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IMPROVING LEARNING PHYSICS CONCEPTS OF KINETIC THEORY OF GAS USING STRUCTURED SCIENCE EXPERIENCE INQUIRY MODEL AIDED BY VIRTUAL LABORATORY OF XI MIPA-10 CLASS

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ABSTRACT

This classroom action research aims to describe the implementation of a structured science experience inquiry model using the virtual laboratory in improving learning outcomes physics concept of kinetic theory of gases. The subjects were the students of class XI MIPA-10 SMAN 1 Malang in academic year 2016/2017. This research is a classroom action research with two cycles that follow the steps of planning, action, observations, and reflection. The design of this study refers to Kemmis and Mac Taggart's model. The instrument of this study is the RPP, the test results of the cognitive aspects of learning, learners 'worksheets (LKPD), observation sheets of the learner's activity (field noted), observation sheets of learning implementation and learners' questionnaire responses. The data were analyzed quantitatively and qualitatively. The results showed that after the teaching-learning process: 1) the percentage of learning implementation increases 4%, 2) cognitive test results increase 75%, 3) the average grade of skill aspect increases 3,6, and 4) the learners' attitude aspect become better, more active during the discussion, more respect the others' opinions, more confident, the curiosity is higher and more responsible for what was done.
Keywords: virtual laboratory, learning outcomes, inquiry

INTRODUCTIONS

Along with the rapid development of Information and Communication Technology (ICT), the material of abstract physics can experiment through visualization. The use of IT media is expected more motivated learners to learn independently with the use of gadgets and laptops owned. Learners can do experiments with unlimited time and place Experiments conducted by students are virtual experiments. Virtual experiments are experiments conducted in a virtual laboratory. A virtual laboratory is a computer simulation that allows the important functions of real laboratory experiments to be carried out on a computer. Computer software-based

virtual labs allow learners to experiment virtually based on the basic theory and application software.

According to TÜYSÜZ (2010), a virtual laboratory is now the solution of the problems arising from the use of traditional laboratory and has a positive contribution in achieving the education system. The existence of the virtual laboratory is expected to be a solution to the constraints to conduct experiments at school. Virtual Laboratory is also able to provide scientific simulations on very complex process more concretely. A virtual laboratory is cheaper and safer as well as very helpful to schools with inadequate laboratory facilities. Research on the virtual laboratory in the field of chemical engineering studies, as many as 93% of respondents considered the virtual laboratory has many uses (Domingues et al. 2010). Results of another study by Yuniarti, F (2011) in biology states that Virtual laboratory has a level of acceptability "strongly supported" by students and teachers as well as effective for learning.

The learning model applied by the teacher to learn the concepts of the kinetic theory of gases is a structured science experience. inquiry Pujiastuti research results, A.Y (2013) that the model of science inquiry learning experiences structured through metacognitive strategies can improve learning achievement of physics. According to Government Regulation No. 19 of 2005 article 1 on the instructional model of physics issued by Depdiknas/BPPN/Puskur, explained that physical education is directed to inquire and do, so it can help students gain a deeper understanding of nature around. It means that the presentation of the learning process is student-centered learning, which emphasizes learning on the learner that he himself will build the knowledge. Learners actively construct knowledge, while teachers need to develop competence and ability of learners so that the interaction between learners and teachers.can happen

The results of the interview to five of students in class XI MIPA-10, they say that all physics concepts are important to be applied. But they have difficulty in understanding abstract concepts especially. Learners prefer to memorize formulas rather than understanding the concepts. Learners would rather learn the problems using mathematical operations (formulas) but have less skill in solving questions about the concept. So teachers should seek to innovate in learning. One of the methods applied is

an experiment to make the students more involved with nature to learn about themselves and the prospects of further development and the application in everyday life.

Learning physics with the abstract concepts makes learners difficult to understand the concepts, for example, the concept of kinetic theory of gases. As for the theory of kinetic gas study the properties of the gas on the view of macroscopic (ideal gas) include: pressure, volume, and temperature that meets Boyle's law, Guy Lussac and Charles yields the equation for ideal gases and is reviewed microscopic (particle gas) include: speed effective, the average kinetic energy, momentum, energy equipartition, energy, the degree of freedom for monoatomic gas, diatomic.

An obstacle encountered to understand the concept of kinetic theory gas is present difficulty in presenting physical media for the experiment. Based on the constraint, the teacher provides the solution so that learners can overcome the difficulty. One is a media-based IT support by utilizing the gadget or computer equipped virtual laboratory applications. Thus students can understand abstract concepts of physics without the limitation of space and time. So the physics learning outcomes increase.

