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COLLEGE STUDENT'S WORKSHEET BASED ON PROBLEM WITH SCIENTIFIC APPROACH TO DEVELOP CRITICAL THINKING SKILL

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Abstract-The objective of this research is to get the model,testing the appropriateness level,the legibility after applying college student's worksheet based on problem with scientific approach to develop critical thinking skill of college student in general of physics I academic Year 2014/2015 in one of the universities in Medan. This research method was a research and development (R & D) with 4D stages (define, design, develop, and disseminate). In the stage of limited test this research using pre-experiment method type one-group pretest-posttest.The data collection method in this research was an essay test form consist of 16 questions to measure critical thinking skill. The subject in this research consist of a group with the total amount was 26 people, it was experimental group by applying learning activities using college student's worksheet based on problem with scientific approach .Based on the result which obtained in this research, the average value of pre-test was 19.11 and the average value of posttest was 55.23. Based on the results of the test data analysis showed that learning through college student's worksheet based on problem with scientific approach can develop the college student's critical thinking skill. The percentage of N-gain raising critical thinking skill of university student was 44% in the intermediate category.

***Keywords*:** problem based university student worksheet, scientific approach, critical thinking skill

1. INTRODUCTION

Learning General physics in one of university in Medan commonly using conventional learning with emphasis on the use of mathematical formulas so that the college students tend to memorize just the mathematical formula than to understand the concept and less practicing student critical thinking. As for the practices just only to prove the formula with the instruction that so systematically so that less practice the creativity and critical thinking skills of college students .

Critical thinking skills of student need to be trained to (1) prepare college students to be successfully facing the life [7]; (2) creating a population who have a concern and literacy to the environment [2]; and (3) improve the ability of college students in analizing, criticize, suggesting ideas, give inductive and deductive reason, and to reach a conclusion based on rational consideration [5].

For college students, critical thinking skills is needed primarily to understand the concept in the subjects studied. With the critical thinking skills, college students can analyze problem, identify related concept, consider the credibility of the relevant resources, analyze the argument, criticize argument and evaluate solution that possible so that produced the best solution.

Lecturer admits that learning process like this less able to train college students to be able to construct their own knowledge. As a consequence college students do not have the necessary skills to solve problems and are not able to apply what they have learned in their daily lives whereas physics is very closely related to daily life. It is supported by [3] saying that the work steps in the recipe laboratory recipe is not giving enough opportunity to process information thoroughly, and the main concern of college students is only the completion of practical tasks. This is supported by [11] which says that the prescription of laboratory is generally as an exercise that mainly focus on the verification of evidence laws and principles.

One of the learning model that can be use to equip the college students to master the concepts of physics depth and practice critical thinking skills is *Problem Based Learning* (PBL). PBL is a learning that use the problem as the starting point of learning and to solve the problem, college students needs to requires knowledge. The process of PBL begins with the presentation of the problems and ended on the presentation and evaluation solutions [8].

According to [9], the purpose of PBL is to help the college students to study with reflective and independent learning that can intergrating the knowledge and skills. Beside that the problem based learning aims to develop a basic knowledge substantially. by placing the learners in the role as an active problem solver who is confronted with a situation (ill-structured problems). According to the problem, college students will have the opportunity to learn (learn how to learn).

2. METHODS

The research method that used is *Research & Development* (R & D) through 4 steps, that is *define*, *design*, *develop*, and *disseminate* [10]. This research develop learning model of General physics based problem which can improve critical thinking skills of college students.

Define phase with a preliminary study carried out through the study of literature and and field. Design phase by designing the learning model that will be developed along with the learning devices.

Develop phase, carried out by an expert to validate the draft model that has been developed, then do the limited test and wide scale test. The population of limited test is all of the student that follow the contract of general physics I. the subject in this test is a physics student teachers at one of the universities in Medan, which consists of a class numbering 26 people. The research method is pre-experimental with *one group pretest-posttest design*. the development of *Problem Based Learning*, tested in wide scale test. The population in this test is all of the physics student teachers at one of the university in Medan. The sample in this study consisted of two groups: the experimental group by applying problem-based learning model and the control group with conventional learning. The method used in the study wide scale testing was quasi-experimental with pretest-posttest control group design.

