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The Implemention of Virtual Laboratory PhET Guided Discovery Learning on Students' Achievement: Dynamic Electricity Topic

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Abstract

Dynamic electricity was considered as abstract concepts, needs experimental study. This research tries to apply learning in a virtual laboratory PhET by guided discovery learning where students build their own knowledge, contextual and interactive. Methods used quasi experimental design with non-equivalent control group. Results of the study showed a positive impact on the Group of medium and high IQ showed a significant effect of virtual laboratory PhET in guided discovery learning model. There is no effect for Low IQ groups. Therefore this study has added practical and theoretical to consider to teach abstract concepts in physics.

Keywords: Guided Discovery, PhET, dynamic electricity

1 INTRODUCTION

Education is one of the areas affected by the positive impact of technological developments of the 21st century, therefore the ICT (information Communication Technologies) gets into the main elements, used in education. Application of the technologies used in the field of education such as e-learning, distance learning, virtual learning and virtual classroom (Ahmed & Hasegawa, 2014). Media computer makes the whole subject matter more quickly accepted by students and attracting their interest to learn as well (Gundogdu, *et.al*, 2011). Several teachers have already begun using a range of technologies to enhance the effectiveness of the process of learning and teaching (Kriek & Stols, 2010).

Up to now, the process of teaching and learning in physics is still presented in groups of formulas (Wegener *et.al*, 2012). The abstract concept of Physics makes it difficult to be visualized the physical process display or directly through activities in the real Labs. One of the concepts of physics is the electricity. Electricity is invisible where we can't see the movement of the electrons (electrical charge carriers) on the wire, as well as difficult to learn and to be taught for real (Korganci *et.al*, 2014). The difficulty of this one utilizes a computer to simulate a simple electric circuit in meaningful learning for students (Dorneles *et.al*, 2010). Utilizing the computer to simulate something complicated is called virtual laboratory (Mahanta & Sarma, 2012). Simulation and computer models can help students to understand various concepts of abstract science (Sarabando *et.al*, 2014; Pfefferova 2015; Tolga, 2011; Bajpai. 2015). Virtual Laboratories made students got experience as if a real laboratory experiments (Martinez *et.al*, 2011). Virtual laboratory PhET is interactive, contextual and usage calculation simulation effectively to help students understand abstract concepts (Supurwoko *et.al*, 2016). Virtual laboratory PheT make students exploration as well as the activity of scientists, thus they can learn more and more about a concept of Science (Adams, 2010). According to Ajredini *et.al*, (2014), there is no significant difference between knowledge gained through real laboratory and through laboratory PhET.

The use of virtual laboratory PheT is combined to pedagogic teacher so learning process is more guidable (Sarabando *et.al*, 2014; Wieman *et.al*, 2010). One of the learning models are suitable for

attracting students actively participate in learning and learning outcomes increased is guided discovery learning model (Shien & Yu, 2016; Saeful bahri, 2015). Guided discovery learning that recommended in physics learning helps students create, integrate, and generalize knowledge through problem-solving with constructivist learning prepared materials (Abdisa, 2012). Based on the above explanation, this research aims to implement a virtual laboratory PheT in guided discovery learning model on student's learning outcome of dynamic electricity concept.

2 METHODOLOGY

The research method was quasi experiment design with non-equivalent control group design. The population of the research was the whole grade X senior high school (HIGH SCHOOL) Paradigm Mauk Tangerang Regency, where the school was supported by Computer Assisted Instruction (CAI). The teachers tend to use the Power Point program. Currently power point become a standard technology for public school teaching.

Sample selection technique namely purposive sample. Research was conducted in two classes. Class X2 and X3 classes, each class contains 23 students. X2 was experiment class X3 was control class. Experiment Class used virtual laboratorium PheT guided discovery learning model to learn. Grade control used conventional methods. The students of class X2 and X3 are divided into 3 groups based on the level of IQ. IQ groups are low IQ groups (students have a low IQ), medium-sized groups (students have common IQ) and high-IQ groups (students have a high IQ). The instruments that used to obtain data is the cognitive tests. Cognitive test aims to find out the increasing cognitive ability in the cognitive level C1 (recall), C2 (comprehend), C3 (apply), and C4 (analyse). The data were analysed by using the N-Gain test equation 1.

$$N - Gain = \frac{posttest - pretest}{100 - pretest} \quad (1)$$

Measurement of cognitive ability is obtained from the results of a pre-test and post-test. Interpretation of N-Gain boost test result is 0 0.3 G < category < low, 0.3 ≤ G medium category 0.7 < and 0.7 < G of high category (Ridwan & Akdon, 2013). Prerequisites normality test using the Kolmogorov Shapiro-Wilk and homogeneity test (test Levene). If the data are normal and homogeneous, test hypotheses use testing T. If data is not normal and homogeneous, the hypothesis test use the Mann-Whitney test. Level of significance is 5%.

3 RESULT AND DISCUSSION

Before giving treatment, firstly doing pre-test to determine experiment and controls class. From the whole class X with a total of four classes. Class X3 has the highest average rating, so X3 would be control class and X2 was made as an experiment class. Pre-test results in analysis with Kolmogorov-Shapiro Wilk normality test showed in Table 1.

