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IMPLEMENTATION OF GUIDED INQUIRY LEARNING USING PHET SIMULATION ON KINETIC THEORY OF GASES TOPIC FOR INCREASING THE LEARNING OUTCOME OF GRADE XI STUDENTS AT SMAN 13 SURABAYA

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Abstract

This research aimed to analyze the learning feasibility, student learning outcome, and response toward guided inquiry learning using PhET Simulation on kinetic theory of gases topic. Learning outcome are knowledge and skill aspect. The type of this research is pre-experimental with one group pretest-posttest design by using one experiment class and one replication class. Subject of research are students at grade XI IPA 5 and XI IPA 6 in SMAN 13 Surabaya. Instruments of research are learning feasibility observation sheet, pretest posttest sheets and students response sheet. The improvment of learning outcome was analyzed by t-test and gain score. The result shows that (1) learning feasibility was done in excellent category; (2) improving of knowledge and skill learning outcome in two classes are significant in high category; (3) students show positive response to the treatment applied in very good category. Based on the data, it can concluded that the guided inquiry learning using PhET Simulation on kinetic theory of gases can increase learning outcome of grade XI student at SMAN 13 Surabaya.

Key words: *guided inquiry, PhET Simulation, theory kinetic of gases*

INTRODUCTION

Curriculum 2013 is a curriculum designed to develop students' potentials to suit national education objectives. In realizing these objectives, students are expected to have generic competencies that include three domains of attitude, knowledge, and skill competencies.

The learning process of science focuses on a research process (Wisudawati, 2015). Sutrisno (2006) stated that physics can be considered as a body of knowledge, a way of thinking, and a way of investigating. Physics as the body of knowledge means that physics is the knowledge generated from any kind of research and investigation conducted by physicist. Physics as the way of investigating means that physics can describe how physicist works in order to produce an invention throughout laboratory activities. While the way of thinking and scientific attitude such as honest, objective, open-minded, and self confidence are needed while conducting research and investigation.

İnce et al. (2015) stated that Physics is a discipline established on a conceptual basis and is grounded in experiments. Toplis (2011) stated that experiment has vital role in science including physics. Experiment can develop students' skill, knowledge, and understanding about science. It can also help students to appreciate that science is based on evidence and acquire hands-on skills that are essential if students are to progress in science. Thus students should be given the opportunity to do various experiment and investigation works.

The fact in schools showed that not all topics in physics curriculum can be conducted in laboratory activities easily, such as any topics related to microscopic object. Based on the result of interviews at SMAN 13 Surabaya, physics teacher stated that during the process of learning on kinetic theory of gases has never been done through experiment activities. This indicates that the learning process in the material has not been in accordance with the principles of the Curriculum 2013. The trust of the Curriculum 2013 states that the product or knowledge on the material of physics should be obtained through a procedure or scientific investigation (Permendikbud No. 59 of 2014).

Afifah (2014) stated that theory kinetic of gases is difficult because it has many mathematical equations and abstract. In theory kinetic of gases, student are required to imagine how particle move, how the influence of temperature, volume, amount of substance and pressure. Based on research conducted by Safitri (2015) on grade XI student of SMAN Bawang in the aacademic year 2013/2014, it was found 40% of students who experienced a misconception for sub material of ideal gas characteristic, sub material of the law of ideal gas by 55%, sub material of kinetic theory of gas by 60%, and for sub material of energy equipartition by 42%. In addition, a documentary study at SMA Negeri 13 Surabaya December 2016, as many as 65.71% of students stated that the theory of kinetic gas is considered difficult to understand because it is abstract.

