

Implementation of Project Based Learning (Pjbl) at Basic Physics Course Based on Aeromodelling Project

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Abstract: The objective of this study was to describe students' abilities through Project Based Learning in Basic Physics courses with aeromodelling aircraft manufacturing projects. This research was conducted using a One-Shot Case Study design with subjects consisting of a classroom with a total of 57 students in the teaching and education faculties. Research data obtained from pretest - posttest analysis. Data analysis with percentage technique was then processed descriptively. The results showed that students' comprehension abilities increased with a significant increase in grades. From this study it can be concluded that the Project Based Learning learning model can improve students' understanding abilities.

Keywords: Aeromodelling Project; Basic Physics; Project Based Learning

Introduction

Aeromodelling is something interesting for almost all of student. Project based learning using this kind of project will be joyful and interesting. All of basics concept used by an aircraft to fly is merely physics concept, including aerodynamic, mechanics.

Education is a learning process in the form of teaching and learning activities, where interactions occur between students and teachers. In the field of education, the teacher acts as an educator who guides students to be able to develop knowledge and can change the condition of students from those who do not know to know (Sari, 2017). Education is seen as one of the main factors determining economic growth, namely through increasing the productivity of an educated workforce, and also education is seen as having an important role in ensuring the development and continuity of the nation (Sari, 2016) The quality of education can be known from two things, namely the quality process and product. Education is said to be of quality if there is an effective and efficient implementation of learning by involving all components of education, such as covering teaching objectives,

teachers and students, lesson materials, teaching and learning strategies or methods, learning tools and resources as well as evaluation (Sari, 2017).

The success of implementing education can be influenced by several factors, one of which is the readiness of teachers in preparing students through the learning process. In essence the delivery of learning materials or teaching and learning processes is a communication process, namely the process of conveying messages or thoughts from one person to another, using the right method will make students effectively able to receive the message conveyed (Sari, 2018). Based on Law of Indonesian Government no. 20 of 2003 it is clear that the task of a teacher is not only conveying knowledge but there is still much that must be done by the teacher, namely educating students to become whole human beings, thus it can be said that the teacher's task is heavier. A teacher is required to master various abilities as a professional teacher in his field (Sari, 2016). The ability in question starts from teaching methods, material mastery, selection of various teaching methods, ability to make teaching tools/media, attitudes, role models and so on. A teacher should understand his role so that in conveying material can achieve the expected learning objectives. According to

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Rusman (2012), in understanding the role of the teacher should have 4 basic educator competencies including, 1) Pedagogic Competence, is the ability to manage student learning which includes understanding students, designing and implementing learning. 2) Personal Competence, is a personality ability that is steady, stable, mature, wise, and authoritative, becomes a role model for students, and has noble character. 3) Professional Competence, is the ability to master learning material broadly and in depth which allows, guiding students to meet competency standards. 4) Social Competence, is the ability of teachers as part of society to communicate and interact effectively with students, fellow educators, parents of students, and the surrounding community.

More about PjBL, Fogleman et al. (2011) state that activity structure for students who completed investigations themselves had greater learning gains compared to students merely in classrooms who observed their teacher completing the investigations as demonstrations. Hernandez and De La Paz (2009) examine content issues of knowledge tests, group projects, attitude and opinion surveys to determine relative benefits for students who has participated in a technology-assisted PjBL experience, and contrasted their experiences to those of students who received a traditional teaching instruction. Holm (2011) has performed literature study on the effectiveness of PjBL, its find that PjBL has significantly effective in learning process.

Education is inseparable from the curriculum that has been designed, compiled and determined by the government which influences the quality of education in a country. Referring to the 2006 Education Unit Level Curriculum, it is known that Natural Sciences is related to how to find out about nature in a systematic way, so that Science is not just mastering a collection of knowledge in the form of facts, concepts, or principles. principles but also a process of discovery. Therefore, in the science learning process students are given the opportunity to find the truth of a fact or concept from the material they are studying through experiments, so that students have the skills to observe, analyze, prove and draw conclusions from an object and write down a situation or a process that silent (Sari, 2017).

