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THE DEVELOPMENT OF ELECTRIC CIRCUIT'S PRACTICUM BASED ON PROBLEM TOWARD THE SCIENTIFIC INQUIRY SKILL'S OF COLLEGE STUDENT IN ALTERNATING CURRENT TOPIC

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Abstract-The objective of this research is to determine the effect of model scientific inquiry-based on problem to student achievement on scientific inquiry of college student by developing a model of electric circuit’s practicum based on problem. The Method of this research is research and development (R&D) with steps 4D (define, design, develop, and disseminate). Researcher used true experimental method with randomized pretest-posttest control group design in testing of wide scale. Population in this research for testing of wide scale was all of state university of Medan’s student who have contract with electric circuit’s practicum. Sample in this research consist of two groups, experiment group by applying model teaching based on proble, where the number of college student’s was 33 persons and control group by applying conventional teaching, where the number of college student’s was 34 persons. The method which are used to collect data in this research was test organized as essay to measure scientific inquiry achievement. Based on the result in testing of wide scale showed that teaching electric circuit based on problem, which has been developed significanly, has affected the achievement of scientific inquiry of college student. The percentage of college student development N-gain scientific inquiry was 56% in average while in control class 32% in low category. Over all the model of teaching that developed was effectively used in teaching electric circuit’s practicum in alternating current topic.

Keywords: model practicum electric current based on problem, skill scientific inquiry, alternative current flow

1. INTRODUCTION

Education is one of important component in improving the quality of human resources. Education serves to develop skills and character then civilization of the nation's dignity in the context of intellectual life of the nation, aimed for developing student’s potentials in order to become a man who has faith and fear of God Almighty, noble, healthy, knowledgeable, skilled, creative, independent and become citizens of a democratic and accountable.

Learning physics both top-level and higher education, particularly with respect to the process need to be designed with innovative learning models so that the material provided is not only well understood, but also be able to transfer the knowledge they have learned in new situations, which means that the student must can apply their knowledge in solving the problems and can help themselves by using knowledge that already mastered by them in daily life. This transfer capability is the core of learning process and open the possibility to broaden and deepen student’s knowledge based on mastery of general principles.

Physics uses analysis of the situation which more interactive and innovative, especially in modern area that is aimed for helping students to become independent, self-regulated and problem solver [2]. In fact all this time learning process is still teacher centered so it doesn’t provide an opportunity yet for students to develop independently through discovery and thinking process. Traditional learning environments are too abstract and boring, gives a sense of boredom to students and lack of curiosity. All this time the educational results only from the ability to memorize facts, concepts, theories or laws. Although many children are able to present a good level of memorization of the material which they receive, but in fact they often do not understand in depth the substance of the material.

The design of physics learning model, such as good Electric Circuits Practicum must be in accordance with the purpose of learning physics which are set in curriculum, where one of it is the

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ability to do scientific inquiry, such as identifying problems, performing scientific experiments to collect data, applying numerical methods and statistics to reach and support the conclusions, formulating hypotheses and using the available technology.

Electric Circuits Practicum is a compulsory subject that must be taken by second year students. This course aims to familiarize students in addition to the method and laboratory work is also a characteristic of physics as part of the Natural Sciences (IPA). Experiment (practicum) in study of physics is one way to facilitate students to know scientists thought, such as identify problems, formulate hypotheses, conduct scientific experiments, observe, collect data, apply numerical methods and statistics to make conclusions and experience the process of how a concept found. These activities are part of scientific inquiry.

Practicum is intended not only as a way to try something or just to prove that the results have been in accordance with theory and work steps are very detailed but to train students to be able to solve problems related to daily life, particularly Electric Circuits Practicum is closely related to real life problems.

The fact on the field does not correspond to the truth. At the field, Electric Circuits Practicum is more emphasis on proving the theory (verification) with the steps of practicum which is highly procedural (recipe). [4] warned that the procedure in laboratory recipe is (a verification guide) less provide opportunities to process information in depth and the main concern of students is only the completion of practical tasks.

Based on the conditions described above then efforts should be made to implement the learning of Electric Circuits Practicum that can train students scientific inquiry. One of the learning that can train students scientific inquiry is to develop a model of problem-based learning.

[9] which stated in general, laboratory is training with the main focus on the verification or prove the laws, principles or find the facts objectively. In laboratory, students collect data without knowing or understanding the meaning of their activities. The cognitive demands of the lab tasks generated to a minimum level. To prevent the shortage of activities on college, physics lab should be redesigned using problem based learning. [3] said that PBL is a learning which makes the problem as a basis of the learning process in which a given problem is a specific problem. Based on this given problem, students then work in teams, try to solve problems with their capabilities, and at the same time search for new information that is relevant. [1] also found that PBL can develop problem solving skills and to encourage students to learn new concepts when solving problems. Additionally, [7] also said that PBL is more emphasis on ensuring the process and not just a result of learning which is obtained. If the learning process can run optimally then it is most likely the result of learning obtained are also optimal. PBL also provide supplies to students on how to learn for understanding the problem and solve it so that students actually able to acquire the knowledge and experience that is authentic.

