The effect of the implementation of project based learning on learning activities of electrical engineering students

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Abstract. The purpose of this study was to determine the impact of the implementation of Project Based Learning (PjBL) on learning activities in the Electrical Automation Installation lecture material. Based on the research assessment, it appears that many passive, daydreaming students are busy with cellphones and unrelated activities during the learning process. This research is an experimental study with a class action research model consisting of two cycles. Each cycle consists of two meetings. Data was collected using observation to see changes in learning activities and tests used to measure student learning outcomes. Based on observations, the average learning activities of the first and second cycles were 66.7% and 86.3%. Student learning outcomes also increase classically. In the first cycle, 59.25% or 16 students had reached the minimum mastery criteria, and in the second cycle, 92.6% or 25 students had reached the minimum mastery criteria. This means that the application of Project Based Learning can improve student activities and learning outcomes in learning Electric Automation Installation.

Keywords. PjBL, Electrical Automation Instalastion, learning activities, learning outcomes

1. Introduction

In the era of globalization, traditional education system is losing its relevance [13]. Students educated for the world of the 21st century must develop habits of thinking, researching, and problem solving to succeed in a rapidly changing world [15]. In the process of higher education, there are three elements that determine the teaching process, namely lecturers, students and the curriculum used. Education plays a role in preparing the quality of human resources. Based on the Indonesian National Qualifications Framework (KKNI), the main objective of the learning process in higher education is to require students to successfully apply theoretical and practical abilities through internalization of competencies (knowledge, attitudes, skills) and accumulated work experience. This is in line with the aim of higher education which will produce skilled human resources in their fields supported by satisfying learning outcomes. Learning outcomes can be seen as a measure of student success in the learning process and are considered in determining student abilities.

The students who get low learning outcomes are considered as the results of the teaching methods used by lecturers. Teaching method used by lecturers, in this case, is only lectures-centered. According to Sudjana [11], this model learning strategy quickly spurs student boredom for learning, making it difficult for teachers to see changes in student activities in learning and can lead to low learning outcomes due to the use of more focused learning time to complete learning material.

Responding to the above conditions, it is necessary to improve the quality of learning in terms of electrical automation installation maintenance through the application of learning models that can stimulate the level of student activity and focus on training. One of the learning models used in improving the quality of learning in the subject of the Electrical Installation treatment process is the Project Based Learning (PjBL) model.

This study attempts to integrate assessment of work skills through project-based learning in order to improve the mastery of work skills, competencies, performance, and graduates’ readiness in working in Unesa Electrical Engineering Department. According to the view of constructivism theory in student-oriented learning activities are described as learning where students must actively
build their own knowledge. Project-based learning model is one method that is based on constructivism that supports student involvement in problem solving situations [1][2]. Students in project-based learning are directly involved in the real life environment in solving problems, so that the knowledge gained is more permanent. To develop the students’ soft skill, students need to be given problem solving skills, technical skills, and cognitive skills, then student-centered learning methods such as project based learning are appropriate.

Furthermore, according to Lisminingsih [9] before using the project-based learning model, there are two key elements that need to be considered, namely (1) this method requires the implementation of student-centered learning that is properly designed and adapted to achieve the desired learning outcomes (2) questions about how to structure and implement activities to ensure the right motivation. This is important because project-centered learning is finding concepts, so it must be interesting so that the level of comfort is higher than the traditional learning model.

Electric Automation Installation is one of the material in the Installation course Electricity. This material aims to provide knowledge theoretically and practical arrangement of electrical installation systems automatically using Programmable Logic Controller-Zelio (PLC-Zelio). Based on the assessment carried out on Electrical Engineering Education (PTE) Study Program UNESA 2017/2018 odd semester, seems that in the learning process students are less active and attentive to teaching materials delivered by lecturers, many students are passive, daydreaming, playing cellphone, noisy, and busy with their activities. Results of this student activity is reflected in the learning outcomes that do not meet the completeness criteria Minimum obtained from the Electrical Installation Practicum, Minimum Criteria score competency eligibility is 80.

