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Virtual Lab Experiment: Physics Educational Technology (PhET)Photo Electric Effect for Senior High School

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Abstract. This paper introduced these Physics Educational Technology (PhET) Simulation and demonstrated their utility for Senior High School Students. The PhET simulations are very involved, interactive animated environments that create a unique opportunity for students. In each case, we demonstrate that discussion simulations are more productive, for developing student conceptual understanding for photo electric effect than traditional discussion without simulations. During the discussion with PhET simulation, students can construct their understanding about concepts photo electric effect within this framework. Students learn by building on their prior understanding through a series of constrained and supportives exploration. The simulations support an interactive approach and constrain students productively.

1. Introduction

Physics is one of the most fundamental natural sciences which are a field that involves the study of universal law and the behaviors and relationship among a wide range of physical concept and phenomena. Understanding and mastery of the concept of physics is good and true in learners will be able to contribute appropriately to technological progress. The concept of physics are good and right can be realized through education that is implemented according to the appropriate approach, strategy, method, and media in the learning process. Through the learning of physics student acquires conceptual knowledge relevant to their daily life and develop scientific attitude and vision. This scientific attitude and vision can be developed by allowing young minds to perform experiments in the physics lab and observe and understand the scientific phenomena to happen in a natural world in which we live[10] . The process of reproducing phenomena in the laboratory enables scientists to study, in quantitative detail, aspects of specific phenomena, and to understand specific concepts[8].

One of the causes of low student achievement on the subject of physics is the learning media used by teachers less attract students[12]. In general, Physics learning media rely solely on whiteboards. Physics Learning using blackboards attracts students

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less, because they are less attractive, boring, and require high concentration. The shortage in the use of the blackboard affects the students' motivation in studying Physics Science[9].

The growing of learning media of physics in school cause of learning media to grow one of computer learning. In schools with international standards and schools that have supporting infrastructure facilities must have used computers in learning. Each class is equipped with LCD projector, and each teacher has a laptop or laptop. Besides, regarding human resources, teachers as learning facilitators are required to be able to use the computer to facilitate the arrival of material given to students without having to use the blackboard and stationery[11].

Learning process using a computer can be supported by the existence of computer simulation media that can reduce the real situation from the scientific phenomenon[6]. One of the easiest downloadable simulation media is PhET. PhET is an abbreviation of (Physics Education Technology) is a site that provides simulations of Physics, Chemistry, Biology, and Mathematics learning that can be downloaded for free for the benefit of learning in the classroom. Simulations in PhET are interactive and packaged in a game-like form that makes it easier for students to explore. PhET has more than 50 simulations of learning materials that can be used in various learning such as Physics, Chemistry, Biology, and Mathematics. PhET Interactive Simulations are a substantial and growing suite of professional quality simulations for teaching and learning distributed from the PhET website http://PhET.colorado.edu, with roughly 10 million uses in the past year. The majority of PhET sims are for teaching physics, but there is a growing number in chemistry, biology, math and other sciences. Considerable re- search has investigated the use of PhET sims in a variety of educational settings (PhET Team, 2009). Learning by using PhET simulations makes the students interested and the spirit to do the lab so that it can help in completing the study of students[3].

2. Learning design of PhETSimululation

In each classroom study, there is a syntax or sequence pattern that describes the flow of a series of lessons. Quite a lot of developing a variety of learning approaches that can become benchmarks of teachers in developing learning strategies. If teachers can choose the right strategy, then the learning process innovation will grow. One of the learning innovations that grew in the 21st century is computer-based learning using an animation that is the development of ICT advancement[7]. Animation is used as a virtual laboratory that can be used as a medium of learning in the classroom[4].

Stages of learning using ICT can be seen at figure 1.

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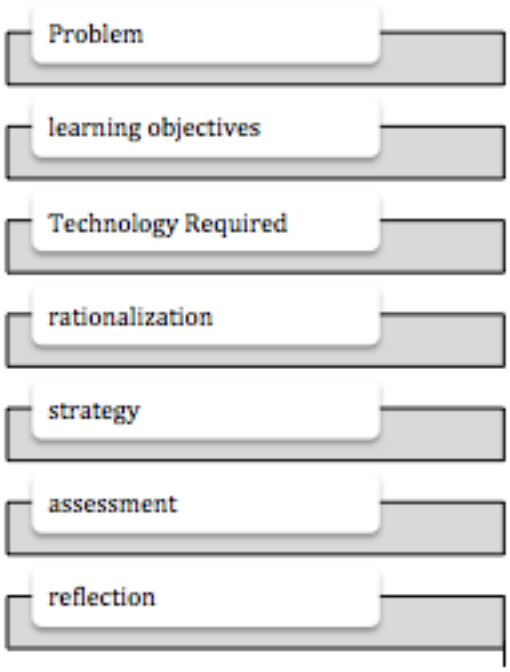

Figure 1. Systematic Model of Topical ICT-Based Integration[5]

Sutrisno (2011: 60) who quotes opinion Warschaner said that "ICT can improve motivation, skills, the structure of thinking, communicate electronically and more effectively in learning". Learning stages can be adapted to the use of learning approaches[5] . The approach used in this paper is the constructivism approach.

Syntax using computer animation media PhET Simulation in Physics learning on Photoelectric Effect material based on constructivism has several stages of invitation, exploration, solution and explanation, follow-up and expansion[1]. Beginning by raising issues relating to the material and phenomena that exist in everyday life that are intended to motivate students, PhET Simulation media exploration by students with the help of LKS to achieve the desired learning targets, discussed based on data obtained by students from experiments using PhET Simulation , Conveying the results of the discussion and concluding. After that, the teacher can guide students to find the application in everyday life.