Disseminate ohase, carried out by implementation model developed on a larger scale again. The final product of the research and development is a model in general physics problem based learning that have been tested which can improve critical thinking skill of the college students

The results of development research of General Physics-problem based learning model with scientific approach which reported here is still in the phase of define,, design and development on a limited test. The development is still done up to limited test phase. Define phase carried out by literature studies and fieldwork. Design phase has made the learning device such as college students worksheet based on problem with the instrument of test in description test 16 question in temperature and heat topic that can measure critical thinking skills of college students and in develop phase has validated the instrument to experts and implement the model developed in a limited testing phase

Syntax problem based learning model by scientific approach consists of five phases, namely: the first phase, orientate the students on issues, second phase 2, organize students to learn, third phase 3) guiding the investigation of individual and group; fourth phase, develop and present the results of the investigation, and fifth phase 5) affirmation and follow up [1] and components of scientific approach is to observe, ask, collecting information, associate and communicate.

3. RESULTS AND DISCUSSION

According to the observation in college, learning process of general physics I in class tend by traditional learning and when performing a practicum, always use practicum handbook verify with tools and materials are available on the practicum table. The demands of practical activities more emphasis on the proving theory not to train the thinking skills such as critical thinking skills, however these skills need to be provided to college students. College students are also not faced with problems relating to the material being studied, whereas the physics of matter very closely in matters of daily life. With such lectures, the students are poorly trained his skills because they are not faced with authentic problems that require further investigation process through experimentation. College students are not trained to make hypotheses before conducting further experiments, college students are not trained to design experiments according to the idea and the creation of each. College students are also not trained to choose and use the tools in which they must choose.

Define phase, was done by (1) Creating a learning management guidelines; (2) Designing syllabus/lesson plans of General Physics I-based problems; (3) make s college students worksheet based problems; (4) arrange the instrument test, such as: critical thinking skills tests on Temperature and Heat topic and guidelines for observation. Steps on college students worksheet activities are: writing the purpose of the experiment; presents a problem in daily life; hypothesizing; write tools and materials to be used; determines the observed variables; explain the steps of the experiment, create

drawing design; write down observation result on the chart; answered questions of analysis; predict and making conclusions. The topic that has developed in Temperature include Expansion. Main topic that has developed in Heat is the effect of Heat against expansion, specific heat, capacity of heat, Azas Black, and heat transfer. The steps to create college students worksheet is to formulate problems in daily life and make the stages of its solution. College students worksheet guide contains college students worksheet and some direction to guide the students.

The indicators of critical thinking skills are developed in this research are: to clarify the issues and questions, summarize and interpret, support the conclusions and interpretations, and evaluate (McLean, 2005). According to the indicator of critical thinking skills, developed grainform of test descriptions, totaling 26 on the topic Temperature and Heat.

Trial limited done at one of the universities in Medan with a sample of 26 people who contracted the course of General Physics I. the method of this research is *pre – experimental* with *one group pretest – posttest design*. The design of this research is :

O X O

Note : O = pretest – posttest critical thinking skills that has been given to the experiment class
X = Problem based learning

The increase of critical thinking skills of students expressed in percentage gain normalized score (N - gain). The score of preliminary tests, final test and% N-gain cognition on the topic Temperature and Heat are shown in Table 1. According to the table 1 shows that %N-*gain* critical thinking skills on the topic Temperature and Heat is about 44% is at the middle category. According to table 1 it can be seen that the application of learning models of General Physics I based problems with scientific approaches can improve students' critical thinking skills.

