Application of the Problem-based Learning Model in the Engineering Drawing Course of Building Engineering Education Students, Faculty of Engineering, Semarang State University, Class of 2021

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ABSTRACT

Technical drawing is one of the compulsory courses in the Building Engineering Education study program curriculum, Faculty of Engineering, Semarang State University. This technical drawing course contains a scope of basic drawing materials such as drawing functions, drawing components, drawing scales, types of drawings, manual drawing tools, drawing symbols and projection drawings (orthogonal, isometry, dimetry and trimetry). The Problem Based Learning model is a learning method with a focus on real problem solving, the process in which students carry out group work, feedback, discussion, observation and making final reports, thus students will be more actively involved in learning materials and develop skills and critical thinking. The application of the Problem Based Learning model in this study aims to determine how much the increase in learning outcomes in the cognitive, affective, and psychomotor domains in students of the Building Engineering Education Study Program Class of 2021. This research uses experimental research methods. The experimental design used is Quasi Experimental Design or pseudo-experiment. The pseudo-experimental design used is Nonequivalent Control Group Design. The subjects of the study were 64 students of the Building Engineering Education Study Program Class of 2021 by dividing two groups as an experimental group and a control group. The data collection method uses documentation, test, and observation methods. The data analysis technique uses a similarity test of two averages (T Test). The calculation results of the two-average similarity test showed that the problem-solving ability of the experimental class students was better than that of the control class. Mastery of the Problem Based Learning model can improve learning outcomes in the cognitive, affective and psychometric domains, shown in the percentage of completeness of the average value of learning outcomes with an average of 86.98. Judging from the average in the cognitive realm, the experimental class was obtained 87.44, the control class 85.22, in the affective realm, the experimental class 88.27, the control class 84.82, while in the psychomotor realm, the experimental class 88.80, the control class 88.44.

Keywords: *Learning Outcomes, Learning Process*, *Project Based Learning.*

1. INTRODUCTION

Learning strategy is a series that contains a design of activities to support the running of the learning process. The learning process is a process in which there are interaction activities between teachers and students and mutual communication that takes place in educational situations to achieve learning goals [1]. Learning objectives can be achieved if the material can be delivered and can be accepted by students according to the targeted achievements. In the learning process, certain strategies are needed through learning models that are in accordance with the material so that the learning process can take place effectively so that learning objectives can be achieved [2][3].

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Technical drawing is one of the compulsory courses in the Building Engineering Education study program curriculum, Faculty of Engineering, Semarang State University. This technical drawing course contains a scope of material such as the basics of drawing, namely drawing functions, drawing components, drawing scales, types of drawings, manual drawing tools, drawing symbols and projection drawings (orthogonal, isometry, dimetry and trimetry). One of the efforts to create an effective learning process, the strategy in the learning process in this technical drawing course is the Problem Based learning model [4][5][6].

Problem-based learning as student-centered learning in accordance with the principles of constructivism. The principle of constructivism is that students can build their knowledge through a given problem. Problem-based learning (PBL) is considered a student-centered instruction approach in which inspired students to apply critical thinking through simulated problems in order to study complicated multifaceted, and practical problems that may have or not have standard answers". PBL is a pedagogical approach that allows students to learn while being actively involved in solving problems, thus it can be concluded that problem-based learning is a learning method with a real problem-solving focus, a process where students carry out group work, feedback, discussion, observation and making final reports, thus students will be more actively involved in learning materials and developing skills and critical thinking. This is expected to add effectiveness to the learning process of the Technical Drawing course so that the learning objectives can be achieved with maximum results [5][6][7][8].

The step in selecting a problem-based learning model in this Technical Drawing course is that the lecturer analyzes the characteristics of the material, analyzes the characteristics of students, then determines the model that suits the material presented [9][10][11].

2. METHOD

The research method used in this study is experimental research with the experimental design used is Quasi Experimental Design. Experimental research is a systematic method to build relationships that contain cause and effect through manipulation, control and observation steps, and pseudo-experimental design is a research design that has a control group, but cannot function fully to control outside variables that affect the implementation of experiments

. The research design used was Nonequivalent Control Group Design, where the experimental group and control group were not randomly selected. The experimental and control groups carried out initial tests. Both groups received different treatment, where the experimental group used a problem-based learning model and the control group used a lecture model and ended with a final test for each group.

Table 1. Research Methods

E	O_1	X_1	O_2
K	O_3	X_2	O_4

Information:
E : Experimental Class
K : Control Class
O1 : Initial test (before treatment) in the experimental group
O2 : Final Test (after treatment) in the experimental group
O3 : Initial test (before treatment) in the control group
O4 : Final Test (before treatment) in the control group
X1 : Application of problem-based learning models
X2 : Application of conventional models

In this study, the form of test questions used is a description test, the selection of questions with this description form aims to find out how far students can understand the material. This test instrument is used during the pretest and posttest with the characteristics of the questions on each test are identical. The first test (pretest) was given before the two groups were subjected to treatment (treatment) which in this case was a problem-based learning model in the experimental class and a lecture learning model in the control class. The second test (posttest) is given after the treatment (treatment) is applied to the experimental class and the control class. The next step is to compare the results of the pretest and posttest for each class, this is done to find out whether the application of the problem-based learning model in the experimental class can improve the ability of students [13][14][15].

