description above, it can be concluded the need for a study about the development of physics learning instrument with approaches science process skills to practice understanding concepts and skills critical thinking of student in Al Hikmah High School Surabaya.

II. EXPERIMENTAL METHOD

2.1 General Background of Research

This research includes research and development (Research and Development). Research and development are research methods used to produce certain products and test the effectiveness of the product. To be able to produce certain products used research nature of needs analysis and to test the effectiveness of the product so can function in the wider community, research is needed to test the product. As the name implies, Research & Development is understood as a research activity that starts with research and continues with development. Research activities carried out to obtain information about user needs (needs assessment), while activities development is carried out to produce learning instrument. Research activities are not only carried out at the needs assessment stage but also in the product development process, which requires activities data collection and data analysis, that is at the expert validation process stage and the stage of empirical validation or testing. Whereas development refers to products produced in research projects. This research develops learning instrument with a process skill approach to train student's critical thinking skills. The device developed is a Lesson Learning Plan (RPP), Student Textbooks (BAS), Student's Activity Sheets (LKS), Assessment Sheet (LP).

2.2 Sample of Research

This research was conducted in odd semester, academic year 2018-2019 academic year in Al Hikmah High School Surabaya. As for who is the subject of research is learning instrument with a process skill approach to train student's critical thinking skills. And the object of research in this study is class of XII Al Hikmah Surabaya High School with 28 students.

2.3 Instrument and Procedures

In this study, to obtain research data used some data collection techniques, namely as follows:

a. Test

The test is used to determine the completeness of learning instruments, mastery of physics concepts and student's critical thinking skills.

b. Observation
The observation technique aims to collect research data by using observation sheets that have been developed by researchers. Observation uses several research instruments to obtain research data on student activities and the implementation of the lesson plan by the teacher.

c. Provision of questionnaires
The questionnaire giving technique is used to collect data about student responses to the learning process. Granting the questionnaire given to students after learning activities are finished.

2.4 Data Analysis

a. Instrument Validation Analysis
RPP tools, worksheets, and student books developed further conducted by experts to provide an assessment. Validity learning instrument in a qualitative descriptive analysis viz by calculating the results of the assessment given by the validator based on component average scores [10]. Average score (X) described as follows:

$x > 4.65$	: Very Valid
$3.45 < x \leq 4.64$	: Valid
$1.15 < x \leq 3.45$	: Invalid enough
a.35 $x \leq 1.15$	: Invalid
$x \leq 0.35$	: Very Invalid

b. Analysis of Readability of Student Worksheets and Student Books
The readability of student worksheets and student books was analyzed by descriptive statistics by asking students to provide corrections regarding readability of student worksheets and student books.

c. Learning Implementation Analysis
In the assessment, there are 3 parts, namely introduction, core activities, closing, processing time and class atmosphere. Percentage RPP implementation is calculated using the following formula:

$$P = \frac{\Sigma K}{\Sigma N} x100$$

Information:
P = Percentage of RPP implementation
∑K = Number of aspects implemented
∑N = Total number of aspects observed
The implementation of the lesson plan at each phase is determined by compare the average rating scale given a second observers with the following evaluation criteria:
1.00 - 1.49: Bad
1.50 - 2.49: Not good
2.50 - 3.49: Enough
3,50 - 4,49: Good
4,50 - 5,00: Very good
To determine the reliability of the instrument of observation of performance RPP, used an interobserver technique using percentage of agreement (R) [11] as follows:

$$R = \left(1 - \frac{A - B}{A + B}\right) x100\%$$

Information:
R = reliability coefficient
A = frequency of behavioral aspects observed by the observer provide high frequency
B = frequency of behavioral aspects observed by the observer provide low frequency
The instrument of observing student activity is said to be reliability if it is of value reliability obtained ≥ 0.75.

d. Data Analysis of Student Activity Observation During Learning
During teaching and learning activities student activities are counted the percentage, then the calculation results are analyzed statistically descriptive. Student activities during teaching and learning activities were assessed by observer.

e. Analysis of Student Responses
To process student response data the percentage (%) is used. The percentage of student responses obtained by using the formula as follows:

$$P = \frac{fa}{fb} x100\%$$

Information:
P = percentage of student activities
fa = student response frequency
fb = overall frequency of response

Student response data were analyzed using descriptive statistics.

f. Analysis of Learning Achievement Tests

1) Individual student completeness

The learning instrument test was analyzed qualitative descriptive. Individually, a student can be said to be complete if the percentage (P) achieved indicators of ≥ 75% (minimum completeness curriculum criteria in Al-Hikmah High School Surabaya).

2) Mastery of student indicators

One indicator is complete when the percentage (P) of students is the accomplishment is ≥ 75%. Student learning instrument data, then processed using gain score (increase score). The percentage formula (P) is:

$$P = \left(\frac{the\ number\ of\ students\ who\ reach\ the\ indicator}{the\ total\ number\ of\ students}\right) x100$$

Student learning outcomes, then processed using a gain score (increase score). The amount of increase or gain is analyzed by the Hake formula [12].

