ISBN : 978-602-50898-0-0

Improve Learning Outcomes of Students Through Implementation of The Collaborative Project-Based Learning Model in Thermodynamics

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ABSTRACT: This paper discusses the effect of CPjBL models to improve students' thermodynamics learning outcomes. The methods of research was a quasi-experimnetal study and the sampel consisted of two classes. One class was assigned to be an experimental group (EG, n=29) and directed as a collaborative project-based learning group. The other class was assigned to be the control group (CG, n=25) and directed as a conventional learning group. The study found that the use of CPjBL model in thermodynamic's subject shown that students were more motivated to learn, more confident and more better solve problems given, responsible and able to work in teams. T-tests of learning outcomes for the experimental and control class were performed significantly difference. Finally, the conclusion of this research was CPjBL model more effective than conventional model in the thermodynamic's subject, especially in technical and vocational education.

Keywords: Collaborative Project-Based Learning, Experimental and Control Group, Learning Outcomes

1. INTRODUCTION

Competition and dynamics in the workplace are getting higher along with technological advances now. This condition requires that vocational education providers should be able to deal with and anticipate changes that occur by utilizing various resources available to create of the learning situations that creative, innovative and adaptive so as to create competent graduates. This is in accordance with the objectives vocational education for the purpose of geared up workforce to accomplish job duty [1]. [2] Vocational education as ”organized educational program which are directly related to the prepration of individuals for paid or unpaid employment, or for additional preparation for a career requiring.

Thermodynamics is one of compulsory subjects to be mastered by students of Mechanical Engineering, Diploma Program of Faculty of Engineering, Universitas Negeri Padang. The implementation of this thermodynamics was very much found in energy conversion machines in the industrial world such as: hydro power plants, steam power plants, gas power plants, geothermal power plants, pump installations and piping systems, heat exchange systems, aircraft combustion systems, combustion engines, fluid engines, refrigeration and air conditioning, hydraulics and pneumatics, and so on.

The results of observation and need analysis that has been done to students in thermodynamic, it was found that most of the students found it very difficult to master thermodynamics teaching by well. To understand the concepts and principles in thermodynamics requires ability of high level thinking by the students because they were abstract. This was what makes students have difficulty in mastering the subject of thermodynamics quickly, turning something abstract into real conditions in the field.

Therefore, it is necessary to improve continuous the learning process in thermodynamic course to use improve the motivation, thinking power and creativity of students by choosing a learning model. more appropriate.[2] Explained that quality education can only be achieved through improvements in the learning process. Further [3] states that the success in the process can not be separated from the role of a teacher.

Application of learning model by combining several precise methods can certainly be the solution of the problems that occur. [4] A learning models is a plan or pattern that we can use to design facce to facce teaching in classrooms or tutorial setting and to shape instructional material-including books, film, tapes, and computer-mediated program and curriculums. Learning model developed should be in accordance with the characteristics of the course, facilitate students in mastering the teaching materials and provide knowledge and skills about the implementation of teaching materials.

One of the effective learning methods to facilitate students in mastering the material was the collaborative learning model. Collaborative learning (CL) model was an umbrela term used for a variety of educational approaches involving joint intellectual effort by student or teacher [5]. A situation in which two or more people learn or attempt to learn something together [6]. Learning collaboratively in groups refers to an instructional method where the work together toward a common goal [7]. Model of collaborative learning will strengthen student's cognitive competence theoretically.

To provide a complex competence about the applicability of the theories studied in the collaborative learning model was to use a project based learning model. The model of project-based learning (PjBL) is a constructivist pedagogy that intends to bring about in-depth learning by learner to use an inquiry. PjBL is well suited to helping students become active learners because it situates learning in real-world problem and makes students responsible for their learning [11].

Looking at the advantages of CL model and PjBL model above, then the combination of these two learning models called collaborative-project based learning (CPjBL) model is suitable for use in thermodynamics learning. The CL model to strengthen student cognition by studying in groups solves the problem given and the PjBL model will train students to think critically to find solutions to the given project task.

2. METHODS

This research was an experimental research. The research design used was classical experimental design. The population in this study was the students of the Diploma Program of Mechanical Engineering, Engineering Faculty, Universitas Negeri Padang whose takes in the thermodynamics on academic year 2015/2016, as many as 54 people. The students were divided into two groups, the experimental group (EG, n = 29 and control group (CG, n = 25).

Table 1. Research design of collaborative project-based learning model on thermodynamic course.

R	O1	X1	O2
	O3	X2	O4

ISBN : 978-602-50898-0-0

Description: O1: data of preliminary observation experimental group, O2: data post-test of experimental group, X1: treatment with of CPjBL model, X2: treatment with of conventional learning model, O3: data of preliminary observation control group, O4: data post-test of control group

3. RESULTS

To see the effectiveness of the CPjBL model and conventional model in thermodynamics in vocational education, it is necessary to analyze t-test statistics on pre-test and post-test students. The t-test of the pre-test results is done on the average of the student's average and the t-test on the post-test results to determine the final outcome of the lecture. What are the significant differences between student learning outcomes in the experimental group and student learning outcomes in the control group.