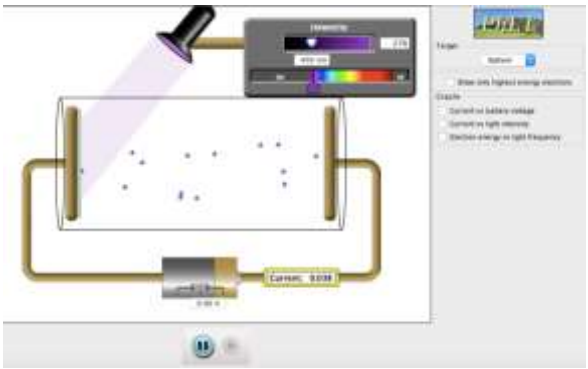

Figure 2. Screenshot of PhET Simulation, Photo electric effect[2]

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Display a photoelectric animation that will be used for virtual experiments and divide the students into groups of 4 students. Students discussed based on students' prepared worksheets. In the worksheet, there is a goal to be achieved that students can know the relationship between Intensity, wave frequency, and metal types to electrons out of metal.

3. Research Studies

Physics Education Technology (PhET) Simulation is an interactive physics simulation software available on sites that can be downloaded for free and can be run online or offline[5]. Physics Education Technology (PHET) Simulation or PHET is an interactive animation of research-based physical phenomena, which can be used for free. The PhET team from the University of Colorado at Boulder America states a research-based approach, combining previous research results with self-directed activities, enabling students to incorporate real-life phenomena and underlying science. This will ultimately deepen their understanding and increase their interest in the science of physics. All simulations have been extensively tested and evaluated to ensure the effectiveness of teaching and their use. The tests include interviews with students, simulation practices in various situations, lectures, group work, homework and laboratory work. The ratings indicate that testing of each type of simulation is sufficiently complete and sufficient.

To prove that discussion simulations are more productive, for developing student conceptual understanding for photo electric effect than traditional discussion without simulations conducted research in SMAN 4 Surakarta. The method that used in this research is the experimental method. Variables used in this research are an independent variable which consists of constructivism approach and student's learning motivation and dependent variable that is student's cognitive ability. The study used two classes of experimental class and control class that had the same initial ability and were treated differently. The experimental class is treated in the form of learning with a constructivism approach using virtual simulation discussion method, while the control class is treated in the form of learning with constructivism approach using traditional discussion method.

From the observation found that students in the experimental class more active during the learning process. Students interact with the PhET media and group friends to discuss issues raised through worksheets. Students are more active in asking and discussing photoelectric effect materials. PhET simulations can describe the photoelectric effect phenomenon that is easy to understand because the photoelectric effect phenomenon is described through an interactive and attractive virtual simulation. PhET wrapped in colorful packaging so as to increase students' interest to use it.

Based on the research, both learning methods used have advantages and disadvantages when used in classroom learning. The advantages and disputes to discuss using the method of virtual simulation discussion and discussion freelance. The advantages of virtual simulation discussions using PhET Simulation are students can interact actively during the learning process. Students have the opportunity to directly seek answers from the simulated media provided by the teacher.

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Students with high learning motivation in Physics subjects will have great effort and willpower in trying to understand the material of Physics. Efforts that can be observed are where students carry books related to physics, actively ask and argue, pay attention to teacher explanation, do not disturb friend when lesson, doing the task from the teacher, recording material of physics and not doing other subjects task. Highly motivated students have a strong impetus to study Physics to get satisfactory results. While students who have low learning motivation Physics gets less satisfactory results. Also in the discussion of students can emerge new questions that arise because using simulation PhET media and can be interpreted students become more creative in asking. While the lack of virtual simulation discussions using PhET is the students need more time to explore and seek answers to questions provided through LKS. Where each meeting of students in 2 × 45 minutes is less than the maximum to use the simulation PhET Simulation media and answer questions of teacher given through worksheet.

The advantages are reinforced by the research of Taufiq in S. Prihaningtias (2013, 5-6), PhET simulations give a positive, interesting, and entertaining impression and assist in a thorough explanation of a natural phenomenon. Therefore, students practicing PhET simulations are happy and easy to learn. PhET Simulation gives a positive impression, interesting and entertaining, and helps in deep explanation of a natural phenomenon. Therefore, students who practice with PhET Simulation feel happy and easy to learn[3].

Learning about the Photo Electric Effect can be generated in easy-to-use and easy-to-understand animations. Students can change free variables such as photon intensity, photon frequency, target metal, and voltage. Students can observe how electrons jump from metals in photoelectric effect events even students can see the number of electrons and compare the electron velocity out of the metal from the treatment of changing the independent variables. With the PhET Simulation, teachers can be learning material that is abstract into material that can be seen directly through computer-based animation.

4. Conclusions

PhET Simulations learning about the photoelectric Effect can be generated in easy-to-use and easy-to-understand animations. Students can change free variables such as photon intensity, photon frequency, target metal and voltage. Students can observe how electrons jump from metals in photoelectric effect events even students can see the number of electrons and compare the electron velocity out of the metal from the treatment of changing the independent variables. With the PhET Simulation, teachers can be showing material that is abstract into material that can be seen directly through the computer-based animation. Syntax using computer animation media PhET Simulation in Physics learning on Photoelectric Effect material based on constructivism has several stages of invitation, exploration, solution and explanation, follow-up and expansion. Beginning by raising issues relating to the material and phenomenon that exist in everyday life that are intended to motivate students, PhET Simulation media exploration by students with the help of LKS to achieve the desired learning targets,

discussed based on data obtained by students from experiments using PhET Simulation , Conveying the results of the discussion and concluding. After that, the teacher can guide students to find the application in everyday life.

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