THE 4TH ANNUAL INTERNATIONAL SEMINAR ON TRENDS IN SCIENCE AND SCIENCE EDUCATION 2017 State University of Medan November 14th - 15th Grand Mercure Hotel, Jl. Sutomo, No. 1, Medan, Indonesia

The Influence of Problem Based Learning Model on Student's Achievement for Experimental of Electrical Circuit Lecture

Sehat Simatupang[1, a)], Togi Tampubolon[1)], Juniar Hutahaean[1)], and Mariati Purnama Simanjuntak[1)]

[1)]Lecturer from Department of Physics FMIPA Unimed

[a)]corresponding author: simatorop15@gmail.com

ABSTRACT

The objective of this study is to determine the influence of problem based learning model (PBL) forExperimental of Electrical Circuit lecture on student's achievement in the cognitive aspect on thecourse of direct current circuit. Population in this research is all the FMIPA students who taken the Experimental of Electrical Circuit lecture at one ofthe university in Medan. Sample was consisted of two classes, experimental class which applying PBL model for 33 students and control class with conventional learning for 34 students. This research method was conducted with randomized control group pretest-posttest design. The research instrument used was a test of cognitive aspect on the course of direct current circuit as many 25 multiple choices question. Based on the analysis of data using different test (t-test) showed that PBL model couldinfluence the student's achievement. Percentage of N-gain improvement was 46% for experimental class and 36% for control class in medium category respectively. Based on the result of data analysis could be concluded that PBL model was better to improve student's achievement in the cognitive aspect compared to conventional learning.

Keywords: problem based learning model, student's achievement in the cognitive aspect, direct current

INTRODUCTION

Development of science and technology must be equivalent with development of human resources. For that reason,the university aims to form a reliable student such as students who are able to understand the science and technology provided byuniversity and able to develop and realize it in society. Learning science, including physics was more emphasis on process, students are active during learning activity to build knowledge through a series of activities so that learning becomes meaningful for students. In the study of physics, students act as if a scientists, using scientific methods to find answers to a problem being studied. The role of students as if as a scientist means that in learning physics was using the process of science to gain knowledge in form of concepts being studied. This is appropriate with things expressed by Cain & Evans (1990) that science as a product means in science there are facts, laws, accepted theories and science as a process means all activities and attitudes to gain and develop knowledge.

Education program in Department of Physics aims to prepare student who have the knowledge and ability in developing various technologies with the basic of physics and the ability to integrate, connect and realize new physics concepts in various science and technology disciplines. The material presented is expected to be able to be applied in accordance with what has been taught. Therefore, it is necessary to practice a practicum as means of debriefing for the students to apply the knowledge and concepts obtained during the lecture. One of the expertise lecture provided to students is the Experimental of Electrical Circuit. The purpose of this experimental of electrical circuit were: (1) To understand the use of technological equipment and compare it with the concept of technology obtained fromuniversity, especially about Electric Circuit; (2) As a means to train student's skills in using electrical circuit applications in daily life and technology; (3) Initial understanding of the students about electrical circuits as a modal to be able to make an electrical circuit.

Importance of Experimental of Electrical Circuit is not supported by learning process in one of the university in North Sumatra, on lecture of Experimental of Electrical Circuit. Based on the experience ofresearcher and observation on field, found some problems such as the management of this lecture generally still tend to lead to the provision of information so that the learning is still dominated by the lecturers and the lab work is still just prove the theory by following the steps of more detailed. In this learning, student's ideas are less excavated, tend to be passive, less motivate students to learn independently, and knowledge sharing among students is less facilitated.

The process of Experimental of Electrical Circuit in laboratory is more dominant using very detailed practice manuals which leads to less effective learning because students gain physics knowledge which emphasizing evidence of existing theories rather than training their constructs of knowledge whereas they can construct a deeper understanding which will influence of their achievement. Ünal&Özdemir (2013) and Heller & Heller (1999) emphasized that the steps in prescription laboratories (verificativeguides) are less likely to process in-depth information and the student's main concern is the completion of practicum tasks. Development of student's skill through practicum can be done by managing the condition of learning in such a way therefore the students gain experience which can improve the achievement and thinking skills.