The steps taken in testing research instruments are instrument validity tests, instrument reliability tests, instrument difficulty tests, instrument differentiating power. Data analysis is carried out by normality test, homogeneity test, then hypothesis test. Test the hypothesis using the t-test, which is a difference test of two averages, is used to test the hypothesis of whether learning with the application of the problem-based learning model is better than learning with application lecture learning model. Therefore, the formula used is as follows:

$$t = \frac{X_1 - X_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Information:

X1 : average gain score of the experimental group
X2 : average gain score of the control group
N1 : number of experimental class learners
N2 : number of control class learners
$S^2 1$: variance of experimental group scores
$S^2 2$: control group score variance

3. RESULTS AND DISCUSSION

The results of this study showed differences in the average learning outcomes of experimental classes given treatment with problem based learning models with control classes with lecture learning model treatment. Some of the steps taken in this study are (1) Testing pre-test questions to students in the treatment class and also the control class; (2) The results of the pre-test treatment class and control class are tested by a different test, namely the t-test. to find out the absence of significant differences; (3) After being tested the treatment class and the control class have no difference, the two classes can be carried out the learning process according to the learning model of each class. If the test results are different, the experiment cannot continue; (4) After the treatment class and control Classes are given the treatment of learning models. Next steps to test post test; (5) The results of the post test of the treatment class and the control class are tested again with a difference test (t-test) to determine whether there is a significant difference; (6) The last step is to test the learning process by calculating the gain score and the pre test and post test difference test to find out that the process is significant or not can improve learning outcomes.

The calculation results of the similarity test of two averages with the t-test showed that the problem-solving ability of the experimental class students was better than that of the control class. Mastery of the Problem Based Learning learning model can improve learning outcomes in the cognitive, affective domains and psychometrics, shown in the percentage of completeness of the average value of learning outcomes with an average of 86.98. Judging from the average in the cognitive realm, experimental class 87.44 control class 85.22, in the affective realm experimental class 88.27 control class 84.82, while in the psychomotor realm experimental class 88.80 control class 88,44.

Based on the results of the study, it can be concluded that the Application of the Problem Based Learning Model in the Engineering Drawing Course of Building Engineering Education Students, Faculty of Engineering, Semarang State University, Class of 2021 can improve student learning outcomes in the cognitive, affective and psychomotor domains. This proves that the Problem Based Learning model can be applied to technical drawing lecture material where PBL is a pedagogical approach that allows students to learn while being actively involved in solving problems, in the technical drawing course lecturers provide the subject matter in the form of understanding types, benefits and objectives. One of the outputs in the technical drawing course is that students are able to understand the function of drawings, drawing components, drawing scales, types of drawings, manual drawing tools, drawing symbols and projection drawings (orthogonal, isometry, dimetry and trimetry) by proving their ability through a large task, namely drawing practice. In the learning process, both theory and practice, the Problem Based Learning model is able to increase the effectiveness of learning [10][11][12].

4. CONCLUSION

Based on the results of the study, it can be concluded that the Application of the Problem Based Learning Model in the Engineering Drawing Course of Building Engineering Education Students, Faculty of Engineering, Semarang State University, Class of 2021 can improve student learning outcomes in the cognitive, affective and psychomotor domains. It can also be concluded that the learning model applied to the learning process must be adjusted to the type of learning material taught.

REFERENCES

[1] W. Aisyah, Pembelajaran melalui model PBL (Problem Based Learning) dalam upaya meningkatkan mutu Pendidikan. http://Wianti.multiply.com./journal/item/7

[2] S. Arikunto, Dasar-dasar Evaluasi Pendidikan, Penerbit Bumi Aksara, Jakarta, 2011.

[3] Anitah, dkk, Strategi Pembelajaran, Jakarta: Departemen Pendidikan Nasional, 2019.

[4] S. Amri, Pengembangan & Model Pembelajaran dalam Kurikulum 2013, Jakarta: Prestasi Pusatak Publisher, 2013.

[5] R. I. Arends, Learning to teach: Belajar untuk Mengajar, Yogyakarta: Pustaka Pelajar, 2018.

[6] S. Arikunto, Dasar-dasar evaluasi pendidikan, Jakarta: Bumi Aksara, 2020.

[7] A. Cahyono, Pengembangan perangkat pembelajaran problem-based learning berorientasi pada kemampuan berpikir kreatif dan inisiatif siswa, Pythagoras: Jurnal Pendidikan Matematika, 12 (1), 2017, pp. 1-11.

[8] Fathurrahman, dkk, Strategi Belajar Mengajar, Bandung: PT Refika Aditama, 2020.

[9] H. Lukmanul, Perencanaan Pembelajaran. Bandung: CV Wacana Prima, 2019.

[10] Hamdani, Strategi Belajar Mengajar, Bandung: Pustaka Setia, 2020.

[11] I. M. Lena, I. A. Anggraini, W. D. Utami, S. B. Rahma, Analisis minat dan bakat peserta didik terhadap pembelajaran, Terampil: Jurnal Pendidikan dan Pembelajaran Dasar, 7(1), 2020, pp.23-28.

[12] A. Y. Wang, Contexts of creative thinking: A comparison on creative performance of student teachers in Taiwan and the United States, Journal of International and cross-cultural studies, 2(1), 2011, pp.1-14.

[13] A. E. C Sotos, S. Vanhoof, W. Van den Noortgate, P. Onghena, Students' misconceptions of statistical inference: A review of the empirical evidence from research on statistics education, Educational research review, 2(2), 2007, pp.98-113.

[14] M. Ansori, Metode Penelitian Kuantitatif Edisi 2, Airlangga University Press, 2020.

[15] M. Anshori, S. Iswati, Metodologi Penelitian Kuantitatif: Edisi 1, Airlangga University Press, 2019.