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The Effect of Using the Project Based Learning (PjBL) Learning Model to Increase UPI YPTK Padang Students' Understanding of the Application of Basic Physics Courses

Zakirman

FKIP, Universitas Terbuka, Indonesia

zakirman.official@ecampus.ut.ac.id

Abstract: The linkage and coherence of Basic Physics material with material applications in real life is a new problem in Basic Physics lectures at Putra Indonesia University YPTK Padang. The purpose of this study was to see the effect of using the PjBL model to increase students' understanding of the application of the Basic Physics course. This type of research was a quasi-experimental involving a research sample of Informatics Engineering students at the Faculty of Computer Science UPI YPTK Padang who took the Basic Physics course in the 2019/2020 academic year. The sampling technique used is random sampling. In this study the sample class was divided into two categories, namely the experimental class of 51 students and the control class of 51 students. The instrument used is a work assessment sheet in the form of a portfolio. The data analysis technique used was an independent sample t-test, with prerequisite tests first being carried out, namely normality and homogeneity tests. Based on the results of the data analysis performed, the sig-2 tailed value for the independent sample t-test was 0.00 < of the value $\alpha = 0.05$. The conclusion from this study is that there are differences in student understanding between classes whose lectures use the PjBL model and classes that carry out conventional learning.

Keywords: Project, PjBL, Applied, Physics

1. INTRODUCTION

Physics is one of the compulsory subjects that students need to take in the Informatics Engineering study program, Faculty of Computer Science, UPI YPTK Padang. The Physics course in the Informatics Engineering Study Program discusses the topic of unit quantities, mechanics and motion, work and energy and magnetic electricity. Physics is a part of the natural science family that discusses the phenomena that occur in nature (Zakirman & Hidayati, 2017). All topics and discussions in the Physics course have many applications in everyday life. In fact, balanced learning is a process that cannot be separated from the presentation of concepts, practicum and introduction to the application of concepts in everyday life.

Various applications of physics learning concepts and theories for higher education are often encountered in everyday life. The introduction of the application and application of material concepts in everyday life to students is an important point that is mandatory and needs to be introduced to students. Apart from being an important aspect that influences student understanding, the introduction of concepts and application of theory in everyday life can be a motivation for students to better understand the importance of learning Physics.

The smooth running of a lecture is not only determined by the skills of the lecturer and good course design, but also by the availability of time and infrastructure (Siew & Ambo, 2020). In general, tertiary institutions already have certain criteria in completing facilities and infrastructure, this is because facilities and infrastructure are one of the important points in the accreditation program, both study programs/departments and universities (Mcfarlane, 2015). For this reason, there is no need to doubt the availability of facilities and infrastructure for each tertiary institution. This of course will also affect the availability of laboratory facilities and infrastructure, especially Physics at the university/college level. Problems regarding facilities and infrastructure, especially in Physics lectures, are no longer a problem because indirectly they have been fulfilled in accordance with the ongoing accreditation demands.

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The problem that is a bit forgotten in Physics lectures is the time allocation that has not been ideal with the demands and achievements of lectures/learning. The Basic Physics lecture in the Informatics Engineering study program at UPI YPTK Padang only has 3 credits, this means that face-to-face lectures in lecture classes are only carried out in a span of 3 x 50 minutes. Of course in that short time, lecturers must be able to carry out learning for understanding theory, practicum and understanding applied theory. If the three learning criteria are difficult to fulfill given the limited time available. For this problem, the lecturer's expertise is highly demanded in designing lectures so that the three criteria for lectures are achieved without forgetting the achievement of targets and achievements in the Physics course. To overcome these problems, lecturers can design and design lectures by carrying out the concept of "student center". This learning concept allows students to be active knowledge builders in accordance with constructivism learning theory.

Lectures that are conducted with lectures and discussions have weaknesses because of the limited information that students will get (S. D. Putri et al., 2020). Therefore, learning models and strategies are needed that can be integrated by lecturers in Physics lectures at the tertiary level. These learning models include discovery, inquiry, problem-based and project-based learning models. If you look at the existing problems, especially in Physics lectures at the UPI YPTK Padang Informatics Engineering study program, lecturers can use the project learning model (PjBL) in order to accommodate a balance between understanding concepts/theories and applying material amid the limited time available. The Project Based Learning (PjBL) learning model was chosen because it is considered the right solution to overcome problems in Physics lectures and has several advantages compared to other learning models (Aslanides et al., 2016).

