

The Effect of Project-based Learning and Creativity on the Students' Competence at Vocational High Schools

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Abstract—The preliminary surveys show that many students are less creative, so that it difficult to understand the concept of physics. Many students who do not mastery learning of physics so that it difficult to applied the concept of physics in relevant subjects. Therefore, project-based learning is implemented. This study aims to determine the effect of project-based learning and creativity on the students' competence. This research used quasi experiment method with pretest-posttest group control design. The subjects of the research were students of eleventh grade at vocational high schools. Data were collected using observation sheets, creativity tests, and achievement tests. The result of the research shows that the project-based learning impact on the students' competence, in the terms of: (1) There is a significant difference of the students' competence who use the project-based learning with students who use the conventional learning. (2) There is a significant difference of competence between students who have high and low creativity in project-based learning. (3) There is interaction of learning model and creativity that effect to the students' competence. Thus, student competence is significantly influenced by the implementation of project-based learning. The effect of project-based learning model to the competence of students includes large categories.

Keywords—*project-based learning; creativity; students competency*

I. INTRODUCTION

The government has made various efforts to improve the quality of education, including changes in curriculum, improving the quality of teachers, facilities and infrastructure. The teacher is a facilitator in the learning process. Therefore, in the learning process the teacher must be able to use the right methods and media so that learning objectives can be achieved. The teacher must try to carry out the learning process that can motivate student learning activities. One of the efforts made by the teacher to obtain optimal learning outcomes is to create a learning atmosphere that can actively engage students. The active involvement of students in learning activities enables the student to develop the potential he has well. One of the subjects in the Electrical Engineering Department at the State Vocational High School 5 of Padang is the Physics subject. This subject aims to enable students to master the concept of physics and be able to apply it in subjects of expertise relevant to physics.

Physics is a branch of science that has a large role in science and technology. Physics not only makes a real contribution to technological development but also educates students to have intellectual and religious attitudes. Therefore, students are required to be able to act on the basis of logical thinking, critical thinking, creative, and innovative. In essence physics is a collection of knowledge, investigation, and scientific way of thinking. Physical learning must use an effective and efficient learning model and be able to motivate students to learn physics.

Physics is the natural knowledge that is gained from experience through observation and applied in the real world. Physics has facts, concepts, principles and laws. Many physical concepts include abstract concepts. The concept of abstract physics is often an obstacle for teachers in delivering physical material to students, so that students are not yet optimal in understanding the concepts described by the teacher. This has an impact on students 'interest in learning in physics which causes the students' low competence to solve problems. The problem that often occurs in the process of learning physics is the use of learning models that are not optimal. The use of learning models that are not in accordance with the material and the ability of students causes an unfavorable or boring learning atmosphere.

The results of interviews with physics teachers at SMK 5 Padang obtained information that students were less enthusiastic about taking lessons and were lazy to do assignments. Students are less active and if asked a few questions can answer. Students are less motivated to ask or express opinions. In the learning process students tend to record rather than understand the material being taught, resulting in low student learning outcomes (48% of students have not yet finished learning physics). Thus the teacher must find the right way to improve in the learning process. Steps that can be taken by the teacher as an effort to actively engage students to improve student learning outcomes include using various learning methods and motivating students to learn better.

One solution to the problem is the application of a project based learning model to improve the competence of students. Project based learning is an innovative learning centered on

students, teachers as motivators and facilitators. Students are given the opportunity to work and construct their knowledge. The project based learning model involves students on the problem, the solution uses project work so students are trained to act and think creatively. Project based learning models can improve physics learning outcomes in the affective, cognitive and psychomotor domains [1]. Project based learning models have a positive influence on students' cognitive abilities [2,3].

According to Waras project based learning is a project that focuses on product development and performance, students conduct group learning activities, conduct research, solve problems, and synthesize information [4]. This model is part of the Contextual Teaching and Learning approach that is carried out through a project within a certain period of time with steps consisting of preparation, project determination, planning, investigation, preparing reports, communicating the results of activities and evaluations. According to Sulvian Project Based Learning is very suitable to be carried out in physics learning because through this project student are involved mentally and physically, including social skills by constructing knowledge based on their own experience through actions in the project [5]. Students are required to be able to share information and respect others, collaborate in groups. The project is the core of the Project Based Learning model. Hiscocks states that the Project is an activity where the participants have a degree of choice in the outcome. lab periods [6].

