The Application of Guided Inquiry Approach Based on Virtual Laboratory to Increase Students' Learning Outcome of Global Warming in Sma Muhammadiyah 2 Surabaya

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Abstract

The research objective was to describe the increasing of students' learning outcome in global warming topic by implementing guided inquiry based on the virtual laboratory. The learning outcome which increased were cognitive and skill competence. The research used pre-experimental with one group pretest-posttest design and used three class as sample namely XI MIPA 1, XI MIPA 2, and XI MIPA 3 of SMA Muhammadiyah 2 Surabaya. The increasing of students' learning outcome was analyzed by paired sample t test and normalized gain. The result of this research showed that (1) the learning process was conducted very good; (2) the students' cognitive competence increased significantly in high rate and the students' skill competence increased significantly in medium rate; (3) the students' responses due to physics learning based on virtual laboeatory of global warming was very good. Based on those result it showed that implementation of guided inquiry approach based on virtual laboratory could increase the students' learning outcome.

Keywords: virtual laboratory, kognitive competence, skill competence, global warming.

INTRODUCTION

Materials Science and Earth Sciences (IPBA) in the Curriculum 2013 revised is one of the clumps of science. IPBA learns about the phenomena of earth and space. IPBA develops with activities to find out how the processes of earth and space occur in life using scientific methods (Pujani, 2014). Finding activities is the key word of the curriculum 2013 revised.

Physics subject is one of the subjects included in the national exam at high school level. Physics subject is included in the national exam is what makes teachers in high school many who use the method of lectures without providing direct experience in the form of seeking information themselves through laboratory activities. The lecture method used by the teacher aims to be taught material can be completed on time, but not all materials of physics can be taught by using the lecture method.

By using one lecture methods, students can not have experiential experiences on the mechanisms of symptoms present in the subjects of Physics, in particular the material of Global Warming.

Hope from this research with Global Warming material that is student's learning result can increase. To improve students 'learning outcomes, there is a need for innovative learning model changes that can create an atmosphere in the classroom to be fun and can generate student interest to pay attention, not only by using one-way method or lecture which can decrease students' interest in Physics learning. One of the methods that can arouse students' curiosity is through laboratory activities. The learning process in the laboratory activities will make the students able to find the concept independently and actively better, so that this is in accordance with the selected learning model.

Global Warming is a phenomenon of increasing the average temperature of the earth's surface. According to (SOS, 2011) At first the increase was very slow, ie an average of only 0.2 ˚C from the Year 1000 to the beginning of the 19th century. But since 1850, this temperature increase was rapidly running at 0.35 ˚C in 1940 and 0.55 ˚C in 2000. There have been 11 hottest year records in the last 12 years. In addition, based on the Intergovernmental Panel of Climate Change (IPCC) records, the global average temperature has increased by 0.78 ˚C over the last 100 years (1906-2005) (SOS, 2011). Increased average temperature is getting higher is what is often called Global Warming (Sugiyono, 2006).

Laboratory activities can be performed in real laboratories and virtual labs. The real laboratory has an advantage on Physics material that requires direct experience with the physical object being studied. On the other hand, where virtual labs are the only way to visualize the phenomena being studied such as microscopic objects or massive objects (Farrokhnia & Esmailpour, 2010). The reason researchers use a virtual laboratory is Global Warming material needs to be proved about the greenhouse effect, where about 30% of solar electromagnetic wave radiation is reflected back into space by clouds and aerosols. The gases present in the Earth's atmosphere can not be seen or observed directly. Therefore, virtual laboratories are effective to overcome the proof of the presence of gases present in the earth's atmosphere and to know how the process of greenhouse effect that causes Global Warming.

PhET is a simulation program created by the University of Colorado that contains biology, chemistry, physics and mathematics learning simulations to help teachers and students understand concepts. The PhET simulation emphasizes the relationship between a real-life phenomenon with a science that supports and

underlies an interactive and constructivist approach, and provides a creative workplace (Finkelstein, Perkins, Adams, Kohl, & Podolefsky, 2005). PhET can be used as an alternative to a rill lab with its completeness and facilities is a site that provides free learning simulations that can be downloaded for free for the benefit of teaching in school or for individual learning interests. PhET simulation has advantages that can be used offline, not easy to hang because the file is very small, and very interesting because it can be run easily, fun, and fun.

According to (Sjahrir, 2015) in his research found that student learning outcomes increased by using virtual lab-based learning. (Santoso, 2015) in his research found that the application of virtual lab-based learning methods can be an alternative method for better student learning outcomes. Based on the results of these studies, obtained information on the activities of virtual labs can improve student learning outcomes. Improved learning outcomes can be seen from the significant increase in student posttest outcomes compared with pretest values.