Information:
g (gain) = Increased learning achievement
S_{pre} = Pre-test average (%)
S_{post} = Average post-test (%)

3) Sensitivity

The sensitivity of the multiple-choice form questions is used as a formula following:

$$S = \frac{B_{ss} - B_{sb}}{T}$$

Information:
S = Item sensitivity
B_{ss} = Number of students who answered right after the learning process teach
B_{sb} = Number of students who answered correctly before the learning process teach
T = Total (number of students)

For the calculation of the sensitivity index of item about form description, used the formula [13] according to as follows:

$$S = \frac{\Sigma U_{21} - \Sigma_{U12}}{N(skor\ max - skor\ min)}$$

Information:
S = sensitivity index
$\sum U_{12}$ = number of pre-test scores
$\sum U_{21}$ = number of post-test scores
Maximum score = maximum score achieved for each test item
Minimum score = minimum score achieved for each test item
N = number of students taking the test

According to Arikunto, the items were able to measure the effect learning is a matter that has a sensitivity ≥ 0.30.

g. Analysis of Mastery of Concepts and Critical Thinking Skills

Increased mastery of student's physics concepts and thinking skills critical in learning with the science process skills approach is calculated based on a normalized gain score. Increase which occur before and after learning is calculated by the gain score developed with the formula:

$$< g >= \frac{(S_{post} - S_{pre})}{100\% - S_{pre}}$$

Information:
g (gain) = Increased learning outcomes
S_{post} = Average post-test (%)
S_{pre} = Pre-test average (%)
Hake classifies the gain as follows:
g - high = g > 0.7
g - medium = 0.7 > (g) > 0.3
g - low = (g) < 0

III. RESULT AND DISCUSSION

Based on the analysis of the results of the assessment of the instruments and the results of implementation in class, then a discussion is carried out to describe the feasibility of the device learning, research instruments, and answering research problems based on the results of the implementation of the physics learning device compiled with a process skill approach to practice student's critical thinking skills. In connection with the results of the analysis, it will be described regarding the discussion of research results as follows:

1. The Validity of Learning Instrument

Learning instrument are the teacher's main instruments to carry out learning. The validity of the learning instruments developed determined based on the assessment of RPP, BS, LKS, and LP.

a. RPP

The RPP was developed as a scenario for achieving one KD and as guide teachers in managing PBM by using an process skills approach with inquiry models. KD achieved formulating simple closed-circuit electrical quantities (one loop) described into 8 product indicators, 5 process indicators, 1 psychomotor indicator and 8 indicator of critical thinking skills. The RPP consists of 4 meetings with details 3 times for learning and 1 time for assessment. The RPP was developed with the inquiry learning model with the process skills approach. This inquiry activity is very important because it can optimize the involvement of student's direct experience in the process of learning. Through the inquiry model with a process, skills approach the researcher intends to apply this learning to practice the concepts and student's critical thinking skills. The results of the assessment of lesson plans by experts include learning objectives, methods learning, learning phase, time, learning tools and evaluation get an average value of 4 with a category suitable for use and good use as a teacher's guide to managing learning to train student's critical thinking skills.

b. LKS

The development of worksheets is adjusted to the learning material and models used is the inquiry model with a process skills approach. The process skills approach emphasizes how students learn, how to manage their acquisition, so it's easy to understand. In the learning process strived for students to gain experience and knowledge themselves, carry out scientific investigations, train his intellectual abilities, and stimulates curiosity and can motivate its ability to increase the knowledge he has just gained. LKS Expert assessment results get an average value of 4 with a decent category. This shows that the developed worksheet is appropriate as a teacher's guide to managing learning to practice student's critical thinking skills.

c. Student Book (BS)

The student book developed is a BS for the subject matter of dynamic electricity consisting of introduction, content, material characteristics and translation concepts that are supplemented with indicators of critical thinking skills. Results BS assessments by experts obtained an average value of 3.9 which included the category worthy.

d. Readability of Student Books and Student Worksheet

The results of the readability assessment on the student book as much as 89% stated interesting contents and appearance, as many as 86% of students said there were only a few explanations that are difficult to understand, as many as 86% of students have no difficulty in understanding sentences and 89% easily understand images. Rating result readability in LKS as much as 100% states the contents and appearance are interesting, 89% of students said that there were only a few difficult explanations understood, and as many as 86% of students have no difficulty in an understanding sentences. The assessment results developed are good for students to use to train student's critical thinking skills.

e. The assessment sheet

The Assessment Sheet is used to measure the achievement of one BC, i.e. formulate the electrical quantities of a simple closed circuit (one loop). KD achievement is determined based on the completeness of each indicator. An indicator of learning is said to be complete when a student obtains a percentage (P) of the indicator achieved $\geq 75\%$ (criteria completeness minimum curriculum Al Hikmah High School Surabaya). Results The validity of the contents obtained a value of 3.8 which is a good category and language validity obtained a value of 3.9 which is a good category. Whereas for LP critical thinking skills scored 3.9 which is good category and language validity get a value of 3.9 which is a category this shows that the LPs used are good and proper to use to measure the achievement of KD. The results of the sensitivity of the questions to measure the effectiveness of the learning process done by giving a pretest and posttest. From the results of the analysis obtained product sensitivity and critical thinking skills are categorized as sensitive. This matter shows that the items made can provide that information measurement results are the result of learning.

