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The Effect of Project Based Learning as Learning Innovation in Applied Physics

Chairatul Umamah[1)], Herman Jufri Andi[2)]

1Physics Education Study Program, Faculty Of Teacher Training And Education, Madura Islamic University
JL.PP Miftahul Ulum Betet Pamekasan, Madura

[1)] chairatul.physics@gmail.com [2)] hermjufriandi@gmail.com

Abstract. This study aims to identification the effect of project-based learning model for student learning out comes in applied physics. This study confirm the student learning out comes before treatment and after treatment. This study is an experimental research with pretest posttest control group design. The experimental method which used was quasi experimental with pretest-posttest control group design. In this study, there are two classes will be used, one class is given an experimental treatment and one class is treated as a comparison. One class that were given experimental treatment were taught using project based learning (PjBL) model, and other class treated as a comparison (control) was taught using inquiry learning models. Experiment class is consist of 22 students and control class consist of 22 students. At the end of learning evaluation is done by giving posttest, then the data obtained from the evaluation questions in the experimental and control classes are analyzed with appropriate statistics. The results of normality test of experimental class data and control class are normally distributed. The results of homogeneity test is homogeneity. And hypothesis test, it indicated that there is an influence of the project based learning learning model on achieving student learning outcomes. it can be concluded that experiment class has achievement of learning outcomes that are significantly higher than the control class.

Keywords:

INTRODUCTION

Education serves to help student in their self development, namely the development of all potential skills and personal characteristics to be positive, both for their self and their environment. Education was developed as an instrument to guide student being qualified human which capable and respond proactively to answer the ever changing of modern era[2]. The development is done to create competent and characterized generation in carry out activities in accordance with their expertise. In globalization era, competition in education is getting complicated. Only competence people who can survive in competition, that is why Madura Islamic University (UIM) started the process towards a world class university. In order to improve the quality of education towards world class university (WCU), it takes more efforts, both on academic activities, as well as on efforts to improve quality in all aspects of campus activities. Improving learning quality of learning in study program both in terms of materials, processes, and evaluation is one of the main factors that must be done to development academic process[10].

One of activities to support world class university program is improving the quality of learning, include in Applied Physics courses. Applied Physics Course is connecting course between theory and application that requires critical thinking skills, high creativity and good physical concepts in producing contextual work both individually and groups. The result of work will be evaluated through skills competency assessment with practice and project tests. This course emphasizes that students can be innovation in applied of physics that they have learned.

The findings stated that learning activities in some subjects for Physics Education study Program include Applied Physics are generally the implementation in class is teacher centered learning (TCL). Actually, learning process is

depend on the role of lecture in present information, lecturers use discussion method only and giving task in the learning process. Students are less involved in the Physics learning process, so that creativity, motivation and critical thinking ability students' is less. Learning process in Physics Education Study Program are still more focused on learning outcomes in the form of knowledge only. It is very superficial only up to the level of knowledge (C1), comprehension (C2) and application (C3), it has not been much touched on aspects of analysis (C4), evaluation (C5), and synthesis (C6). This means that generally, learning process has not invited students to apply, every element process of concept learned to synthesis generally, and has not invited students to evaluate (think critically) on the concepts and principles that have been studied. Meanwhile, aspects of psychomotoric and attitude is also much neglected.

From pretest data, the result show that student competence in Applied Physics are inhomogeneous distribution of value. As many as 20% of students are in good level competence, 22.5% are in sufficient level competence and 50% are in low level competence and 7.5% student are in very low level competence. This condition causes difficulties for lecturers in implementation learning process. Given the importance of mastery competencies given in applied physics, so that needs to be pursued innovation model with experiment. innovation learning model which can increase student ability and motivation that ultimately will be improve learning outcomes. Learning model that have been still monotonous and theoretical based classes must to be changed with learning model which more involving students and field based learning. The goal of the use of innovation learning models is to improve the quality or competence of graduates.

In this study, one of learning model that leads to create an activity atmosphere that can be increase of skills, creativity and subsequently improve students learning outcomes (cognitive) in applied physics course through planning activities and field activities is Project Based Learning (PjBL). The focus of PjBL is in concepts and main principles of discipline study, so that allowing students to work autonomously to construct their own knowledge. It is hoped that the use of PjBL model in applied physics course can improve students' creativity thinking ability, skill and motivation which certain can be influence for student learning outcomes in producing a product (works) within a certain period of time collaboratively, then the results will be presented[4].

PjBL is learning model or approach innovative learning, which emphasizes contextual learning through complex activities [5]. The focus of learning is concept and the main principles of discipline study, involving student to investigation of problem solving and activities of other meaningful tasks, and reach the peak of producing of its products [3]. PjBL asks a question or poses a problem that each student can answer. PjBL asks students to investigate issues and topics addressing real world problems while integrating subjects across the curriculum. The characteristics of PjBL are developing student’s thinking skills, allowing them to have creativity, encouraging them to work cooperatively, and leading them to access the information on their own and to demonstrate this information. PjBL usually require students to participate willingly in the meaningful learning activities proposed, mostly teamwork[11].