One effort that can be done to improve the achievement is through the implementation of problem-based learning (PBL) on lecture of Experimental of Electrical Circuit. The subject of this study is Direct Currentthat is an essential topic for Physics Education Study Program because it is related to the problems of daily and technology.

Problem based learning is defined as a series of learning activities that emphasize the process of solving problems scientifically. PBL is one model that makes students solve problems creatively, actively and appreciate the diversity that arises during the process of solving problems, in other words PBL is a learning model that uses real-world problems as a context for students to learn about problem-solving skills for obtaining information, knowledge

and essential concepts. Problem solving through scientific inquiry can train thinking processes that will improve the achievement.

According to Arends (2008) PBL model was a learning model that organizes learning around questions and problems, through the submission of authentic and meaningful real life situations. The problem presented was a contextual problem or problems that ordinary experienced or observed by students in daily life. Problem-based learning, students are required to solve the problems presented by digging information as much as possible, then analyzed and sought from the solution of the existing problems. The solution of problem is not absolutely has one correct answer, it means that students are also required to learn creatively. Students are expected to be broad-minded individuals and able to see the relationship of learning with the aspects that exist in the environment. Joyce, et al., (2009) stated that PBL is a learning model that involves optimally active students, allowing students to investigate and then integrate it. This model includesthe analysis of information around the problem and performing problem solving analysis.

The constructivism view of PBL model places the student as an active constructor of knowledge flexibly. Knowledge is learned in a meaningful context similar to that of which the student applies their knowledge. PBL also facilitates the development of cognitive learning outcomes and provides intrinsic learning motivation. The lecturer acts as a facilitator in PBL, have a job to help by giving the students with experience in problem-solving design.

Based on the condition of physics learning which has been described above, an effort is made to implement the Experimental of Electrical Circuit that can affect the student'sachievement. The problem-based learning for Experimental of Electrical Circuit is expected to improve student's ability to remember and understand concepts, apply them in daily life, analyze, evaluate and create.

Based on the above description, the purpose of research is to determine the effect of PBL model on student's achievement with application of problem-based learning for Experimental of Electrical Circuit. The material studied in this research is direct current circuit.

MATERIALS AND METHODS

The population in this study is all the FMIPA students who taken the lecture of Experimental of Electrical Circuit in one of the university in Medan. Sample was consisted of two classes, experimental class which applying PBL model for 33 students and control class with conventional learning for 34 students. This research method was conducted with randomized control group pretest-posttest design. The research instrument used was a test of cognitive aspect on the course of direct current circuit as many 25 multiple choices question which has been validated. The research design used can be seen in Table 1.

Table 1.Research Design of Control Group Pretest-Posttest

Class	Pretest	Treatment	Posttest
Experiment	T_1	X	T_2
Control	T_1	Y	T_2

Note :
T_1 = pretest
T_2 = posttest
X = treatment with PBL learning model
Y = treatment with conventional learning

The syntax of problem-based learning model with scientific approach consists of five phases, namely: phase 1, orienting the student on the problem; phase 2, organizing students to study; phase 3, guiding individual and group investigations; phase 4, developing and presenting the results of investigation; and phase 5, strengthening and follow-up learning (Arends, 2004)

Indicators of learning outcomes in this study: remember, understand, apply, analyze, evaluate, and create (Anderson &Krathwohl, 2001). Based on the indicators and problem-based learning model, the multiple choice test items were developed with five options totaling 26 items on the topic of direct current.

Different test (t-test) is used to know the influence of learning model on problem solving skills with normal and homogenous distribution data. Improved problem-solving skills were analyzed by using a normalized gain ratio (N-gain) learning outcomes obtained in experimental class with those obtained in control class. N-gain is calculated by the equation developed by Meltzer (2002), where:

$$g \qquad (1)$$

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

RESULTS AND DISCUSSION

Based on result of pretest obtained that the experiment class and control class were normal and homogeneous distributed. The average of pretest in experimental class was 33.82 and control class was 30.71. Based on pretest data using hypothesis test with different test (t-

test) showed that the students in experiment and control class had similar initial skill level. The average of posttest of experiment class was 64.48 and control class was 56.35. The results of pretest, posttest, normality test, homogeneity and t-test were shown in Table 2. Calculation of normality, homogeneity and t-test for two independent samples t-test using SPSS 15.0.