Electrical Installation Competencies that must be possessed by students in this globalization era are the skills to design and modeling electrical system automation. Students are encouraged to be able to practice their design according to the themes in learning, supported by the use of learning models that can improve their ability to analyze and solve problems independently, one of them by using “Project-Based Learning” in completing authentic work as learning outcomes.

Seeing the advantages of "Project-Based Learning" which can motivate students to improve learning or authentic work activities, the use of this model is an appropriate problem faced by lecturers and students. In the learning process, students need to understand the essence of learning. Rusman [12] states that the essence of learning is the willingness of students to learn about what is given by the teacher.

In the institutional dimension, the implementation of project-based learning must be developed to overcome learning challenges. To build and maintain a PjBL, good institutions are needed that consider lecturers, students, and available resources significantly different from the traditional learning environment. The way in which institutions related to teaching staff is very important to improve the quality of learning. Based on the background described above, the problem studied was the impact of the implementation of project-based learning in the Electric Automation Installation learning on the learning activities of electrical engineering students? While the aim is to find out that the implementation of project-based learning in Electrical Automation Installation can increase the activities of electrical engineering students.

2. Method

The research method used is experimental research with a class action research model used to improve the learning process of Electric Automation Installation practicum in order to obtain better quality learning. This study was divided into two learning cycles. In each cycle, there is a chain of repetitive activities, namely plan, action, observation, and reflection. Planned study, namely two meetings for each cycle. The class action research model used as shown in Figure 1 [6]:
Figure 1. The Model of Kemmis and Taggart

The research conducted on S1 Electrical Engineering Education students, Faculty of Engineering, State University of Surabaya, class of 2016 amounted to 27 people who took Electric Power Engineering in the Middle semester of the 2018/2019 academic year.

The stages of the cycle begin with the planning stage to prepare teaching devices, develop research instruments, and design systematic steps. The implementation phase of the action includes the implementation of project-based learning and assistance tasks. The stages of observation carried out by observers and the collective assessment of student activities in the learning stage to see the improvement of student learning activities and outcomes after the implementation of this project-based learning model.

Assessment for learning is seen from the perspective of the process and results of project tasks that are presented, discussed and collected by students. The final stage is the reflection stage, including evaluation of activities that are based on benchmarks for success criteria and performance tests in the form of product assessments are work processes and presentations, project collection assignments and results of students’ creative ability tests.

Research instruments are skill rubrics for task design, technical planning, creativity, innovation, problem solving skills, communication skills, oral expressions, information seeking, collaborative work skills, and classroom behavior. The analysis technique was carried out using quantitative descriptive.

Data on the observation sheet of student learning activities were analyzed in a quantitative way so as to produce a percentage form. To see the percentage of student activity each cycle use the following formula:

\[ P = \frac{\Sigma X}{\Sigma Y} \times 100\% \]  

(1)

With P is percentage of observation of activities at each meeting, \( \Sigma X \) is value of student activity and \( \Sigma Y \) is maximum number of activity values.

Furthermore, the percentage information obtained is used as an interpretation of the assessment activities of students guided by the following categories [10].
Tabel 1. Aspect of Students Activity Observation Sheet

| No | Interval   | Category   |
|----|------------|------------|
| 1  | ≥75,6%     | active     |
| 2  | 59,6% - 75,5% | quite active |
| 3  | ≤59,5%     | less active |

Meanwhile, to get the percentage of learning outcomes assessment, the formula below is used for individual mastery calculations:

\[ N_i = \frac{T}{S_m} \times 100\% \] (2)

With \( N_i \) is complete learning individually, \( T \) is scores obtained by students and \( S_m \) is the maximum score of the test.

The mastery learning classically was achieved when the classical completeness grade value has reached the percentage value of 80%.

\[ N_k = \frac{\sum X}{\sum S_m} \times 100\% \] (3)

With \( N_k \) is Mastery learning classically, \( \sum X \) is Number of students who mastery the study and \( \sum S_m \) is Number of all students in one class.