The research objective is to determine the effect of problem based learning models against scientific inquiry skills of students through development of models of Electric Circuits Practicum-based problem. The result of this study can be useful to improve the quality of teaching Electric Circuits Practicum in the department of physics FMIPA Unimed.

2. METHODS

Research method that used is research & development through 4-D steps, namely: define, design, develop and disseminate [8]. Define phase is done by collecting a variety of information related to the product being developed. The collection of information is done with a preliminary study through literature and field study. Design phase is done by making the initial draft form of Electric Circuits Practicum-based problem learning model that can increase scientific inquiry and learning tools that support the developed model.

Develop phase is done by validating the draft model that developed to the experts, then revised. Limited scale trials conducted later revised based on the results of the trial. Learning model developed, tested on a wider scale.

Disseminate phase in this research conducted at other universities outside Universitas Negeri Medan in North Sumatra. The end product of research and development in form of learning models of Electric Circuits Practicum-based problem that have been proven to improve student scientific inquiry.

The research results of model development of Electric Circuits Practicum which reported here is still reach at develop phase with large scale trials. Population of large scale trials was all students of physics teacher candidates from Universitas Negeri Medan. Sample of this study consisted of two groups: experimental group by applying problem-based learning model and control group with conventional learning. The method used in large scale trials research was quasi-experimental with pretest-posttest control group design as shown in Table 1. The samples were students taking the course Electric Circuits Practicum at Universitas Negeri Medan in second semester of Academic Year 2015/2016 consisting of two classes which were determined by cluster random sampling. One class was as an experimental group of 33 students by applying the learning model of problem based learning and another class as a control group of 34 students by applying conventional learning. The instrument of scientific inquiry was in form of essay with 8 items on subject of Alternating Current-AC.

Indicators of scientific inquiry skills that will be developed in this research was making a hypothesis, explaining, designing experiments, conducting experiments [10].

Syntax of problem based learning model with scientific approach consists of five phases, namely: Phase 1, orient the students on the problem; Phase 2, organize the students to learn; Phase 3, guiding the investigation of individual and group; Phase 4, develop and present the results of the investigation; and phase 5, reinforcement and follow-up study [2].

Table 1. Control Group of Pretest-Posttest Design

Group	Pretest	Treatment	Posttest
Experiment	O_1	X_1	O_2
Control	O_1	X_2	O_2

Note:
O_1 = pre-test of scientific inquiry
X_1 = problem based learning
X_2 = conventional learning
O_2 = post-test of scientific inquiry

Different test (t-test) was used to determine the effect of learning model against to problem solving skills with the normal distribution of data requirements and homogeneous. Improved problem solving skills was analyzed using normalized gain ratio (N-gain) study results obtained in the experimental class with that obtained in the control class. N-gain was calculated with an equation developed by [6], in which:

$$g = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}}$$

with g is normalized gain, S_{max} is the maximum score (ideal) of the pretest and posttest, S_{post} is the posttest score, while S_{pre} is pretest score. High and low gain which normalized can be classified as follows: (1) if $g > 0.7$, then N-gain resulting in a higher category; (2) if $0.3 \leq g \leq 0.7$; then N-gain resulting in the medium category; and (3) if $g < 0.3$, then N-gain resulting in a lower category.

3. RESULTS AND DISCUSSION

Based on pretest results showed that the experimental class and control class were normal distribution and homogeneous. The average of pretest for experimental class was 25.47 and control class was 23.90. Based on data of pretest using hypothesis test with different test (t-test) showed that experimental class and control student had the initial capability level wass almost same. The average of posttest for experimental class was 73.01 and control class was 46.78. The result of pretest, posttest, normality test, homogeneity and t-test were shown in Table 2. The calculation of normality, homogeneity and t-test for two independent samples (independent samples t-test) using SPSS 15.0.

Table 2. Result of Prestest, Posttest, Normality test, Homogeneity and t-test

Group	Average of Pretest	Average of Posttes	Normality distribution	Variance	*P*
Experiment	27.65	68.47	Normal	Homogeneous	0,000 (significant)
Control	28.01	51.01	Normal		0,000 (significant)

Based on the result of different test (t-test) as shown on Table 2, obtained that there was significant influence from the application of problem-based learning model to scientifc inquiry students on material Alternating Current (AC). Application of problem based learning model was better improve scientifc inquiry than conventional learning.