Based on the background described, a study was conducted to reveal the effect of project-based learning and creativity on the students' competence in physics subjects.

II. METHOD

This research used a quasi-experimental method with a pretest-posttest control group design [7]. The experimental design used was a 2x2 factorial design. The 2x2 design in question is two learning models (project-based learning, conventional) with two categories of creativity (high, low). The study was carried out on students in Physics subjects. The research stages are: (1) conducting preliminary surveys, (2) preparing learning implementation plans, student worksheets, and research instruments, (3) giving pre-tests, (4) providing creativity tests, (5) giving treatment by implementing projects - based learning in experimental class students, while control class students carry out conventional learning, (6) provide post-test, (7) analyze data and interpret results. The instruments used in the study were: observation sheets, creativity tests, and learning outcome tests. Observation sheets are used during the preliminary survey.

Creativity test data were analyzed by percentage techniques to classify students into two groups of learning creativity, namely high and low. Test results data are analyzed quantitatively to determine the effect of project-based learning model on students' competence in learning physics. Data analysis uses two way anova and effect size.

III. RESULT AND DISCUSSION

The effect of project-based learning model on student competency is obtained from the results of two way anova

(analysis of varians) analysis and effect size. Two way anova analysis aims to determine differences in student competencies in the experimental class and the control class in terms of student learning and creativity models. The impact of project-based learning on student competence is known from the results of the effect size test.

A. Differences in Student Competencies Based on Learning Model and Creativity

Before analyzing the data to determine differences in student competencies based on student learning and creativity models, first test the normality of data distribution and test the homogeneity of data. The results of the normality distribution of data distribution showed that the competence of students in the experimental class and control class before learning were normally distributed. Similar results for students' competencies after learning. The results of the homogeneity test of students' competency data before learning showed that the competence of students in the experimental class and the control class was homogeneous, as well as the competencies of students after learning.

After the average difference test on the students' competence data before the learning obtained the result that the average of the students' competency of the experimental class and the control class did not differ significantly ($p = 0.36$). Thus it can be stated that the student's competence before the learning is the same in both classes. The difference of student competence after learning is obtained from the result of two way anova test as in table 1.

TABLE I. THE RESULT OF TWO WAY ANOVA

Source of Variation	SS	df	MS	P-value
Learning model	6850.137	15	346.045	0.0251
Learning creativity	4622.113	1	4258.166	0.0016
Interaction	4354.937	15	243.693	0.0375
Within	5827.5	32	138.544	

Based on the results of the two way anova test, it can be concluded that the results of the first hypothesis test are rejected, meaning that there are differences in student learning outcomes that carry out project based learning with students who carry out conventional learning. Student learning outcomes that carry out project based learning are better than the learning outcomes of students who carry out conventional learning. The results of the second hypothesis test are rejected, meaning that there are differences in learning outcomes of students who have high creativity with learning outcomes of students who have low creativity in project based learning. Learning outcomes of students who have high creativity are better than students who have low creativity. The results of the third hypothesis test are rejected, meaning that there is an interaction between the learning model and students' creativity in influencing student learning outcomes. This shows that the learning model and creativity affect student learning outcomes. Students who have high creativity are easier to implement project based learning than students who have low creativity. The interaction between learning models and student creativity can be presented in figure 1.