The PjBL process involves several activities, including: (a) identifying problems and finding solutions; (b) taking the initiative in various educational activities both individually and in groups; (c) produce the final product; (d) engaged in work for long periods of time; and (e) a shift in teaching from giving lectures to facilitating the learning processs (Albritton & Stacks, 2016; Dole et al., 2016; S. Putri et al., 2019).

Constructivism theory is considered a theoretical foundation of project-based learning. This theory is oriented towards the process of constructing the students' own knowledge and skills (Zakirman, 2017). Students are diverse and each individual student can build new knowledge based on their current knowledge (Alotaibi, 2020). The project-based learning model (PjBL) is a teaching concept in which students respond to real-world questions or challenges through an extended process of inquiry. The characteristics of PjBL are developing students' thinking skills, enabling them to have creativity, encouraging them to work cooperatively, and directing them to access information on their own and demonstrate that information. PBL usually requires students to participate voluntarily in proposed meaningful learning activities, mostly teamwork (Carnawi & Wijayati, 2017; Chiang & Lee, 2016; Sumarni, 2013).

The PjBL model is suitable for students from elementary to university levels. PjBL facilitates students to collaborate on conceptual understanding, applying prior knowledge, and acquiring skills. It can integrate several disciplines to create projects (Ummah et al., 2019). Ideally, PjBL is reflexive, encouraging thinking about solutions to problems and learning processes to arrive at those solutions (Huysken et al., 2019).

The stages in the PjBL model-based learning activities are: 1) starting with essential/investigation questions; 2) designing a project; 3) make a schedule; 4) monitor student and project progress; 5) assess results; and 6) evaluating experiences (Susilawati et al., 2017). The investigative stage demands that the epistemic character of students' curiosity appears optimally (Asmara & Wardono, 2019).

Project-based learning focuses on the core concepts and principles of a discipline, facilitates investigating, solving problems, and other meaningful tasks, is student-centered, and produces tangible products (Deng, 2018). The steps in this learning can provoke students' creativity in thinking which will produce something in the form of a tangible product, increasing students' responses to any changes and consequences of a situation. Another benefit is students' ability to manage themselves, training that demonstrates events and the habit of conducting self-evaluations (Ismuwardani et al., 2019). In addition, by increasing insight and knowledge, students will have competencies that can be used in the future (Zakirman et al., 2020).

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2. METHOD

This study aims to see the impact of using the PjBL model on increasing students' understanding of material related to the application and application of material in Basic Physics lectures at UPI YPTK Padang. This type of research was a quasi-experimental involving two sample class groups of students in the Informatics Engineering study program, Faculty of Computer Science, UPI YPTK Padang. The sampling technique used is random sampling. In this study the sample class was divided into two categories, namely the experimental class of 51 students and the control class of 51 students. The instrument used is a work assessment sheet in the form of a portfolio. The experimental class is a class that teaches Basic Physics using the PjBL model and a control class where learning is carried out conventionally. To get the research conclusions, the data analysis technique used was an independent sample t-test by first testing the normality and homogeneity tests for the two data groups.

3. RESULTS AND DISCUSSION

After conducting research and data collection, the results of data analysis are presented, which consist of: analysis of data normality, data homogeneity and independent *t-test* . The two groups of data that were used as research samples which included the control class and the experimental class were normally distributed, this was confirmed by the results of the analysis of the normality test using the Kolmogorov-Smirnov test. The results of the normality test analysis can be seen in Table 1 below.

Table 1. Data Normality Test Results

No	Variable	Class	
		Experiment	Control
1	*Means*	76.54	61.54
2	*S. Deviation*	11,556	11,469
3	*Z Klm-Smrv*	0.582	0.605
4	*Sig 2-Tailed*	0887	0.858

Based on table 1 it can be seen that the Z values of the two data groups (experimental and control classes), each of which has a value of 0.05. The data is said to be normal if the Sig 2-Tailed value obtained is greater than the alpha value (0.05). So it can be concluded that the two data groups are normally distributed. Furthermore, the data homogeneity test was carried out using the Hartley test. The results of the data homogeneity test analysis are presented in Table 2.

Table 2. Recapitulation of Data Homogeneity Test Results

No	Variable	Score
1	*Levene Stat*	0.004
2	*df 1*	1
3	*df 2*	50
4	*Sig 2-tailed*	0.948

Based on table 2 it can be seen that that the two groups of data are homogeneous, this is based on the Sig 2-tailed value obtained after analysis using the Hartley test which is greater than the alpha value (0.05) so that the conclusion that can be drawn is that the two data groups have homogeneous variants. Because both trial conditions have been met, data analysis can be continued on the independent t-test. A recap of the results of data analysis for the independent sample t-test is presented in Table 3.

