



Blended Learning Using PhET and Props to Improve Students Concept Understanding

Monika Grasiana Benta[✉], Wiyanto

Physics Education, Postgraduate FMIPA Universitas Negeri Semarang, Semarang, Indonesia

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Abstract

This study aims to improve students' understanding of concepts for high school class X on topic of Work and Energy. This research is a quantitative research, a type of experimental research, namely True Experimental Design. The research design used pre-post test experiment design. Instruments used in research using assessment of students' concept understanding. The results of the study of concept understanding using the Blended Learning model are 0.69 and Conventional is 0.64 which both use PhET media and teaching aids. Blended Learning is slightly higher. The effectiveness of Problem-Based Learning between Blended Learning classes shows the average result of understanding student concepts is 84.08 and conventional classes show the average result of understanding student concepts is 82.11. The independent t-test analysis was -1.02 and the significant 2-tailed was 0.31, while the 0.05 study alpa showed $0.30 > 0.05$. Significant results show that Blended Learning classes are more effective than conventional classes.

INTRODUCTION

One of the obstacles that often occurs in learning activities at school is limited teaching time in class. Time management is very important for physics teachers, because there are some physics materials that are very difficult to understand if taught only once. Students who do not understand physics concepts need more time to learn physics material. Understanding concepts is one of the factors needed for learning, so that students can solve problems faced during the learning process (Subagiyo, 2019). However, there are still many students who have difficulty in understanding the basic concepts of physics after being given instruction and students also experience misconceptions in learning physics. Teachers are expected to overcome difficulties that occur by conducting research or conducting innovative and creative learning. One of them is by using the Blended Learning learning model.

Blended Learning is learning that combines delivery methods, teaching models and learning styles and introduces various learning media (Surakarta & Abduh, 2021). Blended Learning is able to stimulate students to be active and increase independence (Marlina, 2020). One of the Blended Learning type is learning that combines offline learning and online learning. Blended learning typically uses learning applications, but still maintains an open meeting and conventional approach to support.

In addition to Blended Learning, a method that can be used to improve student understanding is the Problem-Based Learning method. Problem-Based Learning is learning that uses events seen in everyday life. In solving problems, students must conduct experiments to be able to formulate problems, formulate hypotheses, collect information, conduct experiments, analyze data and draw conclusions. In Problem-Based Learning, teachers must use a learning process that will move students to be independent and learn continuously (Maryam, 2018). Learning requires teachers to develop collaboration skills among students and assist students in integrating problems together and independently (Zunanda & Sinulingga, 2015). The disadvantages of Problem-Based Learning are (a) Problem-based learning it cannot be applied to every subject matter, there is a part of the teacher playing an active role in presenting problems, (b) Problem-based learning is more suitable for learning that demands certain abilities related to problem solving, (c) Problem-based learning usually requires a lot of time so it is feared that it cannot reach all the

expected content. The learning carried out is expected to be effective, so it is necessary to apply media that is able to create a conducive learning atmosphere. Learning media has various benefits, including students being more creative, overcoming limited understanding, increasing enthusiasm for learning, and students can learn independently according to their abilities (Kristiana, et al, 2017).

One of the learning media that can be used is PhET (Physics Education Technology. PhET is a virtual practicum that uses a web browser as long as Flash and Java plug-ins are installed on the laptop. PhET simulation is available for free and downloaded through the website of <http://phet.colorado.edu> (Riady et al., 2016). Students can use PhET at home to practice practicum virtually, helping students be more active and creative. The app has lots of animations, interactives and quizzes for students to explore while playing. However, the use of PhET alone can cause burnout in students. Therefore, to get optimal results, it can be combined using props.

Teaching aids are learning media that make it easier for students to see and touch the tools directly and understand the process (Suwardi et al., 2014). Teaching aids will help students in the development of knowledge, creative, basic material delivery needs and physics concepts. Students often have difficulty in understanding physics concepts, so it is necessary to do virtual practicum and practicum directly, so that students can understand physics concepts correctly. Teaching aids can improve students' ability to understand physics concepts because students directly observe the processes that occur in it so that they can improve learning outcomes, (Oktafiani et al., 2017). Therefore, to improve students' understanding of concepts in this study, a learning model was out "Blended Learning using PhET and Teaching Aids to Improve Student Concept Understanding". In this study, Blended Learning was carried out using PhET and teaching aids. As a control class, the Problem-Based Learning method is used using PhET and teaching aids.

METHODS

The research method is quantitative research. The research design used pre-post test experiment design. This design takes two classes that were randomly assigned out of four classes. The experimental class used a Blended Learning learning model with PhET media and teaching aids and the control class used a Problem-Based Learning model using PhET media and teaching aids. The experimental class conducted PhET virtual

practicum at home and conducted teaching aids practicum in class, while the control class conducted PhET virtual practicum and props practicum in the classroom. The topic studied in this research was Work and Energy. The samples used were students of grade X MIPA 3 (experimental class) and class X

MIPA 4 (control class). The instrument used was an essay to measure students' concept understanding ability with Problem-Based Learning between Blended Learning classes and conventional classes which both use PhET media and teaching aids. The research design is shown in Table 1.

