APPLYING SCIENCE LEARNING PhET SIMULATION TO IMPROVE PROCESS SKILL AND KNOWLEDGE ASPECT OF JUNIOR HIGH SCHOOL STUDENT

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ABSTRACT

This research aims to improve students scientific process and aspects of knowledge, as well as to know activity and the response of the students through the application of science learning assisted PhET Simulation Program to 30 students of eight grades in junior high school. This research was experimental research with one group pretest-posttest design. Data were analyzed by descriptive quantitative results: (a) Students science process skills are increase with an average value post test results of 80 (N-gain; 0.71 with high criteria); (b) Students aspects of knowledge are increase with an average value post test results of 80 (N-gain; 0.74 with high criteria); (c) Frequency of activities that do experiment/ observation that by 18.3 percent while activities that students do at least is behavior that is not relevant to KBM by 3%; (d) The students positive response to learning process (83% with very strong criteria). Conclusion of this research that application of science learning assisted PhET simulation program can improve students process skills and aspects of knowledge.

Keywords: *PhET Simulation Program, Scientific Process, Aspects of Knowledge*

INTRODUCTION

Knowledge is the cornerstone of everything aspects of life. Development of Science and Technology (IPTEK) is increasingly rapidly hit world including Indonesia resulted in various changes in education. The change aims to realize the human resources high quality and professional to capable competing with other countries. *The Partnership for 21 stCentury Skills* (P21) explains that students should master the knowledge and skills in order to be able succeed in his work and life.

Education is closely related to the learning process, so it needs an improvement on the learning process for the purpose of education can be achieved. UU no. 20 of 2003 on the National Education System states educators and personnel education is obliged to create education atmosphere that is meaningful, fun, creative, dynamic, and dialogical. One of the factors that play a role in success of learning process is the ability of teachers to choose methods, models, and appropriate learning media. Permendiknas No. 41 2007 on Education Unit of Standard Process explains that the learning process at each educational unit takes place interactively, inspirational, fun, challenging, and capable motivating students to actively participate in learning, so that learning is no longer centered in teachers (teacher *centered*) but rather centered on students (*student centered*). Active student engagement in the learning process will be able to help students in building their knowledge appropriately and more deeply about the nature around.

Toharuddin (2011) states that Nature Science Knowledge (Science) is a unity products, processes, and attitudes, so that science learning objectives refers to these three aspects, namely: (1) knowledge, concepts, laws, and theories as well its application; (2) the ability to process, which is problem-solving process through scientific method; (3) attitudes of scholarship, among others, the attitude of responsibility, critical thinking, attention to the problems of science, and appreciation of the things that are science. Scientific process skills are a skill needed by someone to be able to learn independently (Ibrahim, 2010). Process skills required in do research and problem solving, so science learning should combine between experience of science processes and understanding of science products in the form of a good learning experience in the form of activities laboratories and field activities. Students will be able to learn the concepts well when involved in a manner directly in the induction process as observed some examples, searching and testing a case, and able to explain findings with the right words (Yang, 2010).

The observation result that has been done in schools, shows that student learning outcomes on the science lessons are lower when compared with student learning outcomes on other subjects. Students appear less active when teaching (Jurnal learning process take place. Students are less eager to follow lessons, even consider the science as difficult and boring lesson because of presentation of teachers who are still conventional and considered less attractive. One concept that is considered difficult for students is the material of Light and Optical Instruments, because the material is widely available concepts that are abstract and related with the phenomena that exist in everyday life, so it will be difficult to understand if the learning process only by reading or simply explained by teacher. Nur (2008) explained that the role of teachers in the learning process is to help the students in finding facts, concepts, or principles for themselves, rather than giving lectures and controlling all class activities.

The science lesson will be interesting and fun if there are variations of models, approaches, and learning media. One of the media that can be utilized is the medium of learning with utilizing Information and Communication Technology (ICT). Children's interest in the ICT world can used to teach a concept on students. Computer simulations will visualize the material which is difficult to serve, especially abstract physical phenomenon. Enriched learning with computer simulations are expected to add student interest in teaching materials and create atmosphere learning more fun. Kriek and Stols (2010) mention that computer simulation can be used effectively as a teaching tool in the classroom, as well as can provide greater conceptual benefits because students are better able to integrate their knowledge comparing if the students only using textbooks in the learning process. The development of ICT in learning has developed in various forms of interactive multimedia. One of the applications that can be used in science learning is a simulation program called *Physics Education Technology* (PhET).