Table 1. Comparison of Mean of Pretest, Posttest and% N-Gain Critical Thinking Skills

Topic	**Mean of Pretest**	**Mean of Posttest**	**N-*gain* (%)**	**Category**
Temperature and Heat	19,11	55,23	44	Middle

Note : maximum score 100

The increase of % N-gain critical thinking skills that are translated based on the indicators of each of its components, including clarifying problems and questions (CT-1), infer and interpret (CT-2), supports the conclusions and interpretations (CT-3), and evaluating (CT-4) consecutive magnitude of 46%, 50%, 42% and 37%. This indicates an increase % N-gain for each of the indicators of critical thinking skills that are in the middle category. Comparison of % N-gain cognition shown in Figure 1.

The increase of students' critical thinking skills categorized as middle category. However, if observed increase in % N-gain critical thinking skills per indicator there are differences. The percentage of N-gain to summarize and interpret indicators (CT-2) most high at 50%, while the percentage of N-gain to the lowest evaluated indicators, namely 37%.

According to the research findings it can be said that a set of indicators of critical thinking can be expressed in a problem-based learning using problem-based college student worksheets, it turns out the skills of college student in terms of evaluating lower than other indicators of critical thinking. This is because the evaluating activities is the hard part because these activities require college students to be able to evaluate the results of observations, consider the completeness of the solution, conclusions, or interpretations, evaluate new evidence, insight, or modify an investigation when there is evidence and enough reasons to do it.

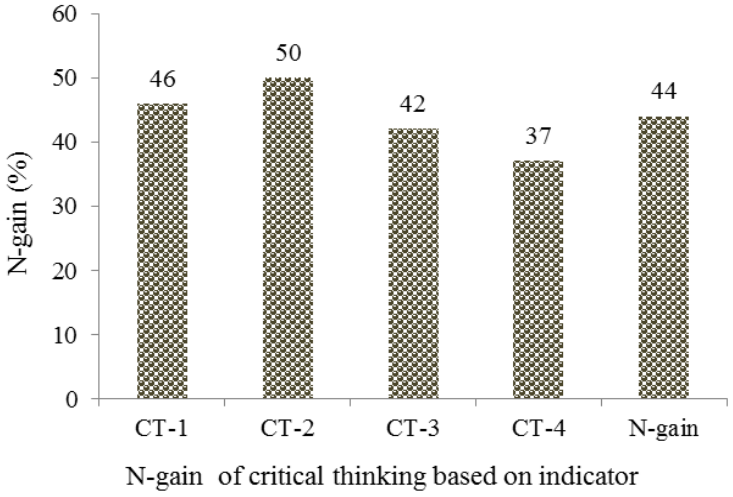

Figure 1. Comparison of % N-gain cognition

The value of pretest and posttest is still low and the percentage of N-gain of critical thinking skills on the development learning model in General Physics based on problem with using college student worksheet is in middle category. This is possible because of college student has never participated the learning like this, they are still really common in this regard. it was clear at the first meet, they are many who asked what is the problem at hand, how to make a hypothesis and how the procedures work solving the problem. But in the next meet, the college student were more familiar. This is was clear because at the next meeting the students were is getting a bit to ask and have started to make hypotheses and troubleshooting procedures so that the learning activities is increasing.

According to the explanation, we can make a conclusion that learning model of general physics that developed with college student's worksheet based on problems can increase the critical thinking skills because with this learning, college students required to make hypotheses before conducting further investigations, choose and write down the tools and Material used in the experiment; determining the variables observed; explain the steps of experiments, create a design drawings; write down observation result; analyzing and making conclusions.

This is supported by [4] states that activity in laboratory experiments intended to train problem solving and critical thinking skills; scientific thinking habits; understand how science and scientists are working; and generate interest and motivation. This is supported by [11] who said through problem-based worksheets, students become more active, learn to solve authentic problems, create a hypotheses before conducting further experiments with the guidance of the lecturer. Problem based learning can help college students to construct knowledge and critical thinking skills compared to traditional learning Mitchell in [8].

4. CONCLUSIONS

The conclusion is based on the research that has been conducted based on limited test outcomes showed that the learning model of General Physics based scientific approach are developed using problem based worksheets can improve of critical thinking skills in the middle category.

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