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The Learning Outcomes's Increasing Of Basic Engineering Mechanics Students Of Civil Engineering Study Program Through The Project Based Learning (PjBL) Model

Muhammad Rahman Rambe[1)], Rizky Febriani Pohan[2)]
[1,2)] Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University, Padangsidimpuan

[*]Coresponding Author
Email : rambe.rambemuhammad@gmail.com

Abstract

Basic Engineering Mechanics is a science that plays an important role in civil engineering disciplines, especially in the construction sector. In studying Basic Engineering Mechanics, a Project Based Learning model is needed that can help students to more easily apply it. This study aims to determine the increasing in learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students through the application of Project Based Learning model. The type of research to be conducted is experimental research using the pretest-posttest control group design. The research subjects were students of the Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan for first semester in Academic Year 2021-2022, totaling 60 people. Research instrument in the form of pre-test and post-test. The data analysis technique used in this research is comparative descriptive analysis, while the increasing in student learning outcomes through the application of Project Based Learning (PjBL) model is calculated using g-factor (normalized gain score). Based on the research results obtained, it can be concluded that the Project Based Learning model can increase the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students by 37.74%. While the conventional learning model can only increase the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students by 31.41%. So that the Project Based Learning model is more effectively used in Basic Engineering Mechanics courses than conventional learning model.

Keywords: increasing, learning outcomes, Project Based Learning, Basic Engineering Mechanics

INTRODUCTION

One of the subjects that must be followed by students of Civil Engineering Study Program is Basic Engineering Mechanics. Basic Engineering Mechanics is the study of the forces acting on construction with the principle of balance of forces. In Basic Engineering Mechanics, there are solutions with determinate static methods and solutions with indeterminate static methods. To more easily understand and learn Basic Engineering Mechanics, students of Civil Engineering Study Program are expected to first understand and understand vector material in mathematics (Wesli, 2012).

Experience and facts during lectures, there are still errors mistakes made by students in solving course questions low learning outcomes of Basic Engineering Mechanics are as follows: (1) Students do not master the prerequisite material for Basic Engineering Mechanics that they have studied before; (2) Students do not master and understand the concepts of Basic Engineering Mechanics steadily; (3) Students who are less able to study independently, still use the rote method; (4) Students are less careful and thorough in working on the questions. The number of mistakes made by students in working on the questions can be an indication of the extent of their mastery of the existing materials. From the mistakes made, a learning model can be applied that can overcome the problems faced by students while studying Basic Engineering Mechanics (Nugraheni, 2017).

Basic Engineering Mechanics is a science that plays an important role in the field of construction and underlies the development of modern technology. In addition, Basic

Engineering Mechanics also has an important role in civil engineering disciplines and develops human thinking power. Thus, we need a learning model that can help students learn it more easily. The Project Based Learning model is the right solution to increase the success of students learning Basic Engineering Mechanics (Nurfitriyanti, 2016). The success of student learning can be seen from the increasing of learning outcomes through the application of Project Based Learning model (Surya, 2018).

Project Based Learning is a learning model that focuses on the main (central) concepts and principles of a discipline, involves students in problem solving activities and other meaningful tasks, provides opportunities for students to work autonomously and ultimately produces work products (project result). So this learning model has enormous potential to make learning experiences more interesting and meaningful (Erisa et al., 2021). Thus, this learning model is expected to increase learning outcomes of Basic Engineering Mechanics for students of the Civil Engineering Study Program.

Project Based Learning model is an innovative learning centered on students (student centered) and places lecturers as motivators and facilitators (Anggraini & Wulandari, 2021). Project Based Learning (PjBL) provides an opportunity for students to determine the project they will work on, both in terms of formulating questions to be answered, choosing topics to be researched, or determining research activities to be carried out. The role of the lecturer in learning is as a facilitator, providing materials and work experience, encouraging students to discuss and solving problems and ensuring students remain enthusiastic during project implementation (Sudrajat & Budiarti, 2020).

This learning model has been widely applied in the world of education, starting from the elementary school to university level. The success of the Project Based Learning model in increasing student learning outcomes is shown by the research of Fatmawati et al. (2014), which stated that student learning outcomes in Food Technology courses increased by 15.21% through the application of Project Based Learning model. In addition, research conducted by Assidik (2018) also shows that the Project Based Learning model can increase student learning outcomes in Learning Media course by 11.90%.

Therefore, the authors are interested in applying this Project Based Learning model in the Basic Engineering Mechanics course. So that through this learning model, the learning outcomes of Basic Engineering Mechanics students of Civil Engineering Study Program can increase. The purpose of the research to be carried out is to find out if there is an increase in the learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students through the application of Project Based Learning model. Thus, through the research results obtained, the Project Based Learning model can be applied to other subjects, especially those based on civil engineering.

