

**IMPLEMENTATION OF GUIDED DISCOVERY LEARNING MODEL USING PHET SIMULATIONS ON IDEAL GAS MATERIALS IN XI MIPA OF STATE SENIOR HIGH SCHOOL 2 NGANJUK**

**Fitriatus Sabrina, Wasis**

Physics Departement, Faculty of Mathematics and Natural Science, State University of Surabaya

Email: [fitriatusabrina@mhs.unesa.ac.id](mailto:fitriatusabrina@mhs.unesa.ac.id)

**Abstract**

This research aims to analyze the implementation of guided discovery learning model using PhET simulations. More specifically, it aims to analyze a lesson about ideal gas. It is pre experimental research with one grup pretest-posttest design. Using random sampling, students of XI MIPA 4, XI MIPA 5, and XI MIPA 7 were involved. Methods of data collection were observation. The data analysis techiques were analysis of implementation of learning. The data analysis reveals that the implementation of guided discovery using PhET simulations shows that PhET simulations in class XI MIPA 4, XI MIPA 5, and XI MIPA 7 in State Senior High School 2 Nganjuk was successfully carried out.

**Key Words:** Guided discovery, PhET, ideal gas, implementation of learning

**Abstrak**

Penelitian ini bertujuan untuk menganalisis keterlaksanaan model pembelajaran *guided discovery* berbantuan media simulasi *PhET* pada materi gas ideal kelas XI MIPA di SMA Negeri 2 Nganjuk. Penelitian yang dilakukan ialah penelitian *pre experimental* dengan rancangan *one grup pretest-posttest design*. Pemilihan sampel menggunakan *random sampling* dengan cara diundi, sehingga didapatkan sampel kelas XI MIPA 4, XI MIPA 5, serta XI MIPA 7. Metode pengumpulan data menggunakan metode observasi. Teknik analisis data menggunakan analisis keterlaksanaan pembelajaran. Berdasarkan analisis data dapat disimpulkan bahwa pembelajaran *guided discovery* berbantuan media simulasi *PhET* pada materi gas ideal kelas XI MIPA di SMA Negeri 2 Nganjuk terlaksana dengan sangat baik di ketiga kelas.

**Kata kunci:** *Guided discovery*, *PhET*, gas ideal, keterlaksanaan pembelajaran

**INTRODUCTION**

In the 2013 curriculum it is expected that student-centered learning where students become the subject of learning, while the teacher is only as a facilitator in learning (Fadlillah, 2014). In general, teachers often apply teacher center, where the teacher's role is more dominant such as explaining material to students, giving examples of questions, and asking students to do training practice. This way makes students less active in learning because students consider the teacher to be the only source of learning in the classroom. In addition, the repeated use of the lecture method resulted in students being less interested in learning physics.

This is in line with the research (Sari, et al., 2016) where learning that does not involve the role of students or the teacher only conveys the material completely, making students less interested in learning. This will have an impact on the low motivation and activeness of students during learning. Therefore it is necessary to have an appropriate learning model to overcome these problems,

one of which is discovery learning. On discovery learning is student centered, in addition discovery learning makes students who have a diverity of experiences can take the initiative to develop skills in problem solving, decision making, and also research so as to enable students to be students through out the life (Nurdin & Andriantoni, 2016).

One branch of discovery learning is guided discovery. In this guided discovery model the teacher's role is to guide students to have experience and connect these experiences to find physical concepts and principles so that they can be stored in long-term memory and meaningfull learning, the teacher's way of guiding students by conducting experiments.

Based on the results of the questionnaire given to State Senior High School 2 Nganjuk's students, information was obtained that 70% of students stated that experiments were only carried out in certain chapters. This is reinforced by the results of observations in State Senior High School 2 Nganjuk which show that there are no real practical tools

for abstract material, especially ideal gas. Based on the results of interviews that have been conducted with physics teachers in State Senior High School 2 Nganjuk, information is obtained that teachers usually use verbal language in explaining abstract concepts of physics. When the teacher explains the concept of physics with verbal language, only some students are able to understand the concepts conveyed by the teacher, especially for material that is abstract.