Meanwhile, based on interviews with Physics Teachers in SMA Muhammadiyah 2 Surabaya, Global Warming material is one of the material that is classified as difficult to be practiced in real terms, because the material of Global Warming is related to abstract object and can not be observed directly, so the teacher never do experimental activities for the material. Therefore, students have difficulty in understanding the material of Global Warming. This is shown from the results obtained from pre-research that has been done by researchers in the form of a questionnaire distributed in 40 students class XI stating that the majority of students consider the material Global Warming is an abstract material with microscopic physical objects such as oxygen gas, carbon dioxide gas, and methane. On the basis of this, a research entitled "**The Application of Guided Inquiry Approach Based on Virtual Laboratory to Increase Students' Learning Outcome of Global Warming in Sma Muhammadiyah 2 Surabaya**".

METHOD

The type of research used was Pre-Experimental Design, ie experimental research having treatments, impact measurements, and experimental units but the samples were not randomly selected.

This research was conducted in SMA Muhammadiyah 2 Surabaya in the even semester of academic year 2016/2017. The population in this study, the object studied is all members of the class XI MIA in SMA Muhammadiyah 2 Surabaya. The sample of this study was not chosen randomly but using purposive sampling. Purposive sampling is a technique of determining the sample with certain considerations (Sugiyono, 2009). Samples to be taken are three classes of classes XI MIA 1, XI MIA 2, dan XI MIA 3. Desain research used as in Table 1.

Table 1. Research Design

Class	*Pretest*	Treatment	*Posttest*
Eksperimen 1	O_1	**X**	O_2
Eksperimen 2	O_1	**X**	O_2
Eksperimen 2	O_1	**X**	O_2

(Sugiyono, 2009)

Information:

O_1 = Pretest score before treatment
O_2 = Postest score after treatment
X = Treatment given to the students

This research is in collecting data, the method used is validation, observation, test, and questionnaire. Validation is used to validate learning tools, RPP, pretest and posttest questions, LKS, instructional learning sheets and student response questionnaires. Observation is a method of collecting data based on systematic observation of the behavior of individuals or groups directly in the learning process. The test is done in writing in order to obtain student learning outcomes after learning activities. In this study, there are two types of tests that will be given, namely pretest and posttest. Pretest is used to determine students' early ability, whereas posttest is used to know the ability or result of student learning after learning. The questionnaire method is used to identify students' responses to learning through real laboratory activities and virtual labs. This questionnaire was completed after the learning activity ended.

The analysis technique used in this research is the normality and homogeneity test analysis to determine the sample to be used in the research, paired t pair analysis to know the existence of significant improvement or not, and gain score analysis to know the improvement of student learning outcomes.

RESULT AND DISCUSSION

Observation of the implementation of learning is observed by two observers. The calculation of the average score of learning implementation and criteria can be seen in Teble 2.

Table 2. The result of Learning Activities Observation

No.	Aspek	Rata-rata Perolehan Skor (%)		
		XI MIPA 1	XI MIPA 2	XI MIPA 3
1	Pendahuluan	87,5	87,5	87,5
2	Mengamati	87,5	87,5	100
3	Menanya	81,25	87,5	75
4	Mengumpulkan data	93,75	93,75	96,87
5	mengasosiasi	100	87,5	87,5
6	mengkomunikasikan	95	97,5	95
7	Penutup	96,87	93,75	93,75
8	Suasana kelas	93,75	90,62	93,75
Rata-rata tiap kelas		91.95	90,70	91,17

Based on Table 2, it shows that the implementation of learning is done in very good category. From the pretest and posttest results we can paired t tests to determine whether there are significant differences or not from each class, as well as the normalized score of N-gain scores to describe how high the increase of pretest and posttest values. It is stated that there is a significant difference of value if $t_{hitung} \geq t_{tabel}$ the results of t-pair paired calculations are given in Table 3 below:

Tabel 3. The result of paired t test of knowledge

Class	t_{hitung}	t_{tabel}	Information
XI MIPA 1	34,63		
XI MIPA 2	30,72	1,70	Signifikan
XI MIPA 3	5,15		

From Table 3 above it is known that of the three grades of grades $t_{hitung} \geq t_{tabel}$, so it can be concluded that after given the learning through the virtual laboratory, the student scores of the three classes there is a significant increase. To know the category of improvement, the analysis used N-gain test. The results of the N-gain test analysis are presented in Table 4 below:

Tabel 4. N-Gain Test Result ob Cognitive Competence

No	Class	N<g>	Category
1	XI MIPA 1	0,755	Tinggi
2	XI MIPA 2	0,753	Tinggi
3	XI MIPA 3	0,740	Tinggi

Table 4 above shows that the N-gain test results have increased learning outcomes with high improvement categories for all three classes in the Knowledge aspect.