Other Research which related with PjBL has been widely implemented. PjBL has step guidance: planning; Creating (create or implement); Proccesing [9]. According other references show that using PjBL in biology program that students learning outcomes is increase on the aspects of cognitive, affective, and process skills [5]. Other research conducted the study about the influence of PjBL on the attitude of physics, student achievement and development of scientific process skills, how’s that this learning improves the attitude of the skill they are on the study of physics and students' scientific process skills [12]. [1] show the result that project-based learning can improve motivation and high-level thinking and enrichment students in solving problems. Learning process using PjBL has the following advantages [6]:

1. Increase learning motivation
2. Improve problem-solving abilities
3. Improve collaboration
4. Improve the skill of managing resources
5. Improve social relationships and communication skills
6. Preparing students on employment
7. Increase of student confidence
8. Give students opportunity to develop individual learning skills

When student work in teams, they discover the skills plan, organize, negotiate, and make investigation about issue of the task, who is responsible for each task, and how information will be collected and presented. In group work of project, individual strength and the referred learning method reinforce the team's work as a whole.

Table 1. Steps of Project Based Learning [7]

No.	Phase	Description
1.	Start With the Essential Question	Learning process begins with the essential question and question can give the students assignment (student) in doing an activity.
2.	Design a Plan for the Project	Planning is done collaboratively between lecture and student. Planning is contains the rules of game, selection of activities that can be supportive in answering essential questions, by integrating possible subjects, and knowing the tools and materials that can be accessed to assist in project completion.
3.	Create a Schedule	Lecturers and student collaboratively arrange an activity schedule in completing the project.
4.	Monitor the Students and the Progress of the Project	The teacher is responsible for monitoring the student activities during completing project. Teacher's role as a mentor for the activities of students. In order to facilitate the monitoring process, a rubric is created that can be record all the important activities.
5.	Assess the Outcome	Assessment is done to help lecture on measure standard achievement, play a role in evaluating each student's progress, provide feedback on the level of understanding of student has achieved, assist the lecture in preparing the next learning strategy.
6.	Evaluate the experience	At the end of the learning process, lecture and student reflect on the activities and outcomes of projects that have been implemented. The reflection process is done both individually and in groups.

METHODS

The type of research which is used in this study is experiment. Experimental research method can be interpreted as a research method used to find out the influence of certain treatments on others under controlled conditions[10]. The experimental method which used was quasi experimental with pretest-posttest control group design. In this study, there are two classes will be used, one class is given an experimental treatment and one class is treated as a comparison. One class that were given experimental treatment were taught using project based learning (PjBL) model, and other class treated as a comparison (control) was taught using inquiry learning models. Experiment class is consist of 22 students and control class consist of 22 students. At the end of learning evaluation is done by giving posttest, then the data obtained from the evaluation questions in the experimental and control classes are analyzed with appropriate statistics. This is done to find out students' learning outcomes at the end of the material that has been delivered. Data analysis is done quantitatively with SPSS 20.0 for windows to identification the effect of PjBL treatment for student learning outcome and motivation in applied physics.

Table 2. Research Design of Pretest Posttest control Group design

Pretest	Treatment	Posttest
O1	X1	O2
O3	X2	O4

Explanation:

O_1 = Measurement the initial ability of experimental group (Pretest)
O_2 = Measurement final ability of experimental group (posttest)
X_1 = project based learning treatment
X_2 = inquiry treatment
O_3 = Measurement the initial ability of control group
O_4 = Measurement final ability of control group

Table 3. Indicator for Student Learning Outcomes [8].

Aspect	Competence	Indicator
Cognitive	Knowledge (remembering previously learned information)	Arrange, define, describe, duplicate, identify, label, list, match, memorize, name, order, outline, recognize, relate, recall, repeat, reproduce, select, state
	Comprehension (grasping the meaning of information)	Classify, convert, defend, describe, discuss, distinguish, estimate, explain, express, extend, generalize, give examples, identify, indicate, infer, locate, paraphrase, predict, recognize, rewrite, report, restate, review, select, summarize, translate
	Application (applying knowledge to actual situations)	Apply, change, choose, compute, demonstrate, discover, dramatize, employ, illustrate, interpret, manipulate, modify, operate, practice, predict, prepare, produce, relate, schedule, show, sketch, solve, use, write
	Analysis (breaking down objects or ideas into simpler parts and seeing how the parts relate and are organized)	Analyze, appraise, break down, calculate, categorize, compare, contrast, criticize, diagram, differentiate, discriminate, distinguish, examine, experiment, identify, illustrate, infer, model, outline, point out, question, relate, select, separate, subdivide, test
	Evaluation (making judgments based on internal evidence or external criteria)	Appraise, argue, assess, attach, choose, compare, conclude, contrast, defend, describe, discriminate, estimate, evaluate, explain, judge, justify, interpret, relate, predict, rate, select, summarize, support, value
	Synthesis (rearranging component ideas into a new whole)	Arrange, assemble, categorize, collect, combine, comply, compose, construct, create, design, develop, devise, design, explain, formulate, generate, integrate, manage, modify, organize, plan, prepare, propose, rearrange, reconstruct, relate, reorganize, revise, rewrite, set up, summarize, synthesize, tell, write