2. Results of Implementation of Learning Instrument

a. Implementation of RPP

Implementation of lesson plans in implementation with an average value of 3.83 with the good category. This shows that the CSP can be implemented with good and the RPP Implementation Instruments used can be said to be reliable. Also, observations of the preliminary, core, closing, and atmosphere activities the average class get good grades. The implementation of learning activities with the approach of the process skills obtained data students work in a way independent in small groups with teacher guidance. Basic skills include observing, classifying, communicating, take measurements, predict, infer, and interpret. Integrated skills include the ability to identify variables, determine operational variables, explain the relationships between variables, formulate hypotheses, design procedures and carry out experiments for data collection, analyzing data, presenting experimental results in a form tables and graphs, discuss, conclude and communicate in a manner written or oral. It can be used to practice student's critical thinking skills. Thus expected in the implementation of guided inquiry learning by a science process skill approach capable of producing interactions between ideas that students believed before the experiment would be proven to reach the truth after going through experimentation and exploration and evaluation.

b. Student Activities

The results of student activity by two observers on average were good. Which activity the most dominant in every meeting is in making observations, plan experiments, and conduct experiments. Student activities decreased in listening to the teacher's explanation, and behavior did not relevant. Instead, activities in analyzing data and presenting trial results have improved. The activity shows that learning initially centered on the teacher becomes centered on the student. The Student Activity Observation Instrument used is reliable. Student activities in critical thinking that are published with the inquiry learning various student activities are involved in observation, ask questions, test hypotheses and prove with experiments, using tools, analyzing and interpreting data, propose answers and predict and present the results.

c. Student Response

Student responses to teaching materials, student books, worksheets, learning atmosphere and the way to teach teachers is 93% feel

attracted 93% feel new to that component. Student responses to the ease of understanding the deep language student books, worksheets, and ways to teach teachers 88% feel interested in learning with the approach of science process skills to train critical thinking skills. Student responses to the teacher's explanation at the time PBM took place and teacher guidance in critical thinking through the process skills approach is 93% and for the ease of answering critical thinking questions by 89% easy and for the concept 93% easy. This shows that learning with the approach of science process skills can help students in practice high-level thinking skills or critical thinking skills.

d. Complete Learning Achievement

To describe the extent to which students can reach the indicator or learning objectives measuring learning instrument include measurement of the completeness of product learning achievement and critical thinking skills. Measurement of mastery learning achievement and student's critical thinking skills are carried out before learning (pretest) and after learning (posttest). Learning achievement consist of 20 Learning Achievement Test products multiple-choice questions and the Critical Thinking Test process as many as 8 question descriptions. Product Learning Achievement Test are used to measure the completeness of student learning achievement towards understanding the concept of Dynamic Electric material, while the Critical Thinking Testl is used to measure student's critical thinking skills. Measurement of learning achievement refers to the Reference Assessment Benchmark (PAP), so that the completeness of Student Learning Achievement is determined based on the Minimum Criteria for Completeness (KKM) that has been determined. The KKM for physics class XII Science in Al Hikmah High School Surabaya Academic Year 2018-2019 is ≥75. Next, it will be described as consecutive results, student learning achievement, and critical thinking skills. To measure the learning achievement of products and processes, item questions are used has a sensitivity level greater than 0.30 meaning the item able to measure the effects of learning. The results of the sensitivity analysis of items were Researchers have done showed that of the 20 concept questions, there were 18 sensitive questions and 2 non-sensitive questions. While the product and 8 items questions that have been tested all have higher levels of sensitivity greater than 0.30, meaning that the item can measure the effects of learning [14].

e. Constraints During PBM

Barriers that exist during learning with the process skills approach to practice intermediate student's critical thinking skills others: 1) students are not accustomed to using science process skills in solving critical thinking skills problems, 2) students are not yet skilled put forward problems so that some students are still passive, 3) some students are not yet skilled in communicating opinions in front of the class, the constraints faced above can be used as input for research the next is to further optimize the process skills approach for practice critical thinking skills.

IV. CONCLUSION

Based on the analysis of the results of research and discussion, obtained the conclusion as follows:

1. Feasibility Learning Instruments

   The validity of the learning instruments includes lesson plans, student's book, LKS, LP are valid categories, readability of Student's Book and LKS shows that the contents and appearance are attractive and easy understood so that it can be applied in learning.

2. Learning Instrument Test Results

   The implementation of the lesson plan shows that the lesson plan can well-implemented and instrument of implementing RPP which used reliably, the most dominant activity is deep make observations, plan experiments, and do experiment or work with science process skills for practice critical thinking skills, student responses after application learning instrument are relevant to the results, the completeness of the results learning products, processes, psychomotor individually and classically has been achieved, the results of the sensitivity analysis of the items are sensitive.

Based on the conclusions above, it is obtained a conclusion general that learning instrument with science process skills approach to practice critical thinking skills is worth using in learning.

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