Therefore, teachers must be able to create a conducive and enjoyable learning atmosphere for students so that learning objectives can be achieved properly. Responding to this fact, teachers are required to make improvements and practice learning in class, one of which is by using the Project Based Learning (PjBL) model. Project Based Learning is "a learning process that directly involves students to produce a project. Basically, this learning model develops more solving skills in working on a project that can produce something. In its implementation, this model provides

broad opportunities for students to make decisions in selecting topics, conducting research, and completing a particular project. Learning by using the project as a method of learning. The students work in real terms, as if there is a real world that can produce realistic products. Based on the background above, the formulation of the problem raised is "how is student basic physics understanding through the application of the Project Based Learning model?" The research objective is to describe student basic physics understanding through the application of the Project Based Learning model.

Method

The research design is a One-Shot Case Study experimental design (Sugiyono, 2008:78). The research subjects were students of one class in the food technology study program at University of Mataram consisting of 49 students in 2022. The learning process emphasizes project-based learning to construct aeromodelling aircraft to increase understanding of basic physics subject.

The aircraft can fly because of the lifting force of the aircraft wing as the result of the pressure difference between the air below minus the wing and the air above the wing. This difference of pressure arises due to the difference in the velocity of the airflow above and below the aircraft wing caused by the cross-sectional shape of the aircraft wing or better known as the airfoil. The higher the difference in velocity above the wing and under the wing, the greater the upward force of the plane's wing as shown in Figure 1 (Zuhdi, et al. 2022).

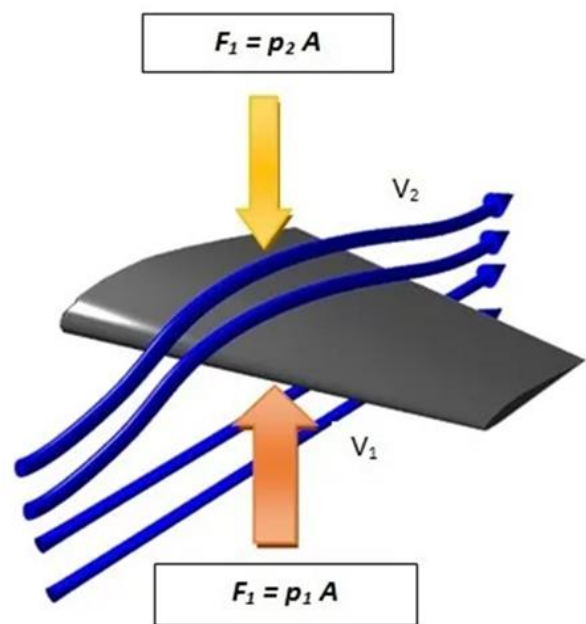


Figure 1. Air flows over aircraft wings surface

In order to fly, an air modeling aircraft must meet the requirements of the laws of physics, including the lift force of the aircraft, the center of gravity of the aircraft and the thrust of the aircraft. An understanding of aircraft lift is based on basic physics on fluid kinetics and force balance.

An understanding of the center of gravity of the aircraft will provide students with an understanding of basic physics material in the sub-chapter of the center of mass of the center of mass torsion translational equilibrium and rotational equilibrium. An understanding of aircraft thrust provides students with a good understanding of the material in sub-chapter Newton's laws and force vector analysis.

The instrument used in this research physics test sheet developed by researcher. The observed data is pretest and posttest. The data obtained was analyzed using the percentage formula proposed by Hake (2018).

Table 1. Increment Criterion of normalized N-Gain according to Hake (1998)

N-Gain	Increment Criterion
$G \geq 0.7$	High
$0.3 \leq G \leq 0.7$	Fair
$G \leq 0.3$	Low

Result and Discussion

Students' ability to construct aircraft shows understanding of physics concept. Assessment of aircraft ability to maneuver during testing the aeromodelling will bring deeper understanding in basic physics concept. The test of aircraft performed in June 2022 in Selaparang ex airport of West Nusa Tenggara Province, in Lombok Island, Indonesia. Pretest was performed before lecture and the posttest is performed as an examination test in the semester.



Figure 2. Type of Delta Wing aeromodelling aircraft developed by the students.