Model effectiveness test in improving the skill of inquiry scientifc expressed by % N-gain on the topic of Alternating Current (AC). The improvement percentage of scientifc inquiry skill in experimental class was 56%, while in control class was 32%, respectively in the middle category. The average of N-gain of scientifc inquiry skill for an experimental class was larger than the control class. The comparison of the percentage of N-gain of scientific inquiry skill for experimental class and control class was shown in Figure 1.

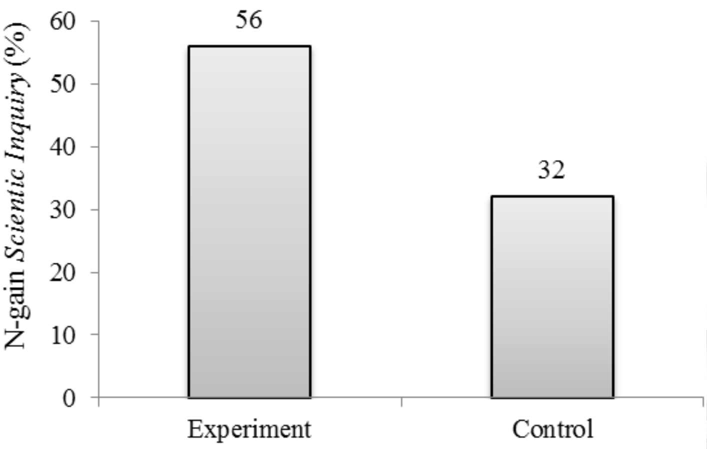

Figure 1. Comparison of Percentage Average of N-gain of scientifc inquiry skill from Both Class

The percentage of N-gain can be described by each indicator of scientific inquiry skill, which is hypothesis (SI-1), explain (SI-2), design the experiment (SI-3), and conduct experiment (SI-4) between the experimental and control group as shown in Figure 2. Based on Figure 2, for an experimental class, % N-gain of scientific inquiry skill on indicator and SI-1 (67%); SI-2 (69%); SI-3 (65%), and SI-4 (56%). The percentage of % N-gain of scientific inquiry skill in indicator SI-1 (37%); SI-2 (41%); SI-3 (35%), and SI-4 (26%). The skill improvement of scientific inquiry was the highest achieved either an experimental group or control group on indicators explained (SI-2) and the lowest on indicators of experiment (SI-4).

Application of problem based learning model give better effect in improving the skills of scientific inquiry compared to conventional learning. This is due to the application of problem-based learning, students were faced with the problem before making further investigations, they have to make hypotheses, selecting tools and lab materials to be used, making strides trial, sketching the design of the experiment, doing experiment and observation, collecting data and analyze it. This is supported by [9] who said that the problem based learning such as inquiry-based learning, where learning was organized to investigate, explain, infer from the problems that matter. In its activities, problem based learning centered for student and occurs in small group under guidance of lecturer. Real world problems faced with the situation of the learning process. To solve the problem, the students proposed a hypothesis, and test the hypotheses through appropriate experimentation design. Laboratory design with problem based learning design is very suitable to practice the scientific inquiry skill.

This is supported by [5] state that experiment in the laboratory is intended to improve the mastery of concepts in science and its applications; problem-solving skill and scientific skills; scientific thinking habits; understand how science and scientists are working; and foster interest and motivation.

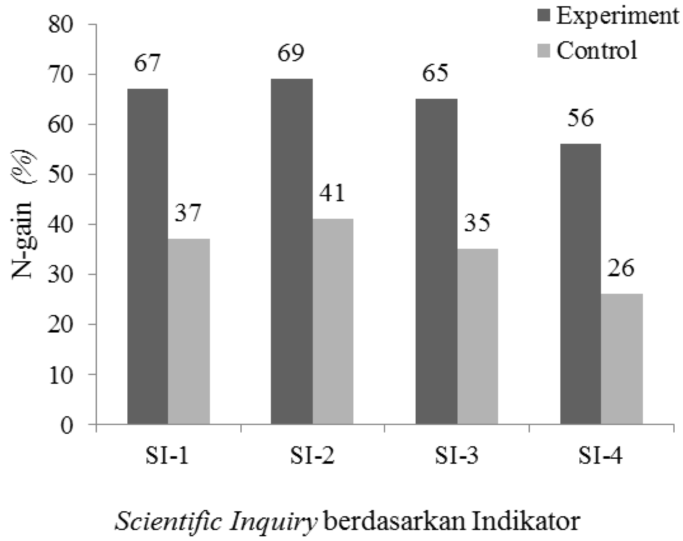

Figure 2. Comparison of Percentage of N-gain based on Indicator of scientific inquiry skills between experimental and control group.

4. CONCLUSIONS

The conclusion which obtained based on the results of research that has been done is as follows: (1) based on research result, it found that there was a significant difference due to the application of problem based learning model against to scientific inquiry skill of students for subject of Alternating Current; and (2) the percentage of scientific inquiry skill improvement for experimental class was higher than control class and included as medium category.

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