RESULTS AND DISCUSSION

Normality Test

The normality test is done to find out the data comes from a population that is normally distributed or not. The statistical test that will be used is taking a significance level of $\alpha = 0.05$ with the following statistical hypothesis:

H_0: Data of students' learning out comes is come from a population that is normally distributed,

H_1: Data of students' learning out comes is come from populations that are not normally distributed.

The test criteria are: H_0 is accepted if the significance value> 0.05 and H_0 is rejected if the significance value is <0.05. The results of normality test for the experimental class data are presented in Table 4, while the control class data are presented in Table 5.

Table 4. Normality Test of experiment class

		Posttest learning outcomes
N		22
Normal Parametersb,c	Mean	72.0000
	Std. Deviation	9.69717
Most Extreme Differences	Absolute	.182
	Positive	.182

	Negative	-.108
Test Statistic		.182
Asymp. Sig. (2-tailed)		.082d

a. class = Experiment
b. Test distribution is Normal.
c. Calculated from data.
d. Lilliefors Significance Correction.
e. This is a lower bound of the true significance.

Table 5. Normality Test of control class

		Posttest learning outcomes
N		22
Normal Parametersb,c	Mean	62.8788
	Std. Deviation	11.78715
Most Extreme Differences	Absolute	.155
	Positive	.155
	Negative	-.106
Test Statistic		.155
Asymp. Sig. (2-tailed)		.186d

a. class = control
b. Test distribution is Normal.
c. Calculated from data.
d. Lilliefors Significance Correction.
e. This is a lower bound of the true significance.

The results of normality test of experimental class data and control class according to Table 4. and Table 5. respectively have p-values are 0.082 and 0.186. Pretest and posttest data have p-value> α (α = 0.05), it is indicated that H_0 is accepted. Thus, according to Kolmogorov Smirnov's test, it can be concluded that experimental class data and control class are normally distributed.

Homogenity Test

Homogenity test is done to determine the variance of homogeneous data or not. The statistical test that will be used is taking a significance level of α of 0.05. with the statistical hypothesis as follows:

H_0: Both data have homogeneous variances

H_1: Both data have non-homogeneous variance.

The test criteria are: H_0 is accepted if the significance value> 0.05 and H_0 is rejected if the significance value is <0.05.

Table 6. homogeneity test

Variable	F	df1	df2	Sig.
Learning outcomes	2.105	1	42	.155

The results of homogeneity test for students learning outcomes data according Table 6. have p-value of 0.155> α (α = 0.05). Thus, we can conclude that data is homogenity and H_0 is accepted.

Hypothesis Test

Hypothesis test is done to find out whether there is influence from the use of project-based learning models for learning outcomes, then hypothesis test can be done using the t-test statistical test, with the provisions of the hypothesis as follows:

H_0: there is no significant effect of using PjBL model on student learning outcomes.

H_1: there is a significant effect of using PjBL model on student learning outcomes.

A summary results of anacova for students learning outcomes using project based learning is shown in Table 7.

Table 7. anacova analysis for the effect of PjBL for learning outcomes

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4635.018a	2	2317.509	96.059	.000
Intercept	14.740	1	14.740	.611	.439
Xhasilbelajar	3763.436	1	3763.436	155.992	.000
Kelas	1195.007	1	1195.007	49.532	.000
Error	940.908	41	24.126		
Total	195366.667	44			
Corrected Total	5575.926	43			
a. R Squared = .831 (Adjusted R Squared = .823)					

Based on the results of anacova test in Table 7., it can be seen that F calculated treatment difference in learning model is 49,532 with p-value = 0,000. p-value <α (α = 0.05). Thus, H_0 which reads no difference in the achievement of learning outcomes between the two classes is rejected. Thus, the research hypothesis which reads that there is a difference in achievement of learning outcomes between two class of experiments class and control class is accepted. That is, there is an influence of the project based learning learning model on achieving student learning outcomes.

Table 8. average corrected of learning outcomes

Class	Pretest	Posttest	Difference	Enhancement	Average corrected
Experiment	54.667	72.000	17.333	31.71%	72.836
Control	56.061	62.879	6.818	12.16%	62.118

The average corrected for learning outcomes of two classes are presented in Table 8. Based on Table 7. and Table 8. it can be seen that experiment class has achievement of learning outcomes that are significantly higher than the control class.

CONCLUSION

Based on the result of analysis data and discussion, it can be concluded that there is a significant effect of using project based learning for students learning outcomes in applied physics course. it can be seen that experiment class has achievement of learning outcomes that are significantly higher than the control class.

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