RESEARCH METHODS

The type of research to be conducted is experimental research. Experimental research is a research that is used to find the effect of certain treatments on others under controlled conditions. Thus, experimental research is always carried out by giving treatment to the research sample and then seeing the effect of the treatment (Sugiyono, 2012). The design used in this study was the pretest-posttest control group design. In this design, subjects were selected and divided into two groups (experimental group and control group) randomly and given pre-test and post-test. However, only one group was given the treatment. The pre-test was carried out at the beginning of the study and the post-test was carried out after the study was completed (Fitrianingsih & Musdalifah, 2015).

The population of this research is all of the first semester students of Civil Engineering Study Program in Academic Year 2021-2022. Due to limited time, funds, manpower, and facilities to support this research, the students studied were only the first semester students of the Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan in Academic Year 2021-2022, totaling 60 people, consisting of 40 males and 20 females. The university was chosen as research site to make it easier for researchers to determine the sample (Pohan, 2020).

The instrument used in this research is a test. The tests carried out consisted of two kinds of tests, namely the initial test (pre-test) and the final test (post-test). The test is in the form of a multiple choice test and is a written test. Validation of the test instrument was carried out by testing the validity, reliability, discriminating power and level of difficulty of the questions. Pre-test is a type of initial ability test that is carried out before students experience the learning process in a course. Pre-test aims to determine the ability of students with regard to the competence or teaching materials to be studied. The information obtained from the pre-test can be used to determine policies in carrying out learning activities.

The pre-test was conducted before the students were given treatment. This test is used to get an idea of the level of student ability, then it is used as a reference to carry out Project Based Learning (PjBL) for the experimental group. While the post-test is given at the end of the lesson. This test is used to get an overview of student learning outcomes as a whole after experiencing the application of Project Based Learning (PjBL) model compared to conventional learning models (Pohan, 2020).

The data analysis technique used in this research is comparative descriptive analysis, which is to compare the test scores before the Project Based Learning (PjBL) model is applied and the test scores after the Project Based Learning (PjBL) model is applied. Analysis of research data in the form of pre-test and post-test learning outcomes data from the experimental group and control group (Janah et al., 2019). Then calculate the increase in student learning outcomes through the application of Project Based Learning (PjBL) model using g-factor (normalized gain score) so that the objectives of this study are answered.

RESULTS AND DISCUSSION

Description of Control Group Learning Outcomes

The control group is a group that is given conventional learning (without treatment). The learning outcomes of the control group can be seen based on the pre-test and post-test scores obtained. The pre-test was carried out before learning (at the beginning of the study) while the post-test was carried out after learning (after the research was completed). The pre-test results obtained describe the initial abilities of students in the control group, while the post-test results describe the final abilities of students in the control group after being given conventional learning. The results of the pre-test and post-test in the control group are briefly presented in Tables 1 and 2 below.

Table1. Statistics of Control Group Pre-test Results

Statistic	Pre-test Result
Statistics Sample Size	30.00
Mean	63.17
Median	62.50
Mode	50.00
	60.00
Standard Deviation	11.78
Lowest Score	40.00
Highest Score	85.00

Table 2. Statistics of Control Group Post-test Results

Statistic	Post-test Result
Statistics Sample Size	30.00
Mean	73.17
Median	72.50
Mode	60.00
	70.00
Standard Deviation	11.78
Lowest Score	50.00
Highest Score	95.00

Based on Tables 1 and 2 above, it can be explained that the average value of the pre-test and the average value of the post-test are 63.17 and 73.17, respectively. This shows that the average value obtained by the control group in the pre-test and post-test has increased by 10 after learning with the conventional model. Although student learning outcomes increase after conventional learning is carried out, the results are still not optimal because monotonous students still depend on lecturers so that the level of creativity and discipline in doing the tasks given is very low. Thus, a Project Based Learning model is needed to reconstruct the learning carried out so that students become more independent, creative and disciplined in doing the assigned tasks.

Description of Experimental Group Learning Outcomes

The experimental group is a group that is given Project Based Learning. The learning outcomes of the experimental group can also be seen based on the pre-test and post-test scores obtained. The pre-test was carried out before learning (at the beginning of the study) while the post-test was carried out after learning (after the research was completed). The pre-test results obtained describe the initial abilities of students who are in the experimental group, while the post-test results describe the final abilities of students who are in the experimental group after being given Project Based Learning. The results of the pre-test and post-test in the experimental group are briefly presented in Tables 3 and 4 below.