PhET is a simulation program that has been developed by a group of researchers from the *Universityof Colorado* (Wieman, Adams, Loeblein, & Perkins, 2008). Limitations of learning by an experiment in the labaroratory can also be simulated through computer so that the PhET simulation program can be functioned as a virtual labaratory. Eggen and Kauchak (2012) state though the simulation is not providing immediate experience for students, but simulation is more flexible and interactive so it can improve students' motivation and understanding. Learning process by utilizing computer simulation program also provides an opportunity to bring the world of education at a higher level of quality (Ajredini, Izairi, &Zajkov, 2013).

Light and Optical Instruments are the material related to daily life. Based on analysis of Basic Competency 3.11 in class VIII semester 2, "Describe the properties of light, formation shadows, and its application to explain human vision, and the working principle of optical tools ", there is nowledge that is abstract, so less precise if the material is taught only verbal or through the image media only. Then need an interactive learning process for learning does not tend to be boring.
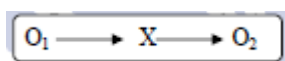
Learning science by using PhET simulation program is expected to help students in the process of building knowledge and skills, increasing students' motivation in learning, and making the learning process becomes more interactive. Science learning becomes meaningful when students have the skills of the science process, so students are able to investigate and observe

natural phenomena that is around scientifically. It is supported by research that has been done by Sugiarti (2015) about the use of PhET simulation program in learning which is able to build concepts and students' science process skills. Research result by Permatasari(2013) shows that learning science in junior high school with worksheet as supporting virtual media PhET can accomplish cognitive learning outcomes product and process skills as well as gain a positive response from students.

Based on the description of the problem, it is necessary to do research with the title "Applying Science Learning PhET Simulation to Improve process skill and Knowledge Aspect of Junior High School".

RESEARCH METHODS

This research is a pre experimental research, which only provides treatment in the absence of comparator class (control class). The research design used is *One Group Pretest-Posttest Design*, as shown below.

$$O_1 \longrightarrow X \longrightarrow O_2$$

Notes:
O 1: *pretest* (before treatment)
X: treatment (learning science with PhET simulation program)
O 2: *post test* (after treatment)

The trial of this research was conducted on 30 students class VIII at SMPN 1 Ngoro 2016/2017. The research procedure includes the preparation stage, namely preparing learning tools and instruments research, then the implementation phase in class. The research instrument is validated by three validators. Technique of taking data in this research conducted through test, observations, and questionnaires. The material developed is Light materials and Optical Devices.

RESULTS AND DISCUSSION

Based on the results of science study aided PhET simulation program implemented in SMP Negeri 1 Ngoro in the form of, the skill of science process, aspects of knowledge, student activities, and student responses.

A. Skills of Student Science Process
The result of the students' science process skill pretest no complete students with an average score 29, while at the time of *post test* all students have completed both individually and classically with average scores of 80 and a gain of *N-gain score* of 0.71 with high criteria. Here is the data completeness of each aspects of process skills.

Table 1. Each Aspect of Skills Process Completeness Data

Process Skill	Pretest (%)	Posttest (%)
Formulating problem	28,7	80,7
Formulating hypotheses	32,7	79,3
Data Analyzing	25,3	77,3
Communicating	30,7	81,3
Concluding	30	80

Based on the table can be known that after the learning process of science with aided PhET simulation program, every mastery aspects of process skills have increased, with the highest percentage of mastery at *post test*which is the communication aspect of 81.3% and the lowest on the aspect of analyzing data of 77.3%.

B. Aspects of Student Knowledge
Cognitive learning product outcomes are measured by tests aspects of knowledge. The *pretest* results show that no students are thoroughly experienced and obtained an average score of 24, while at *post test* all students have been completed both individually and classical with an average score of 80. *N-gain* equal calculation to 0.74 with high criterion. Here is the data mastery of each aspect of student knowledge.