This research can be said to be successful and can be stopped if it has reached the desired indicator. Indicators of the success of the implementation of actions to improve the quality of learning can be determined by the lecturer, in this case the researcher himself, according to the ability of students and the level of improvement to be achieved. Success criteria in improving the quality of learning in research through the application of project-based learning are: (1) Learning activities: (a) In the first cycle, student learning activities reach a percentage of 60%, and (b) In the second cycle student learning activities reach a percentage of 80%, (2) Learning Outcomes: (a) In the first cycle, student learning outcomes reach a percentage of 50%, and (b) In the second cycle, student learning outcomes reach a percentage of 80%.

3. Result and Discussion

This research was conducted in 2 cycles consisting of 2 meetings in each cycle. Based on the actions taken in the first cycle, it is known that the activities and student learning outcomes have reached the indicator of success in action in cycle I. Where the activity of students is taken through activity observation sheets with a percentage value of 66.7% and classical learning outcomes taken based on tests at the end of the cycle the first is 59.25%. But in the first cycle it did not meet the Minimum Mastery Criteria set at 80%. At the first meeting, the lecturer conveyed about the learning process that will be applied, a review of the assignments will be given, the procedure for using the learning trainer, asking for student participation in learning and the division of small groups of 2-3 people.

The lecturer said that project-based learning is expected to facilitate students in mastering and understanding lecture material. This is considered reasonable because students feel 'comfortable' when doing ordinary learning where the lecturer explains and students hear, pay attention, and take notes. Weaknesses found in the first cycle were in the first meeting when the lecturer gave practice questions and discussed them in class. Seeing the emergence of turmoil, open discussion forums of lecturers related to students' views on the Electrical Automation Installation practice material that they will study. From the results of the class discussion, it appears that students assume that automatic control material is a difficult subject. This assumption arises because students are silent without action and are busy with their respective activities (see lecture notebooks, handbooks and other literature) that they get.
In the second cycle, learning is divided into 3 learning sessions and one quiz implementation. At the first learning meeting in the second cycle, lecturers add variations from the project task group. After the presentation and group discussion, each group was asked to make a question and solution. In this project, it is expected that each group member can implement the results of the project design in the learning trainer, have good knowledge of what and how to solve the problem he made. At the end of the meeting, the lecturer reminded again that there will be a second presentation at the next meeting. Students no longer show their surprise as proven during cycle I. Meanwhile, the actions taken in cycle II have been able to improve learning activities and student learning outcomes in the Electrical Automation Installation practicum. This is evidenced by the increase in student activities as shown in Figure 2:

![The increase in student activities](image)

Figure 2. The increase in student activities (%)

By paying attention to the graph of the increase in learning activities, it can be said that project-based learning is used right with a description of the success of "Achieved" according to table 2. In addition, PjBL is very suitable to help students become active learners because it puts learning in real world problems and makes them responsible for their learning [5][8].

| No | Criteria for Success | Indicators of Success (%) | Research Result (% | Description of Action Success |
|----|----------------------|---------------------------|------------------|-------------------------------|
| 1  | Learning Activity    | 80                        | 66.7             | 86.3                          | Achieved                       |
| 2  | Learning Outcomes    | 80                        | 59.3             | 92.6                          | Achieved                       |

Implementing project-based learning increases student participation in classroom activities and improves critical thinking skills. Some researchers found a significant correlation between problem-based learning activities and critical thinking skills needed by students in the 21st century [2][7][15].

The results of data analysis and observations in the second cycle showed there was an increase in the level of mastery of skills skills based on project learning, as shown in figure 3:
The findings of this study support the findings of the Vicente study [11] which states that student-centered PjBL encourages active learning, increases understanding, memory and the development of lifelong learning skills. This shows that, basically, students have the ability to develop and develop the ability to think higher, but they need continuous and continuous encouragement, motivation and mentoring so that they are accustomed to doing it not only in class lectures but globally in their days.

4. Conclusion

Based on the results of data analysis obtained in this study, conclusions can be drawn as follows: (1) the application of problem-based learning models can increase student activity. This increase in activity is evidenced by the increase in student activity from the first cycle of 66.7% with the active category being 86.3% in the second cycle with the active category, and (2) The application of the project-based learning model can improve student learning outcomes. The improvement in learning outcomes was evidenced from the increase in classical completeness which was previously in the first cycle 59.3% with 16 students completing in the second cycle to 92.6% with 25 students completing from a total of 27 students.
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