This is in line with the research (Saputri & Rahman, 2018) where lecture learning makes students feel bored, this is because students do not go directly in experiments, so students cannot verify the material being studied. Even though physical material, especially abstract material, requires verification so that students understand more about the material. For example in the ideal gas material students have difficulty in seeing the movement of gas particles, this is in line with research (Sofi'ah et al., 2017) where kinetic theory of gas studies physical objects to the arrangement of atoms or particles in ideal gases that cannot be seen directly.

Faced with this problem, there needs to be an experiment that uses virtual laboratories to describe the behavior of gas particles. One of the virtual laboratories that can be used in delivering physics concepts is PhET software. PhET (Physics Education Technology) was developed by the University of Colorado, in this software there are theoretical simulations and experiments that involve users actively (Wati & Joko, 2015), besides that this simulation is also an discovery-based interactive simulation and serves to clarify concepts physical. The purpose of the PhET simulation is to make it easier for students to experiment specifically for abstract physical material, such as ideal gas material. In this simulation students can see directly the shape of particles and their movements, because this simulation is designed to approach ideal conditions, so it is very easy for students to find the variables needed in the ideal gas material. This is in line with research (Ramadhaniyah & Supardi, 2018) that PhET is learning media that can help teachers become facilitators in delivering material so students can understand learning.

The selection of guided discovery learning model because this learning model involves the maximum ability of students in searching, finding something systematically, logically, and analytically. This is in accordance with the purpose of discovery which is to provoke students to issue ideas when the teacher poses a problem, and prove his hypothesis through an experiment (Nurdin & Andriantoni, 2016). In this guided discovery the teacher's role guides students in connecting the experiences they have received

with new problems to find a concept, so that the learning is meaningful

The purpose of this research is to analyze the implementation of guided discovery learning model using PhET simulation on ideal gas material in XI MIPA of State Senior High School 2 Nganjuk.

## METHOD

The research carried out was classified as a quantitative study with one type of pre-experimental one group pretest-posttest design. In this study measuring and observing the class not only after being given treatment, but also before. In this study students were given a pretest before treatment, and posttest after treatment.

The population in this research were students of class XI MIPA, which consisted of XI MIPA 1 until XI MIPA 7 which consist of 252 students. Before sample selection is carried out, the homogeneity and normality of the population is tested first to determine the homogeneity and normality of the population. Test for homogeneity and normality of class XI MIPA 1 until XI MIPA 7 uses the value of UAS that has been given by the physics teacher of State Senior High School 2 Nganjuk. After being analyzed using the homogeneity and normality test with SPSS, the results of a homogeneous population and normal distribution were obtained. Then using random sampling, students of XI MIPA 4, XI MIPA 5, and XI MIPA 7 were involved. The design of pre experimental research with one grup pretest-posttest design can be described as Table 1.

**Tabel 1 One group pretest-posttest design**

Pretest	Treatment	Posttest
O <sub>1</sub>	X	O <sub>2</sub>

(Sugiyono, 2009).

Information:

O<sub>1</sub>: Pretest (initial test) conducted in the experimental class and replication aims to determine the students' initial abilities before being given treatment.

X: Guided discovery learning model using PhET simulations.

O<sub>2</sub>: Posttest (final test) conducted on the experimental class and replication aims to determine student learning outcomes after being treated.

The method used in the research is the observation while for the analysis technique used is the learning implementation.

## RESULT AND DISCUSSION

In this research the analysis of the implementation of learning included the analysis of the implementation of the Learning Implementation Plan (RPP) which aims to determine the ability of teachers to manage classes in

accordance with the syntax of guided discovery learning model using PhET simulations or not. This assessment is carried out when the teaching and learning process takes place by three observers, one observer is a physics teacher of State Senior High School 2 Nganjuk and two observers are physics students in State University of Surabaya. Assessment of the implementation of the Learning Implementation Plan (RPP) was carried out for three meetings in each class with an allocation of 6 x 45 minutes. The results of the implementation of the Learning Implementation Plan (RPP) in each class can be described as follows.