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

Class	Average of Pretest	Average of Posttest	Normality Distribution	Variant	*P*
Experiment	33.82	64.48	Normal	Homogeneous	0.000 (significant)
Control	30.71	56.35	Normal		0.000 (significant)

Based on the different test results (t-test) as shown in Table 2, it was found that there was a significant effect due to the application of PBL model to the student's achievement on Direct Current (DC) course. Application of PBL model was better to improvestudent's achievement in the cognitive aspect compared with conventional learning. Comparison of student's achievement averagefor cognitive aspect in experiment and control class was shown in Figure 1.

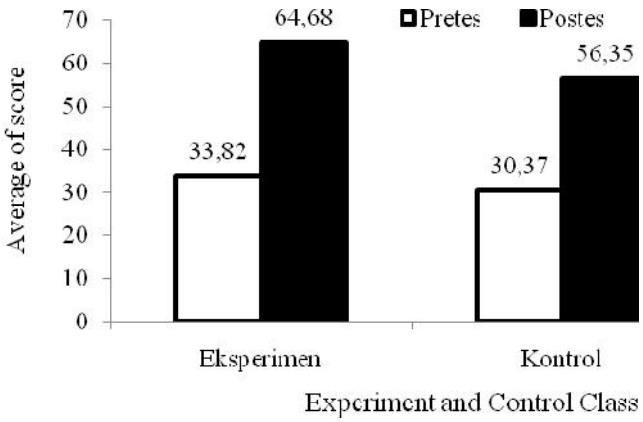

Figure 1. Comparison of student's achievement average for cognitive aspect in experiment and control class

The trial of model effectiveness in improving student's achievement for cognitive aspect was expressed by% N-gain on the course of Direct Current (DC). The percentage of student's achievement improvement for cognitive aspect in experiment class was 46% while in control class 36% which in medium category respectively. The student's achievement average of N-gain in cognitive aspect for experiment class was higher than control class. The comparison of average fromN-gain percentage of student's achievement for cognitive aspect in experiment and control class was shown in Figure 2.

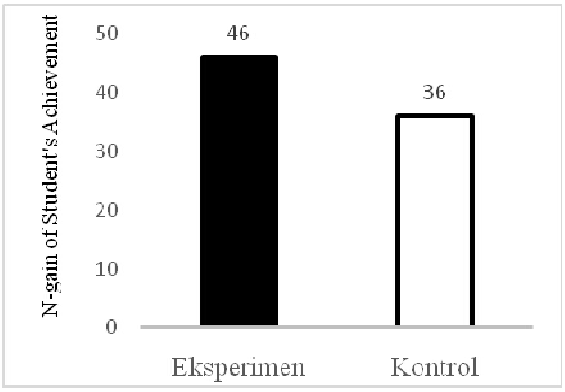

Figure 2. Comparison of Average from N-gain percentage of student's achievement for cognitive aspect in both class.

The percentage of N-gain can be described based on each indicator namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), and creating (C6) between experiment and control class shown in Figure 3. The highest improvement of student's achievement achieved by both experiment and control class was on remembering (C1) indicator and the lowest on evaluating indicator (C5).

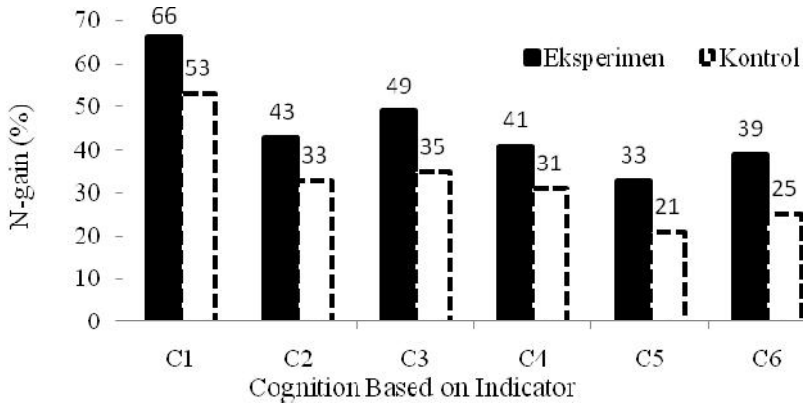

Figure 2. Comparison of percentage of N-gain based on student's achievement indicator for cognition aspect between experiment and control class

The application of PBL model had a significant influence on student's achievement compared to conventional learning. In other words, the application of PBL model was better than the conventional learning in Experimental of Electrical Circuit for Direct Current (DC) course.