Table 3. Independent Sample t-test results

No	Variable	Score
1	*F*	0.004
2	*Q*	4,698
3	*df*	50
4	*Sig 2-Tailed*	0.000

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Based on table 3 it can be seen that there are differences in student understanding between classes whose lectures use the PjBL model and classes that carry out conventional learning.

Physics is actually a blend of learning in theory, hands-on practice and an understanding of the application of material in everyday life. There are many ways that can be done so that these three concepts can run concurrently and cohesively blend in with each other in the learning/lecturing process. One way that can be done is to use the PjBL model. The PjBL model can accommodate the lag and limited time available in face-to-face learning and replace it in guided independent learning. In addition, learning using the PjBL model can enrich students' knowledge of material application due to the nature of the implementation of the PjBL learning model which is direct by involving learning objects as a whole and concretely. The use of this PjBL model also allows students/students to be actively involved in building knowledge, accommodates the duration of independent study time in a structured manner and improves the skills of working together /working in teams.

The concept of independent learning is one of the achievements that will be achieved in the learning process in the future (Lille & Romero, 2018). Independent learning has also begun to be activated and prepared for students in welcoming education in the era of the industrial revolution 4.0 (Lee et al., 2019). The PjBL learning model is an appropriate model and can be applied to train student learning independence. Basically learning with the project concept (PjBL) does not necessarily let students learn for granted. However, there are a number of things that are important to note, including educators still acting as mentors in learning, educators can also play a role as determinants of learning directions and projects so that student achievement can be achieved in accordance with predetermined targets. In addition, if under certain conditions, there are obstacles in the implementation of project activities, the educator can act as a solution guide so that the implementation of learning activities can be carried out properly.

Projects made in learning Physics in tertiary institutions can be adjusted to the relevance of the disciplines of the majors. For Physics learning in majors related to informatics fields and disciplines, projects aimed at increasing understanding and training students' skills in the field of information technology. The project implemented in basic physics lectures in this research is the design of an audiovisual media that contains content related to the application presentation of basic physics material that has been studied in face-to-face learning in class. Students are assigned to choose an application from the topics that have been studied in the basic Physics course, then make a video that is packaged attractively related to the application of the material.

This project-based learning activity which involves making videos is proven to be able to increase students' understanding of the application and application of basic physics material in everyday life. Presentations and reviews arranged in the form of digital products allow students to collaborate with each other and explore in-depth information on lecture material. Information about lecture material is important for students in their lectures. Difficulties in meeting students' needs for information on course material will have an impact on their learning achievement (Zakirman & Rahayu, 2018).

There are many ways that can be done to equip students skilled in the concept of active learning, such as project-based learning that has been studied. Students are faced with a situation where the information and material descriptions obtained are not only limited to the presentation presented by the lecturer, but furthermore it is expected that students are able to explore and elaborate on material by utilizing a wider range of learning resources (Felek & Gül, 2015). One of the learning resources in question is learning with the concept of " *learning by doing* " using the concept of project-based learning (Hanif et al., 2019).

In the future, it is hoped that the PjBL model will not only be developed and implemented to increase students' understanding of the material, furthermore the PjBL model can become a forum for training the skills and abilities of the students themselves. Various significant impacts were observed during the research activities including: 1) The use of the PjBL model can train students' communication skills; 2) The PjBL model can enable the creation of problem-based learning nuances and train critical thinking skills; 3) will eventually produce a product. Creative works in the form of products can be a guide in assessing one's creativity. This means that the PjBL model also supports the honing of student creativity; 4) The concept of project-based learning that allows students to work in teams can train student collaboration skills.

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Based on the presentation and research findings described previously, it can be concluded that the PjBL model can train the 4C *(Collaboration, Communication, Creativity, Critical thinking and Problem solving) skills* needed in preparing students to face the industrial revolution era 4.0. In addition to increasing understanding which is a direct impact of the PjBL model, the accompanying effects that have emerged and been observed in the research that has been conducted include improving students' 4C skills. Therefore, other researchers can make this PjBL model one of the models that need to be considered in designing future learning/lecture concepts and scenarios so that they can assist in achieving learning objectives.

4. CONCLUSION

Understanding of theory and application of material must be in line with Basic Physics lectures, especially at the tertiary level. Based on the results of the analysis and statistical tests as well as the discussion, it was concluded that the use of the PjBL learning model in Basic Physics lectures at UPI YPTK Padang has proven to show better results and increase student understanding when compared to conventional lectures. The PjBL model is an active learning model that can be used and recommended in Basic Physics lectures. The PjBL model can be a forum for practicing independent learning and can improve several student skills including: data literacy, technology literacy and managerial abilities.

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