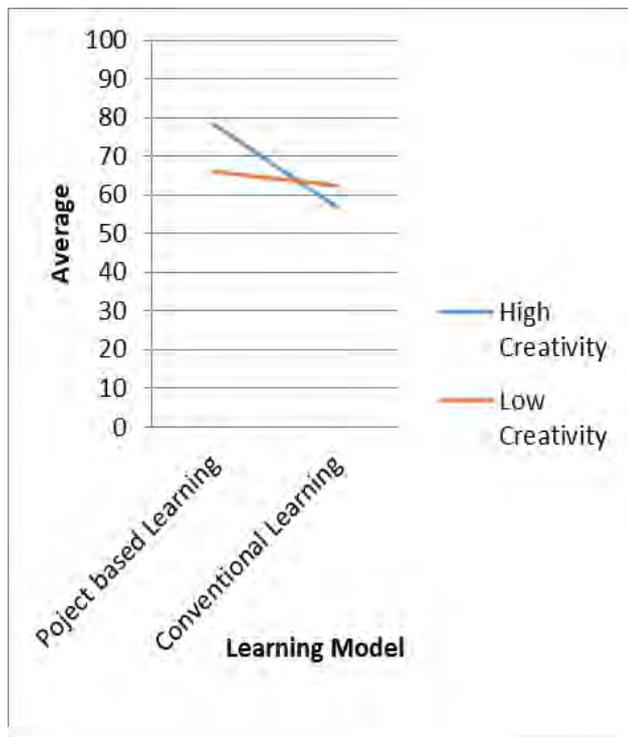


Fig. 1. Interaction between learning model and student's creativity.

B. The Effect of Learning Model on Student competence

The effect of the implementation of project based learning model on student competence is calculated using the effect size with the Cohen's formula, the effect size is 1.97. These results indicate that the effect of project based learning on student competence is a large category.

C. Discussion

The implementation of project based learning models in physics teaching aims to improve the student competence and creativity. The results showed that the effect of project based learning on student competence included a large category. This means that project based learning is more effective than conventional learning. Project based learning has an impact on students' learning mastery and creativity.

Project based learning can improve student competence [8-10]. Project based learning has an effect on increasing learning motivation, creativity, students' critical thinking and cognitive abilities [11,12]. Project-based learning model with production approach based on expert assessment might develop student's generic green skills in patisserie as it further emphasizes on the development of project management abilities, collaboration abilities, creativity and problem solving abilities [13]. Corebima found that projects focus on product development and performance [14].

Project-based learning can enhance student creativity. Student creativity is seen during learning, when students are faced with existing problems, they have to solve it and present it then their creative ideas emerge. This creativity is seen from the products produced from the project in the form of reports, posters and products. In learning, the teacher facilitates

everything that is needed by students. Students are required to be skilled in making decisions in dealing with problems in detail (elaboracy), fluency of students in working on projects is seen in groups of students who have high creativity capable of completing the project according to the scheduled time. Flexibility of students is seen when the project group has difficulty in finding instruments, they are able to bring up their ideas (originality) to use simple tools in working on the project. They think about the details in the set of tools that they have in order to work. This is the creativity that students have shown in trying new things, even though this group needs a long time.

Students have creative abilities when faced with various skills and competencies such as collaboration, project planning, decision making, and time management through project-based learning [15]. Student creative thinking in a project based learning model is greater than conventional learning. It proves learning process with project based learning actually effective to advance student creative thinking processes and observations made by the observer indicated that the student activity is positively increased [16]. It caused in learning of a project based learning model that students trained to design, analyze, and apply their ideas [17,18].

Creativity is one of the basic human needs, namely the need for self-realization (self-actualization) and is the highest need for humans [19]. Basically everyone is born into the world with creative potential. Creativity can be identified and developed through appropriate education [19]. Creativity includes aptitude features such as fluency, flexibility, and originality in thought, as well as non aptitude characteristics, such as curiosity, likes to ask questions and always want to find new experiences. Creativity is the ability to combine, solve or answer problems, and the operational ability of creative students [20]. The implementation of physics learning using project based learning can improve student creativity and learning outcomes [21].

IV. CONCLUSION

There is a significant difference of the students competence using project based learning with students using conventional learning. There is a significant difference of the students competence that high and low creativity in project based learning. There is an interaction of implementation of learning model and creativity in influencing students competence. Student competence increases because of the implementation of project based learning model. Thus the students competence is significantly influenced by the implementation of project based learning model. The effect of project based learning model on students competence is in the large category.

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