Syaifulloh (2014) states that to understand abstract concepts, it needs high reasoning by tapping the students' visualization through various text, sound, image, video, animation, simulation in interactive multimedia which can be presented offline or online so that the concept which was originally abstract and elusive to be relatively

One of the simulations that can be used to perform

easy. the experiment is *PhET Simulation*. PhET is a free and offline-used simulation medium released by the University of Colorado that aims to advance natural science and math through free interactive simulations. *PhET simulations* are virtual labs that feature an abstract or invisible animation of Physics with the naked eye, such as atoms, electrons, photons, and magnetic fields. Perkins et al. (2006) stated that *PhET Simulation* uses dynamic graphics by using visual animation and concept models used expert physicists. McKagan et al. (2008) suggests that *PhET Simulations* are very effective in assisting students in building understanding and intuition for abstract phenomena.

Based on the above explanation, the researcher conducted the research entitled "Implementation Of Guided Inquiry Learning Using Phet Simulation on Kinetic Theory Of Gases Topic For Increasing The Learning Outcome Of Grade XI Students At SMAN l3 Surabaya" with the aim to analyze the implementation of learning, improvement of learning outcome, and student's response to guided inquiry learning using PhET Simulation.

METHOD

This research used pre-experimental design with one-group pretest-posttest design. The subjects of the study were students of class XI IPA 5 and XI IPA 6 in SMA Negeri 13 Surabaya. The study used one experiment class and one replication class .

Aspect that are measured include the implementation of learning, improvement of learning outcome, and student response. The method used is observation for learning implementation; test method for learning outcome; questionnaire method for student's response toward the learning.

Learning outcome consist of attitude, knowledge and skill, but learning outcome of skill is difficult to assess, so the learning outcome assessment only includes knowledge and skill. Increased learning outcome of knowledge and skill are obtained through pretest and postest.

RESULT AND DISCUSSION

Learning Implementation

Learning implementation was observed by three people and given a score in each activity. This activity include preliminary, core and closing activity. The learning implementation is showed as follows

Table 1 Learning Implementation Result

Aspect	Score (%)	
	XI IPA 5	XI IPA 6
Preliminary	84	86
Exploration	86	86
Concept formation	81	85
Application	84	87
Closing	85	83
Time Allocation	82	85
Average each Meeting	83	85
Average each Class	84	85

Based on the table above, learning implementation in two classes achieved very good category with details of class XI IPA 5 get score 84% and XI IPA 6 get score 85%. It is caused the constraints that occur during the first meeting can be overcome at the next meeting.

Knowledge Learning Ooutcome

The improvement of student's knowledge learning outcome was obtained from pretest and postest value then tested by one tail t-test and gain score analysis. One tail t-test conducted to find student learning outcome after learnig is better than before learning. The one tail t-test result is showed as follows

Table 2. One Tail t-test Knowledge Learning Outcome

No	Class	T_{count}	t_{table}	Conclusion
1	XI IPA 5	15,49	1,697	Ho is reject
2	XI IPA 6	17,48		

Based on one tail t-test, it was found that the average of student's knowledge learning outcome XI IPA 5 and XI IPA 6 after the learning activity is better than before the learning activity, so there is an increase knowledge learning outcome.

The category of improvement in student's knowledge learning outcome can be analyzed by a normalized gain score analysis. The result are presented in Table 3

Tabel 3. Gain Score Analysis of Knowledge Learning Outcome

No	Class	N <g>	Category
1	XI IPA 5	0,710	High
2	XI IPA 6	0,730	High

Table 3 above shows that the gain score analysis of two class is different. Two classes have high category, so it can be categorized that the gain score rate obtains high category for knowledge learning outcome.

Increased student learning outcome is not independent of guided inquiry learning using PhET Simulation. This is because PhET Simulation is very effective in helping student to build understanding and intuition for abstract phenomena (McKagan et al., 2008), whereas guided inquiry has been proven to improve student's conceptual understanding of science (Mcdonnell, 2013). This is reinforced by the statement of Khulthau et al. (2007) that guided inquiry helps students develop research and knowledge competency and

motivation, reading comprehension, language development, writing skill, cooperation among student and socual skill.