Table 2 is the result of the students' pre-test t tests for the experimental and control groups. After being treated in the experimental class using the Collaborative Project Based Learning (CPjBL) model in thermodynamics in vocational education, both groups of students were also given a post test in writing. The result of post-test of students for experiment and control group can be seen in table 3.

Table 2. Test-t value of the post-test for the control and experimental class

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Result	Equal variances assumed	5.256	.026	1.406	52	.166	1.92490	1.36899	-.82218	4.67198

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									Lower	Upper
Result	Equal variances assumed	5.256	.026	1.406	52	.166	1.92490	1.36899	-.82218	4.67198
	Equal variances not assumed			1.363	40.015	.180	1.92490	1.41195	-.92872	4.77851

Table 3. Test-t value of the post-test for the control and experiment class

4. DISCUSSION

Based on the result of t-test the value of pre-test in table 2 obtained the results of the significance of both classes are 0.166 and 0.180, which means the value is greater than 0.05. From these results, it can be stated that based on the students' pre-test values for the experimental and control classes, students have the same average ability. From these results it can be concluded that at the beginning of the lecture there was no significant difference in the results of the pre-test grade of the experimental class and control class. The conclusion of the t-test for the pre-test values that at the initial condition that the students' learning ability of the control class and the experimental class is almost the same before there is treated the use of CPJBL model in thermodynamics in vocational education.

In table 3, we can see the result of t-test on the student's post-test result on the experimental class and control class. The t-test results obtained the significance of the two classes is 0,000 which means a small value of 0, 05. From this result it can be stated that the experimental and control classes have different learning results. From these results it can be stated that there is a significant difference between the control class learning outcomes and the experimental class at the end of the lecture. On average, student learning outcomes using CPJBL models are much higher than student learning outcomes using conventional models.

The learning model applied to the learning of thermodynamics in vocational education is a combination of the learning model that is a collaborative model with a project-based learning model called collaborative project-based learning (CPjBL) model. The application of CPJBL model in the learning of thermodynamics gives the effect of changing the way students learn more effectively in improving and developing their competence. In applying the CPjBL model, the students are divided into groups, each member of the origin group with the same material meets in the expert group (group companion) to discuss the lesson items to be studied, in accordance with the learning objectives to be achieved. In the group of experts, students learn from each other the same material, and devise a plan how to convey to a friend if back to the original group.

They took turns teaching their teammates about the sub-chapters they understood and each other listening intently. After students discuss in groups of experts and groups of origin, then each group is asked to present the results of their discussion in the form of presentation in front of the class. It is intended that lecturers can equate students' perceptions of thermodynamic teaching materials that have held discussions. The joy of this chase is impressed by the concept of kolabiratif learning. In collaborative learning, learners work together to improve their learning and learning [8].

Further learning activities carried out by applying the method of project-based learning, the stages of learning activities started from each group of students to observe the world of industry. Through this task, students will be able to address the teaching materials that have gained on collaborative learning methods with the real world in the industry. In industry they will see machines or equipment related to thermodynamic teaching materials. From the process of viewing, emerging and analyzing engine performance, students look for problems that occur in machine systems or tools in the industry. Project-based learning provides real-world, motivating and meaningful tasks at the center of student attention [12].

Departing from the problems found in the industrial world, students make this problem as the basis of the task. Furthermore, students create a task that will be a solution in solving problems that have been found from the industrial world. The end of the project assignment, students make reports and present the results of their duties in the presence of appraisal lecturers and other students in the class. From the results of the implementation of this task the students get direct experience of the applicative of the science of thermodynamics, this is what strengthens the customer.

Applications of real-world theory, exploratory opportunities and practical design skills, and peer learning are considered by students as the most valuable aspect of project experience [13]. Project-based learning (PJBL) provides opportunities for students to build this quality, as well as learn more deeply the traditional academic content and understand how it applies to the real world [14].

4. CONCLUSION

Based on research result that application of CPjBL model in thermodynamic course to student can improve result of learning result from cognitive, affective and psychomotor aspect. From the cognitive aspect there is an increase in student learning outcomes that are higher compared to student learning outcomes in the control class.

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This can be seen from the result of t-test on student post-test result. The result of t-test on student's post-test result shows that there is a difference of learning outcomes that are significance between the experimental class and the control class.

Increased student learning outcomes from affective aspects; students can learn together in solving problems, mutual respect, communicate between teams and be motivated in learning. From psychomotor aspect, able to do project task well. Project tasks include observation to the industry, reporting and presenting the results of project tasks in front of the appraisal lecturer.

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