PBL model was better in improving student's achievement for cognitive aspect compared with conventional learning. This was due to the application of PBL, the students were faced with the problem before conducting the investigation through the experiment, the student first made hypothetical of the problems encountered, designed and done the experiment, collected and analyzed the data, evaluated the results and made the product. Stages of this activity that makes the memory and understanding of students more profound, can apply concepts in daily life, analyze, evaluate and create. In other words, the application of PBL can affect student's achievement.

This was supported by Kharida, et al., (2009) which stated that the problem-based learning model could improve student's achievement on the course of Material Elasticity. Dwi, et al., (2013) suggested that applying PBL model based on ICT could influence the student's understanding of concept and problem-solving abilities. Hofstein&Mamlok-Naaman (2007) stated that laboratory experiments were intended to enhance the mastery of concepts in science and its applications; ability to solve problems and scientific skills; habits of scientific thinking; understand how science and science work; and foster interest and motivation.

CONCLUSION

The conclusions obtained based on the results of research that has been done is as follows: (1) Based on the results of research, it was found that there was a significant influence due to the application of problem based learning model on student's achievement for cognitive aspect of students on course of Direct Current, (2) The percentage of improvement for student's achievement in experiment class was higher than control class and included as medium category.

ACKNOWLEDGEMENT

Sincere gratitude was submitted to the Director General of Higher Education who had provided funding to support the implementation of this competing grant research with letter of agreement numbered 206A/UN33.8/PL/2017.

REFERENCES

[1] Anderson, L.W. & Krathwol, D.R. (eds). (2001). *A Taxonomy for Learning Teaching and Assessing*. A Revision of Bloom's Taxonomy of Educational Objectives. New York: Addison Wesley Longman, Inc.
[2] Arends, R.I.,(2008). *Learning to Teach*. Seven Editions.New York:McGraw-Hill.
[3] Arends, R. I., (2004). "*Learning to Teach,"* 5th Ed. Boston: McGraw Hill.
[4] Cain, S. E & Evans, J. M. 1990. *Sciencing, An Involvement Approach to Elementary Science Methods.* Columbus: Merril Publishing Co.

[5] Dwi, I. M., Arif, H., dan Sentot, K. (2013). Pengaruh Strategi Problem Based Learning Berbasis ICT terhadap Pemahaman Konsep dan Kemampuan Pemecahan Masalah Fisika. Jurnal Pendidikan Fisika Indonesi, 9(8-17).

[6] Heller, K., & Heller, P. *Problem-Solving Labs*. Introductory Physics I Mechanics. Cooperative Group problem-solving in physics, 1999.

[7] Hofstein, A. & Mamlok-Naaman, R. (2007). The laboratory in science education: The State of the Art *Journal The Royal Society of Chemistry Education Research and Practice*,8 (2), 105-107 .

[8] Joyce, B., Marshe Well, and E Calhoun. 2009. *Models of Teaching (8 th ed).* Boston: Allyn & Bacon.

[9] Kharida, L. A., Rusilowati, A., dan Pratiknyo, K. (2009). Penerapan Model Pembelajaran Berbasis Masalah untuk Peningkatan Hasil Belajar Siswa pada Pokok Bahasan Elastisitas Bahan. *Jurnal Pendidikan Fisika Indonesia,* (5), 83-89.

[10] Meltzer, D. E. (2002). "The Relationshif between Mathematics Preparation and Conceptual Learning Gain in Physics: A Possible Hidden Variable in Diagnostic Pretest Score",*American Journal Physics*, 70(2), pp.1259-1267.

[11] Ünal, C. & Özdemir, Ö. F. (2013). A Physics Laboratory Course Designed Using Problem-Based Learning For Prospective Physics Teachers. *European Journal of Science and Mathematics Education, 2013;* 1(1) 29-33.