Table 3. Statistics of Experimental Group Pre-test Results

Statistic	Pre-test Results
Statistics Sample Size	30.00
Mean	73.50
Median	77.50
Mode	80.00
	85.00
Standard Deviation	13.34
Lowest Score	40.00
Highest Score	90.00

Table 4. Statistics of Experimental Group Post-test Results

Statistic	Post-test Results
Statistics Sample Size	30.00
Mean	83.50
Median	87.50
Mode	90.00
	95.00
Standard Deviation	13.34
Lowest Score	50.00
Highest Score	100.00

Based on Tables 3 and 4 above, it can be explained that the average value of the pre-test and the average value of the post-test are 73.50 and 83.50, respectively. This shows that the average value obtained by the experimental group in the pre-test and post-test has increased by 10 after learning with the Project Based Learning model. Thus, the Project Based Learning model is proven to be able to increase the learning outcomes of Basic Engineering Mechanics for students of the Civil Engineering Study Program. The results of this study are not much different from the research conducted by Oktaviani & Marliana (2021), which shows that the Project Based Learning model can increase student learning outcomes in the ICT-Based Indonesian Language Editing course by 16.67.

Increasing Learning Outcomes of Basic Engineering Mechanics of Civil Engineering Study Program Students Through Project Based Learning Models

The increase in Basic Engineering Mechanics learning outcomes for Civil Engineering Study Program students can be calculated using g-factor (normalized gain score) (Ananda & Fadhli, 2018). Based on the results of the g-factor calculation on the learning outcomes of the control group and the experimental group, it was found that the resulting g-factor values were 0.3141 and 0.3774, respectively. From the g-factor criteria, it can be explained that the g-factor values obtained from the two groups are in the moderate category (Jusmawati et al., 2020).

Discussion

Based on the results of the research above, it can be explained that the average pre-test and post-test scores obtained in the experimental group were higher than the average pre-test and post-test scores of the control group. This shows that the learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students who are taught through Project Based Learning are better than the learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students who are taught through conventional learning.

To find out the magnitude of the increase in learning outcomes of Basic Engineering Mechanics students of the Civil Engineering Study Program used the percentage increase in learning outcomes. From the calculation results of increased learning outcomes, it was found that the increase in learning outcomes for the control group was 31.41% using the conventional learning model, while the increase in learning outcomes for the experimental group was 37.74% using the Project Based Learning model (Pohan, 2017). The results of this study are not much different from the research conducted by Hutapea & Simanjuntak (2017), which showed that the Project Based Learning model was able to increase high school student's physics learning outcomes by 41%.

The results of Mukhlisin's research (2022) show that the Project Based Learning model is able to increase the science learning outcomes of elementary school students by 35.51%. Uyun's research (2015) also shows that the Project Based Learning model is able to increase science learning outcomes for sixth grade elementary school students by 40%. The same thing was also shown by the research of Sudrajat & Budiarti (2020), which showed that the Project Based Learning model was able to increase the social studies learning outcomes of fourth grade elementary school students by 37%. So it is clearly proven that the Project Based Learning model is able to increase learning outcomes effectively and optimally.

Based on the research results obtained, it can be seen that the learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students who are taught through Project Based Learning are better than the learning outcomes of Basic Engineering Mechanics of Civil Engineering Study Program students who are taught through conventional learning. This is possible because with the application of Project Based Learning model, students will be involved in problem solving activities and other meaningful tasks. Thus,

providing opportunities for students to work autonomously and ultimately produce work products (project results). So this learning model has enormous potential to make learning experiences more interesting and meaningful (Erisa et al., 2021).

From the results of data analysis, it can be concluded that the Project Based Learning model is more effectively used in the Basic Engineering Mechanics course than the conventional learning model. Because this learning model has advantages when compared to conventional learning models, among others: students can work autonomously and be involved in problem solving and other meaningful tasks. So that student creativity increases through the application of this learning model (Sari & Angreni, 2018). With the increase in student creativity, student learning outcomes will also increase due to the development of self-skills (soft skills) they have. Therefore, the Project Based Learning model is very suitable to be applied to the Basic Engineering Mechanics course.

CONCLUSION

Based on the research results obtained, it can be concluded that the Project Based Learning model can increase the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students by 37.74%. While the conventional learning model can only increase the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students by 31.41%. This increase in learning outcomes can be seen through the average pre-test and post-test scores obtained by the control group and the experimental group, where the average pre-test and post-test scores of the experimental group are higher than the average pre-test and post-test scores of the control group. So that the Project Based Learning model is more effectively used in Basic Engineering Mechanics courses than conventional learning models.

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