**a. Experimental Class**

The results of the implementation of RPP in the experimental class obtained from observations of 3 observers can be illustrated in Figure 1 below.

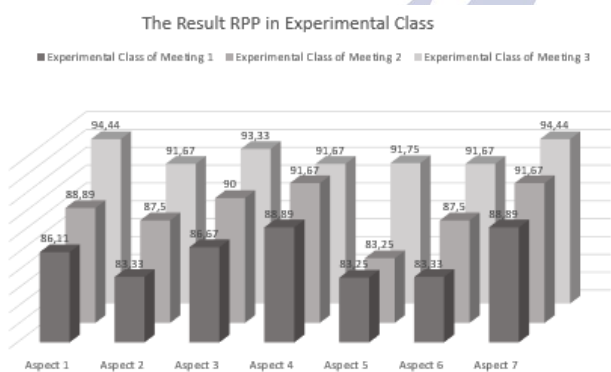


Figure 1 The results of Implementation of RPP in experimental class

Based on Figure 1 it's known that the results of the implementation of RPP in the experimental class during three meetings experienced an increase in each aspect and categorized well. The seven aspects observed were stimulation, problem statements, data collection, data processing and verification, generalization, closure, and class atmosphere.

**b. Replication 1**

The results of the implementation of RPP in replication 1 obtained from observations of 3 observers can be illustrated in Figure 2 below.

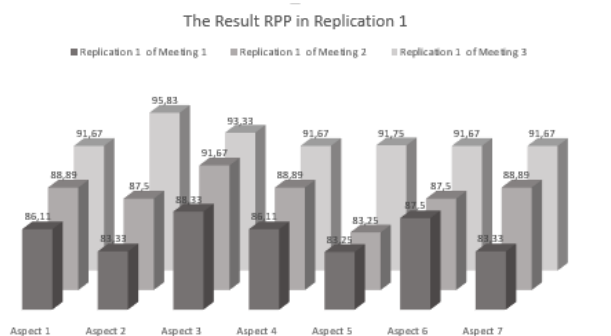


Figure 2 The results of Implementation of RPP in replication 1

Based on Figure 2 it's known that the results of the implementation of RPP in replication 1 during three meetings experienced an increase in each aspect and categorized well. The seven aspects observed were stimulation, problem statements, data collection, data processing and verification, generalization, closure, and class atmosphere.

**c. Replication 2**

The results of the implementation of RPP in replication 2 obtained from observations of 3 observers can be illustrated in Figure 3 below.

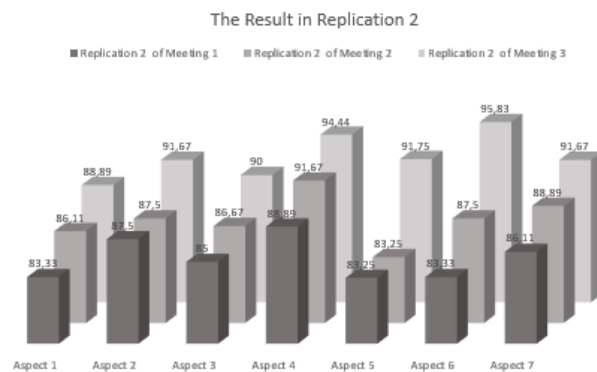


Figure 3 The results of Implementation of RPP replication 2

Based on Figure 3 it's known that the results of the implementation of RPP replication 2 during three meetings experienced an increase in each aspect and categorized well. The seven aspects observed were stimulation, problem statements, data collection, data processing and verification, generalization, closure, and class atmosphere.

Based on the analysis of the implementation of the Learning Implementation Plan (RPP) presented in Figure 1, 2, and 3 for three meetings in each class, it can be seen that the implementation of learning increases in every aspect and is categorized very well. This is in accordance with the percentage criteria for the implementation of learning where 81% - 100% can be categorized very well (Riduwan, 2012).