Skills used are process skills that consist of formulating problems, preparing hypotheses, identifying variables, collecting data, analyzing, and concluding. Skill competence analysis consists of normality and homogeneity test to find out whether pretest and posttest values are normal and homogeneous distributed, then tested by paired t-test, and N-gain test to know improvement of learning outcomes. The result of paired pair t test is shown in Table 5 below:

Tabel 5. T Paired Skill Test Results

Class	t_{hitung}	t_{tabel}	Information
XI MIPA 1	60,98		
XI MIPA 2	54,89	1,70	Signifikan
XI MIPA 3	43,33		

From Table 5 above it is known that of the three classes of $t_{hitung} \geq t_{tabel}$ value, so it can be concluded that after given the learning through virtual laboratory, the student value of the three classes there is a significant difference.

Having obtained the conclusion that there are significant differences, analyzed by using the N-gain test to describe how much improvement of learning outcomes after the implementation of learning. The results of the N-gain test analysis are presented in Table 6 below:

Tabel 6. N-Gain Test Result of Skill

No	Class	N<g>	Category
1	XI MIPA 1	0,631	Sedang
2	XI MIPA 2	0,572	Sedang
3	XI MIPA 3	0,582	Sedang

Table 6 shows that the results of the N-gain test resulted in improved learning outcomes with medium improvement categories for all three classes on skills aspect.

Student response is obtained from the questionnaire given to the student after the learning activity is done.
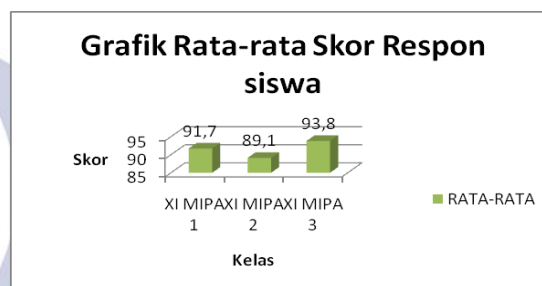
Gambar 1. Rata-rata skor respon siswa

Based on the picture above shows the acquisition score of students' responses to learning through virtual lab activities on Global Warming material. The average score result of the three classes earned the category very well.

Based on the result of paired t pair analysis can be concluded that there is significant difference between student learning result before and after given learning through virtual lab with PHET Simulation media on Global Warming material. In the N-gain test there is a difference with the high category So it can be concluded that the application of virtual lab-based learning on Global Warming materials can increase students' knowledge significantly with high improvement category. Increasing student learning outcomes with high category is due to student interest in learning is good enough. Student interest in learning or learning motivation can also affect student's learning outcomes (Harianto, 2011). This is in accordance with Warsito's opinion in (Depdiknas, 2006) which reveals that the outcome of learning activities is characterized by a more positive behavioral change in a person who has studied. This increase in learning outcomes is also supported by virtual laboratory activities, as global warming materials need to prove the movement of ultraviolet radiation waves on solar radiation and infrared radiation on earth. Virtual labs support learning effectively, in accordance with statements (Kozma, Russell, Jones, Wykoff, Marx, & Davis, 1997) virtual labs can show visualization of phenomena of physics and animation at the microscopic level that can add to students' knowledge. The microscopic movement in physical phenomena can only be demonstrated by a virtual laboratory. This is also supported by Syafulloh's (2014) study of increased learning results by utilizing virtual laboratories.

CLOSING

Conclusion

Based on the results of research and discussion, it can be concluded: (1) The implementation of virtual lab-based learning on Global Warming material is done very well; (2) Improvement of student learning outcomes on competence of knowledge categorized very well while skill competence categorized as medium; (3) Student responses to virtual lab-based learning on Global Warming materials are excellent.

orium virtual pada materi Pemanasan Global sangat baik.

Suggestion

After doing the research stages, there are some suggestions from the researcher for further research if one is going to use virtual lab based learning such as: (1) Learning with virtual lab requires computer as well as internet make sure before learning starts all student computers have PhET installed, so that when the learning takes place students can directly follow; (2) Learning using virtual laboratories on effective global warming materials is used for subsequent learning, in order to optimize the achievement of student competencies, it would be nice if the learning through virtual lab activities is re-applied to other teaching materials or elsewhere.

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