Table 2. Each Aspect of Student Knowledge Completenese Data

KnowledgeAspects	Pretest (%)	Posttest (%)
Describe the nature of light	30	85
Write down the law of light reflection	43,3	85
Identify the shadow formation process on a flat and curved mirror	26,7	80
Apply a mirror equation to express the relationship between the distance of the object, the distance of the shadow, and focal distance	28,3	78,3
Calculate the shadow magnification with hooking between the height of the object to the height shadow and distance of object with distance of shadow	20,6	78,3
Identify the shadow formation process on convex and concave lenses	18,3	82,5
Apply the distance equations of objects, distance shadow, focus distance, and strong lens on a problem	23,3	81,1
Eksplain the importance of light on the process human vision	38,3	85
Identify parts of the eye	30	75,8
Identify the shadow formation process on the human eye	13,3	70
Describe the disturbances that occur on the senses vision	13,3	84,2
Identify all kinds of optical devices exist in everyday life	30,8	88,3

Based on the table, it can be seen that every indicators of the knowledge aspect is experienced enhancement. These results indicate that learning science with effective and PhET simulation program has a significant effect on learning outcomes aspects of process skills and student knowledge. This is in accordance with Sugiarti (2015) who states that learning aided PhET simulation program is effective in building knowledge and skills of students' science processes. The results of

this study are supported by the previous studies results (Prahani, et al., 2015; Prahani et al., 2016; Prahani, et al., 2018; Sudiarman et al., 2016; Yasir, et al., 2016) that the media, teaching materials, devices, and learning models of quality and feasible (meet the valid, practical, and effective aspects) can improve student learning outcomes.

C. Student Activity

Student activity observed is student activity during the learning process takes place. Observation of student activity is done by 2 observers by using the observation sheet student activity. In summary the results of observations of activity students during the learning process can be presented in Figure 1 below.
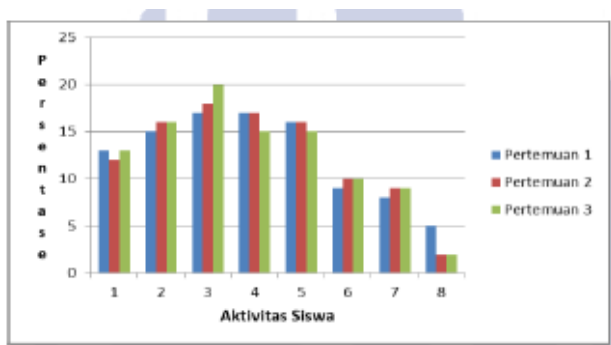

Figure 1. Diagram of Student Activity Observation Results

Notes:
1. Listen and pay attention to teacher explanations
2. Read worksheet and student books
3. Conduct experiment / observation
4. Discuss questions and answers between students and teachers
5. Do worksheet / complete the learning task
6. Ask questions / opinions
7. Listen to the presentation
8. Behavior that is not relevant to teaching and learning process

Figure 1 shows the student activity chart during the learning process of science. The graph shows that students are enthusiastic to follow the process learning is very high, due to activity different learning with previous learning activities with aided PhET simulation program. Students who are active in learning activities will have a positive impact on learning outcomes.

D. Student Response

Response result recapitulation of 30 students to science-assistedPhET simulation program in learning activities on Light material and Optical Instruments presented on Figure 2 below.
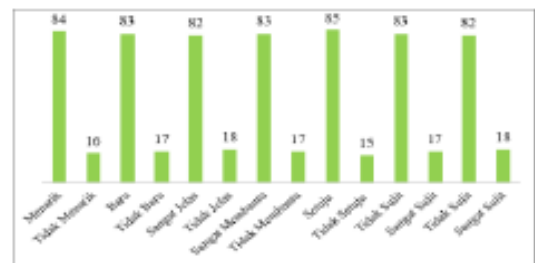

Figure 2. Student Response Percentage Chart

Figure 2 shows that students' response to interest, novelty, ease as well clarity of students in the learning process has implemented good and excellent criteria with percentage response 77% to 90%. Overall students respond positively to the learning process that has been applied.

CONCLUSION AND SUGGESTION

A. Conclusions

Based on the results of research that has been done, it can be concluded that the application of science PhET simulation program in light material and optical tools can improve junior high school students' process skill and knowledge aspects.

B. Suggestions

Based on the results of research that has been done, some suggestions that can be put forward by researchers are worth noting preparations and time management so that the learning process can be more effective and efficient. For further research it is recommended to provide more details about PhET simulation program to be used in the learning process.

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