In Table 2 it can be seen that students' understanding through PjBL learning is in the very high category with an average n-gain of 0.560 obtained by 57

students. The high category is shown by the n-gain value of 0.87 which was obtained by 16 students with highest N-gain of 1.124 and the lowest one of 0.715. The fair category is shown by the n-gain value of 0.511 which was obtained by 33 students with highest N-gain of 0.699 and the lowest one of 0.302. The Low category is shown by the average n-gain value of 0.129 which was obtained by 16 students with highest N-gain of 0.29 and the lowest one of -0.053.

High N-gain scores were obtained by students with average activity above the average activity of their classmates. These students are also active in lectures and in carrying out assignments independently or in groups. Low N-gain scores are obtained by students with lower average activity than their friends and absent several times while studying or working on project based learning. In general, the bus learning project with the aeromodelling project can increase students' understanding of basic physics subjects in this class.

Table 2. N-Gain of all students. Numbers divided based on the criterion of High, Fair and Low

No	Pretest	Posttest	N-Gain
1	61.8	98	1.124
2	65.4	96.7	1.094
3	61.7	95	1.031
4	64.5	94.9	1.031
5	63.7	93.5	0.983
6	64.2	92.7	0.956
7	59.5	90.6	0.901
8	62.9	88.8	0.833
9	59	87.4	0.811
10	63.6	87.3	0.780
11	64.4	87.4	0.777
12	61.4	86.5	0.770
13	63	86.2	0.748
14	61.2	85.7	0.747
15	61.6	85.2	0.728
16	63.5	85.3	0.715
1	61.1	84.1	0.699
2	63	84	0.677
3	60.6	83.1	0.674
4	59.2	82.5	0.670
5	63.5	82.6	0.626
6	61.7	81.5	0.613
7	60.2	80.9	0.612
8	60.1	80.8	0.611
9	60.9	81.1	0.610
10	58.4	79.8	0.601
11	58.1	79.3	0.591
12	63.2	81.3	0.588
13	60.2	79.6	0.574
14	58.8	78.9	0.571
15	58.8	78.4	0.557
16	62.1	79.7	0.552
17	56.7	77	0.544
18	58.2	76.8	0.520
19	59.3	76.2	0.487
20	56.5	74.2	0.472

No	Pretest	Posttest	N-Gain
21	57.2	74.5	0.470
22	61.6	76.6	0.463
23	61.1	75.5	0.438
24	55.4	72.1	0.433
25	58.3	73.6	0.429
26	56.3	72.2	0.422
27	59.8	73.7	0.406
28	59	71.4	0.354
29	58.1	74	0.343
30	59.8	71	0.327
31	55.9	68.3	0.325
32	56.1	67.9	0.311
33	60.9	70.9	0.302
1	57	67.7	0.289
2	57.9	67.4	0.263
3	55.6	63	0.193
4	58.7	64.8	0.173
5	58.5	62.1	0.101
6	58.8	60.1	0.037
7	55.8	56.9	0.029
8	56.2	54.2	-0.053

Understanding basic physics concept is defined as a mental activity that is used by someone to build new ideas or ideas about physics phenomenon in day life activities. Understanding basic physics concept involves logic and intuition together. In particular, it can be said that understanding basic physics concept is a unit or a combination of logical thinking and divergent thinking in order to produce new understanding physics phenomenon.

Conclusion

Through the PjBL learning model, students can increase their basic physics understanding in their daily life. The resulting aircraft have high value of usable physics in technology. This provides opportunities for students to create technical courage spirit. In other words, the PjBL learning model is a learning model that requires skills using the principle of learning while doing (learning by doing). PjBL provides students with opportunities to research, plan, design and reflect on making technology projects. In addition, PjBL model can increase the learning basic physics understanding of students in the class. Basic physics concept thinking in a PjBL requires not only changes in teaching methods and learning conditions, but also adopts new assessment methods such as activity-based portfolios of student. The portfolio will reflect what students have learned how to ask questions, analyze, synthesize, solve problems by generating new ideas, and then design and create a new innovative product. The portfolio also displays how students interact intellectually, emotionally and socially with their colleagues.

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