Skill Learning Outcome

The result of skill aspect are shown as follows

Table 4. One Tail t-test Skill Learning Outcome

No	Class	T_{count}	t_{table}	Conclusion
1	XI IPA 5	21,91	2,000	Ho is reject
2	XI IPA 6	23,28		

Based on table above, it was found that the average of student's skill learning outcome XI IPA 5 and XI IPA 6 after the learning activity is better than before the learning activity. It means an increase skill learning outcome after learning.

The improvement score of pretest to postest was obtained through a normalized gain score analysis. Based on the analysis, it was obtained the following result

Table 5. Gain Score Analysis of Skill Learning Outcome

No	Class	N <g>	Category
1	XI IPA 5	0,730	High
2	XI IPA 6	0,750	High

These result shows that gain score average obtained a high category for skill learning outcome, so it can be concluded that the learning outcome of skilll increased significantly with high category.

This is because when student conduct laboratory activities, student maximize all sense to obtain data. When optimizing all sense, student demonstrate active and independent engagement during learning so produce meaningful learning (Godwin et al., 2015). This is reinforced by the statement of Toplis (2011) that experiment can develop student's skill, knowledge, and understanding about science.

Based on the exposure of improvement in knowledge and skill learning outcome, it is showed that guided inquiry learning using PhET Simulation on theory kinetic of gases can improve the learning outcome of knowledge and skill. This is accordance with statement of Gallego (2016) that guided inquiry encourage the development of knowledge and skill learning outcome in secondary school. In addition, laboratory activities are effective means of creating meaningful learning so as to cultive thinking skill (Olufunke, 2012), shaping scientific attitudes, instilling conceptual understanding, and enhancing investigation skill (Jong et al., 2013). Therefore, guided inquiry learning using PhET Simulation can foster scientific attitudes, ability to think (knowledge), and skill that affect student learning outcome.

Student's Response

The student's response consist of 15 statements. The result of the student responses are showed as follows

Table 6 Score of Student Response

No	Statement	Score (%)	
		XI IPA 5	XI IPA 6
1	The learning model used is easy to understand the concept	83	91
2	The phenomena of illustration presented caught my attention	89	88
3	The phenomena which was presented improved curious	82	80
4	The teaching process allows me to dig information	85	80
5	The teaching process makes easy to connect the concept with everyday life	77	80
6	The learning used make learning more active	86	83
7	The learning used make the material easy to memorable and understandable	85	84
8	The student are stressed and tense during physics learning	83	83
9	Guided inquiry learning using PhET Simulation does not increase unterest in learning	80	82
10	Guided inquiry learning using PhET Simulation makes mateial more difficult to undestand	83	85
11	Guided inquiry learning using PhET Simulation help more skilled in experimenting	80	84
12	Guided inquiry learning using PhET Simulation makes easier in solving problems	83	81
13	Physics becomes more intersting to learn using this learning	80	82
14	Guided inquiry learning using PhET Simulation is better than usual learning	82	83

No	Statement	Score (%)	
		XI IPA 5	XI IPA 6
15	Guided inquiry learning using PhET Simulation can applied to other materials	80	82
Score each Class		82	83
Category		Very Good	Very Good

These result above showed that student respond to learning is very good. According to the questionnaire result, students recommend that guided inquiry learning using PhET Simulation can applied to other material with score of 81% is categorized very good. This suggest showed that guided inquiry using PhET Simulation need to applied to other material to improve learning outcome students especially knowledge and skill.

CLOSING

Conclusion

Based on the result and discussion that have been reviewed then the conclusion can be taken are:

(a) Implementation of guided inquiry learning using PhET Simulation on theory kinetic of gases is done very good. (b) Knowledge and skill learning outcome are increased significantly with the acquistion of high category. (c) Student response to guided inquiry learning using PhET Simulation on theory kinetic of gases get very good categorized score.

Suggestion

Based on the research, the researcher suggested that guided inquiry learning using PhET Simulation should be done on other material to improve a better learning outcome on the knowledge and skills aspect. When the learning process takes place necessary timing is appropriate for the learning activities to go according to plan. Guided inquiry learning activities with PhET Simulation media should be trained how to convert units so that students complete learning.

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