Table 1. Research design pre-post test experiment design

Class	Pre Test	Treatment	Post Test
Experiment	O1	Blended Learning using PhET media and teaching aids	O2
Control	O3	Problem-Based Learning using PhET media and teaching aids	O4

RESULTS AND DISCUSSION

The purpose of the normality test is to find out whether the data is normally distributed or not.

The normality test was performed with the help of SPSS Statistic 21 using the Kolmogrof_Smirnov test. The normality test results are shown in Table 2.

Table 2. Tests of Normality

Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statisti c	df	Sig.	Statisti c	df	Sig.
P Experiment	0,087	36	0,200*	0,979	36	0,725
K Control	0,160	36	0,020	0,962	36	0,239

Based on the Kolmogrof-Smirnov test on the above output with a real level of 5% obtained the significance of the experimental class is 0.725 then H0 is accepted and the control class is 0.239 then H0 is accepted. This means that the study sample is normally distributed.

A. Initial Data Homogeneity Analysis

The homogeneity test was carried out to find out whether the research sample comes from the same homogeneous condition or not. The results are shown in Table 3.

Table 3. Test of Homogeneity of Variances

Levene Statistic	df1	PK		Sig.
		df2		
1,209	1	70		0,275

Based on the results of the SPSS, the significance value is 0.275. Therefore, H0 is accepted. This means that the experimental class and the control class have the same variance.

B. Initial Average Similarity Analysis

A preliminary mean similarity test was performed to determine whether or not the sample group has the same average statistically. The results are shown in Table 4.

Table 4. Independent Test Samples

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
PK	Equal variances assumed	1,209	,275	-,264	70	,793	-,446	1,694	-3,825	2,932
	Equal variances not assumed			-,264	68,629	,793	-,446	1,694	-3,826	2,933

Based on the results of the SPSS, the significance value is 0.793 so that H0 is accepted. There was no difference in significance from the average results of understanding the concepts of experimental and control class students.

C. Final Data Normality Analysis

The normality test was used to determine whether the data on post-test scores of students'

concept comprehension abilities in the experimental class and control class are normally distributed or not. The data used in this test was post test value data. The normality test was performed using SPSS Statistic 21 with the Kolmogorof-Smirnov test, as shown in Table 5. It can be seen that the significance value of the experimental class is 0.081 and the control class is 0.282, so based on the test criteria the hypothesis is that H0 is accepted. This states that the post-test value is derived from the normal distribution.

Table 5. Tests of Normality

Class		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
PK	Experiment	0,106	36	0,200*	0,947	36	0,081
	Control	0.150	36	0.038	0.964	36	0.282

D. Final Data Homogeneity Analysis

The homogeneity test was carried out to find out whether the research sample comes from the same homogeneous condition or not. Based on the results of the SPSS output above, it can be seen that the significance value is 0.646 > 5%, so based on the test criteria, Ho is accepted. There is no difference in variance between the experimental class and the control class. It can be inferred both classes of variance are equal or homogeneous.

Table 6. Test of Homogeneity of Variances

PK			
Levene Statistic	df1	df2	Sig.
0.213	1	70	0.646

E. N-Gain Test Analysis

The results of the N-Gain Test analysis to calculate the increase in students' understanding of concepts in the Blended Learning and Problem-

Based Learning learning models, both of which use PhET media and teaching aids, can be seen below.

Table 7. N-Gain Test

Class	Score	Criterion
Experiment	0.69	Keep
Control	0.64	Keep

The results of the data analysis above showed that the experimental class and the control class experienced an increase in understanding of concepts with moderate criteria. Both learning models can be used to improve understanding of concepts by adding both PhET media and teaching aids. The difference in learning scores between the two models is very small because both models use the same media, namely PhET and teaching aids. The results show that Ho is accepted, that Blended Learning learning is higher than the conventional method.

CONCLUSION

The Problem-Based Learning Model between Blended Learning and Conventional classes which both use PhET media and teaching aids can be used in classroom learning. Both models have improved with the medium category. The percentage of Blended Learning is 0.69 while the percentage of conventional is 0.64. So in the problem-based learning model between Blended Learning classes, students' concept understanding is slightly higher than conventional classes.

The Problem-Based Learning model between Blended Learning classes is more effective than conventional classes. The experimental class's average score was 84.08 and the control class was 82.11. The independent t-test analysis was -1.02 and the significant 2-tailed was 0.30, while the 0.05 study showed $0.31 > 0.05$. Significant results state that Blended Learning classes are more effective than conventional classes.

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