Table 1 Normality *Pre-test* result

IQ Group	Experiment Class		Control Class	
	Significance	Information	Significance	Information
Low	0,200	Normal	0,200	Normal
Medium	0,200	Normal	0,002	Not normal
High	0,200	Normal	0,200	Normal

Students were given a treatment with assisted discovery guided learning virtual laboratory PhET. While the class control using conventional methods. End of learning all students did post-test. Post-test results are analysed with Kolmogorov-Shapiro Wilk normality test on Table 2:

Table 2 Normality Post-test Result

IQ Group	Experiment Class		Control Class	
	Significance	Information	Significance	Information
Low	0,200	Normal	0,200	Normal
Medium	0,200	Normal	0,160	Normal
High	0,163	Normal	0,133	Normal

Pre-test and post-test data then are tested in homogeneous test to know which data homogeneous or heterogeneous. Its homogeneity test with Levene test in Table 3:

Table 3 Homogeneity *Pre-test and Post-test* result

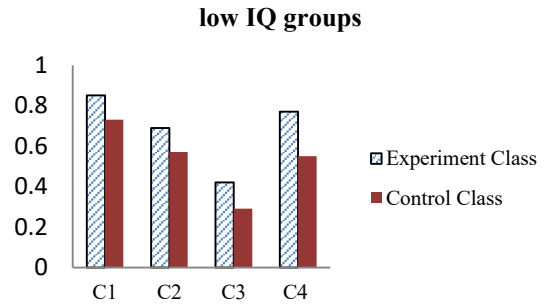
IQ Group	*Pre-test*		*Post-tests*	
	Significance	Information	Significance	Information
Low	0,485	Homogen	0,032	Heterogen
Medium	0,052	Homogen	0,514	Homogen
High	0,371	Homogen	0,571	Homogen

Pre-test and post-test data are tested on hypothesis test to find out the effects of the treatment given. Such a Hypothesis test results Table 4 below:

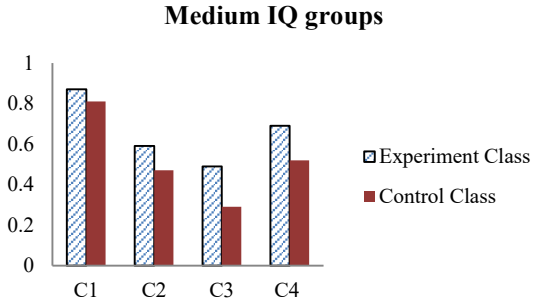
Table 4 Hypothesis *Pre-test* and *Post-test* result

IQ Group	Control Class		Experiment Class	
	Significance	Information	Significance	Information
Low	0,032	H_1 accepted	0,413	H_1 rejected
Medium	0,791	H_1 rejected	0,002	H_1 accepted
High	0,587	H_1 rejected	0,026	H_1 accepted

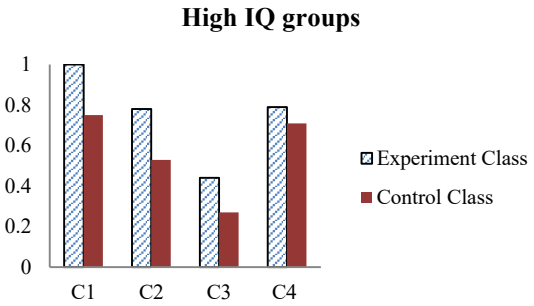
Based on table 4, we can see the effect of guided discovery learning model using virtual laboratorium PhET have no effect on students group of low IQ. While the effects of the PhET effect on both groups of medium and high IQ. This is in accordance with the research Ahvan & Pour (2016) and Laidra *et.al*, (2007) shows that there is a positive relationship between the intelligence and the accomplishment of learning in students. High low intelligence will affect each other so they can be promoted to the low learning achievement high accomplished students. Virtual laboratory PhET made to student involvement in learning increases (Wieman *et.al*, 2008). Learning through discovery students can also be active and participate positively in learning as well as the results of their studies increased Shien & Yu (2016). Student learning outcomes can be seen from the test N-gain in Figure 1 below.



(a)



(b)



(c)

Figure 1 Test N-gain based on the cognitive aspects (a) low IQ groups (b) Medium IQ groups (c) high IQ group

Based on Figure 1 cognitive Level C1 (recall), experimental classes gain percentage higher than the control class from each group IQ. This is because the simulation PhET was able to give real visualization allowing students easy to recall (Supurwoko, Search, Sarwanto, Sukarmin, and Suparmi, 2013). Cognitive aspects of C4 (analyse), experimental class earn a percentage higher than the control class from each group IQ. This is due to the method of research discoveries can improve students' enthusiasm in learning activities processed (Saeful bahri, 2015). Guided discovery learning recommended in physics learning to help students create, integrate, and generalize knowledge through problem-solving constructivist (Abdisa, 2015).

4 CONCLUSIONS

We managed to create a simulation model used in PhET guided discovery learning on the concept of dynamic electricity. The result is just the Group of medium and high IQ were affected while a group of low IQ is not. This means that the virtual laboratorium PhET in the guided discovery does not affect the low group.

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