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Learning Model Optimization *Project Based Learning (PjBL)* Engineering Physics Course as an Effort to Increase Student Creativity

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Abstract

The purpose of this study is to optimize the Project Based Learning (PjBL) learning model as an effort to improve the creativity of Electrical Engineering Education students at the State University of Jakarta in learning the Engineering Physics I subject. The Engineering Physics I subject is an important subject role in the initial conceptual understanding of Electrical Engineering students, especially in other Electrical Engineering subjects. Engineering Physics learning is very important as an initial foundation for students in the future. There are still students who do not understand the Engineering Physics material so that there needs to be a change in the learning model that can improve students understanding and creativity. Optimizing the PjBL learning model is one of the solution as an effort to overcome this problem. The results of the study show that the PjBL learning model is effective in improving students understanding and creativity in the Engineering Physics course at the Electrical Engineering Education Study Program at the State University of Jakarta.

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1. INTRODUCTION

Education has a strategic role in shaping character, 21st century skills, and individual readiness to face global challenges. UNESCO (2021) states that 21st century education must encourage active, collaborative and contextual learning to answer the challenges of the Industrial Revolution 4.0 and Society 5.0. In Indonesia, data from the Ministry of Education and Culture (2020) shows that there are still many universities that apply conventional learning models that are teacher-centered, so that student activity and participation is still low. This phenomenon has an impact on low critical thinking, collaboration and skills problem-solving and Student creativity, which is an important competency in today's world of work.

To answer these challenges, changes and innovations need to be made in the learning process, especially in basic subjects such as Engineering Physics in the Electrical Engineering Education study program. Learning Engineering Physics, many students do not fully understand the material being taught, so it has an impact or influence on their creativity and learning outcomes. Students have difficulty understanding concepts and their relevance to real life. One learning model approach that has been proven to be effective is Project Based Learning (PjBL). According to Thomas (2000), PjBL is a learning model that facilitates students in investigating real problems, creating products, and practicing high-level thinking skills. Research by Astutik & Prahani (2018) also shows that implementing PjBL can significantly increase students' motivation, creativity and conceptual understanding in the fields of science and engineering.

By referring to various research results, optimizing the PjBL learning model is one potential solution to increase learning effectiveness in order to increase student creativity. This learning model not only presents material systematically, but also facilitates students to be directly involved in the learning process through projects that are relevant to real life in the form of simulations and products. Therefore, optimizing the PjBL learning model is very relevant to be applied in Engineering Physics courses as a form of innovation in learning, especially in electrical engineering education study programs.

2. MATERIALS AND METHOD

This research is a type of experimental design research *One-Shot Case Study* (Sugiyono, 2008:78). The research subjects were students of the Electrical Engineering Education Study Program at Jakarta State University in the Engineering Physics I course, totaling 80 students. The learning process emphasizes project-based learning to create simple electric motor simulation products applying the Lorentz Style as creative products resulting from students' creative thinking abilities. The instrument used in this research was a product observation sheet. The observed data is in the form of a creative thinking scale (*Creative Thinking Scale I CTS)* as an assessment of the creative design process of a project. The power obtained was analyzed using the percentage formula proposed by [1]

Information
Na = Affective value
X = Score obtained
Xm = Maximum score

Creativity assessment criteria were adopted and modified from Sari (201263) as in table 1.

Table 1. Criteria for Student Creativity

%	Creativity Criteria
81 – 100	Very high
61 – 80	High
41 – 60	Currently
21 – 40	Low
1 - 20	Very Low

.3. RESULTS

The students' creativity in making simple electric motor simulation products applying the Lorentz Force through PjBL learning shows the expected project. The project assessment is assessed using a creative thinking scale *(Creative Thinking Scale / CTS).* The average student creativity in creating a simple simulation of a simple electric motor applying the Lorentz Force can be seen in Table 2.

Table 2. Average creativity of Engineering Physics I courses students

No.	Observed aspects	Average score	Category
1	Planning	89.5	Very high
2	Implementation	91	Very high
3	Report	85.5	Very high
Average percentage of student creativity		88,67	Very high

The success of using the Engineering Physics teaching module based on Project Based Learning (PjBL) is assessed by the achievement of student learning outcomes which cover three main aspects, namely knowledge, attitudes and skills. Assessment of knowledge aspects is carried out through written tests given after students have completed learning using teaching modules on material applying Lorentz style. The results of the analysis show that the majority of students experienced a significant increase in their grades, with the average final grade being above the Minimum Completeness Criteria (KKM) set by the study program.

Attitude aspects are evaluated through observation sheets during the learning process. Observation results show that students show positive attitudes, such as high curiosity, responsibility in completing projects, and the ability to work together in groups. Most students obtained the "good" to "very good" category in this attitude indicator.

Meanwhile, the assessment of skills aspects is carried out by observing the student project implementation process in completing assignments based on a simple electric motor simulation project as an application of the Lorentz force. The skills assessed include the ability to design simple tools, carry out tests, analyze results, and prepare project reports. The data shows that students show satisfactory skills performance, where the majority are declared competent in all the specified skill indicators.

Overall, the results of this study indicate that the learning model Project Based Learning effectively applied in learning Engineering physics courses as an effort to increase the creativity of electrical engineering education students.

4. CONCLUSION

Based on the results of research and development that has been carried out, it can be concluded that the learning model *Project Based Learning (PjBL)* proven to be able to increase student creativity in the learning process. Implementing PjBL can encourage students to be more active, creative and responsible in the learning process, and able to relate the material to real life. Optimizing PjBL also fosters a positive attitude towards learning and innovative skills needed in the field of electrical engineering. Therefore, the PjBL learning model is suitable to be applied as an innovative learning model in Engineering Physics courses and can be implemented more widely in similar courses in technical higher education environments.

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