As per the syntax of guided discovery learning model using PhET simulations, it can be seen that phase 1 is stimulation. In this phase it consists of the role of the teacher in preparing and conditioning the class, giving apperception in the form of videos related to learning, as well as conveying learning objectives. In accordance with Figures 1, 2, and 3, it can be seen that in all three classes this aspect increases every meeting. At the time of giving motivation in the form of videos related to learning enthusiastic students, but in the replication 2 at this stage in the first meeting had a lower percentage compared to the experimental and replication 1, this is because the

replication 2 is constrained by LCD so it needs time to fix it.

Phase 2 is the problem statement, in this phase the teacher provides an opportunity for students to identify problems and ask students to submit their hypotheses. This aspect in each meeting also increased, but at the first meeting the average class was still unfamiliar with identifying problems, so the teacher had to provide scaffolding to help students identify problems. Scaffolding of the teacher is very helpful for students, this can be seen in the second and third meetings students are accustomed to identifying problems from the given phenomenon.

Phase 3 is data collection, in this phase the teacher distributes worksheets to students after explaining the activities to be carried out, directing students to find solutions to problems through experiments with the help of PhET simulations, guiding students how to use the PhET Gas Properties application, and collecting data. At the first meeting the average class was still confused in the use of the PhET application, this was because students had never used the PhET application before, however, students were very interested in the PhET application. This is in line with the research of Prihatiningtyas, et al. (2013) where PhET is an interactive simulation that is created in such a way that users are interested in the presence of animations on PhET. To overcome this problem the teacher's role is to guide students in using PhET, so that students in the next meeting are more aware of the use of the PhET application.

Phase 4 is data processing and verification where this phase consists of the teacher directing students to make posters related to the results of the experiment, distributing handouts to students, and assessing students' skills. In this phase students discuss with group members about the results of experiments that have been obtained, the teacher provides a handout as a reference for students in processing data. This is in line with (Muryani, 2015) where guided discovery is a learning model that makes students think optimally to find an answer to their findings with confidence. In guided discovery learning the teacher only presents part of the teaching material, it aims to provide opportunities for students to find and find themselves related to the material being taught (Kosasih, 2014).

Phase 5 is generalization where in this phase the teacher guides students in formulating conclusions. In Figure 1, 2, and 3 it is known that in the first and second meetings the percentage is lower than the third meeting, this is because the first and second meetings of the three classes are still not familiar in formulating conclusions, so that students need to get used to form conclusions. The teacher gives scolding so students are accustomed to

formulating conclusions. At the third meeting students were accustomed to formulating conclusions, this was marked by an increase in the percentage in each class. Giving scaffolding to students is in line with research (Jauhari & Wahyudi, 2016) where in discovery learning models create an active atmosphere for students, because students try to find themselves on the answers to problems through relevant sources, but the role of teachers is very important namely guiding students to associate knowledge he has gained with new knowledge to solve a problem and make meaningful learning.

Phase 6 is a closure where in this phase the teacher reviews learning from the beginning to the end after it ends learning. In this aspect there is an increase in each meeting in each class. In addition to these six phases, the classroom atmosphere is also an aspect that is assessed on the learning implementation sheet. The aspects of the classroom atmosphere that were assessed included teacher enthusiasm, time allocation, and the suitability of the steps in the Learning Implementation Plan (RPP). This aspect also increased at each meeting.

From the description above it can be concluded that the teacher's ability to manage classes is in accordance with the syntax of guided discovery learning model using PhET simulations has been going well, this is indicated by the implementation of all guided discovery syntax using PhET simulation.

## **CLOSURE**

### **Conclusion**

Based on the results of research, analysis, and discussion data that have been obtained, it can be concluded that guided discovery learning model using PhET simulations on ideal gas materials in XI MIPA of State Senior High School 2 Nganjuk was carried out very well in all three classes.

### **Suggestion**

1. We recommend that before learning, LCD and laptop are prepared in advance so that when learning takes place the tool can function properly.
2. It is better if guided discovery learning model using PhET simulations with laboratory activities can consider the time allocation that is used so that it can be carried out in a timely manner.
3. Before conducting the research, the researcher first consults the class teacher to know what to do when the learning takes place.
4. To improve student discipline, the teacher is expected to come 10 minutes before learning begins, this can make students begin to prepare themselves so that the learning process can begin on time.

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