Learning outcomes are influenced by several factors, including the internal factor and external factors, (W. S. Winkel in Purwanto's articles, 2010). Internal factors are factors derived from the individual child itself that includes: 1) physiological factors, such as vision, hearing, body structure and so on; 2) psychological factors, such as intellectual (level of intelligence, ability to learn and how to learn), and non intellectual (learning motivation, attitudes, feelings, interests, psychological conditions, and conditions due to circumstances sociocultural); physical condition factors. External factors including external factors cover the factors derived from the individual environment of the child including, 1) regulatory factors studied at schools (curricula, school discipline, teacher, learning, and grouping learners), 2) social factors at school (system social, the social status of students, and the interaction of teachers and learners), and 3) situational factors (political and economic situation, the circumstances of time and place or climatic).

Structured science experience inquiry learning with the help of virtual laboratory can foster trust, emphasis on self-monitoring and the responsibility of learners, enable to organize themselves, be more active in developing itself, and able to motivate

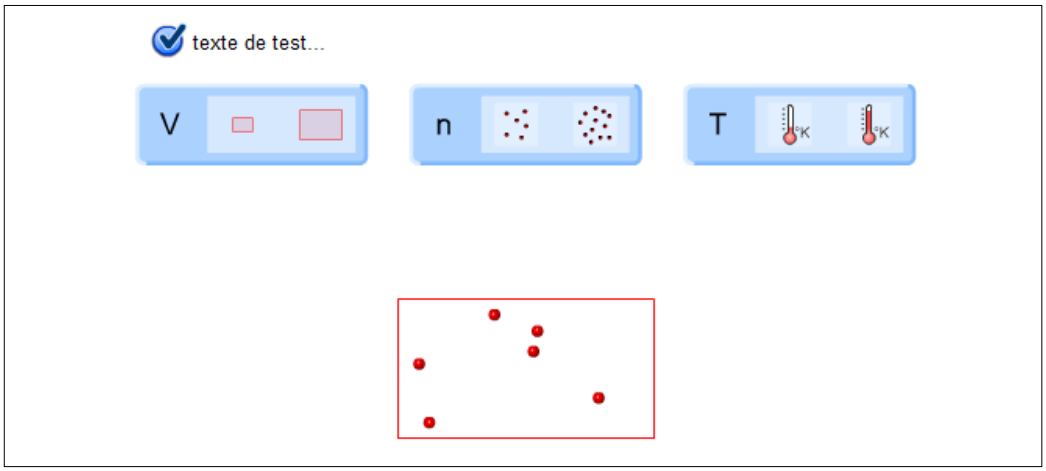
themselves. According to Keeton and Tate (Suciati, 2006) learn through experience can involve students directly in the problem or issue being studied. Learners are invited to experience a direct feel and observe events in the surrounding areas by collecting data from virtual experiments found with the aim that learners are able to report what was found from his experience.

The purpose of this study is "to expose the implementation of structured science experience inquiry learning aided by the virtual laboratory to improve learning outcomes physics concept of the kinetic theory of gases at MIPA-10 class in SMAN 1 Malang."

THEORETICAL FRAMEWORK

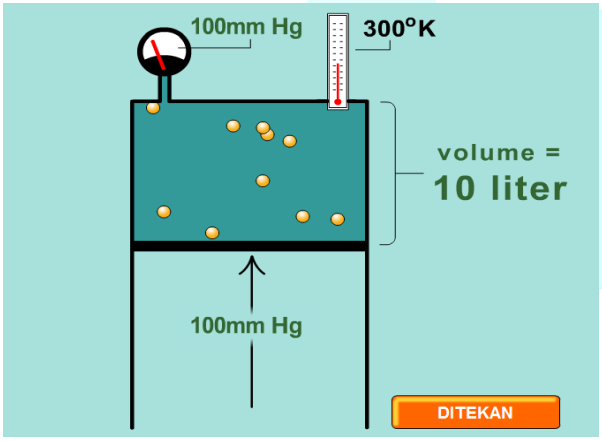
Learning the concept of kinetic theory of gases using a structured science experience inquiry model aided by the virtual laboratory is carried out by stages as follows.

1) The learning process begins with our perception and motivation to gain knowledge about the phenomenon of early learners encountered in everyday life. The teacher gives a question the "why does the wheel motor vehicle easily burst out in the day when it runs?" Learners answer correctly, and the teacher provides reinforcement answers with animated displays. Thus the students become more interested to learn the concepts of the kinetic theory of gases.



The number of particles (n), volume (V) and temperature (T) can be changed by pressing a button.

2) The stage presentation of problems and hypotheses based upon real experiences. Formulation of the problem conducted by activity providing an illustration of the phenomenon in the form of video footage of the balloon can inflate the steam of boiling water. The teacher guides the students to write a hypothesis by displaying animated movement of particles in a confined space below.

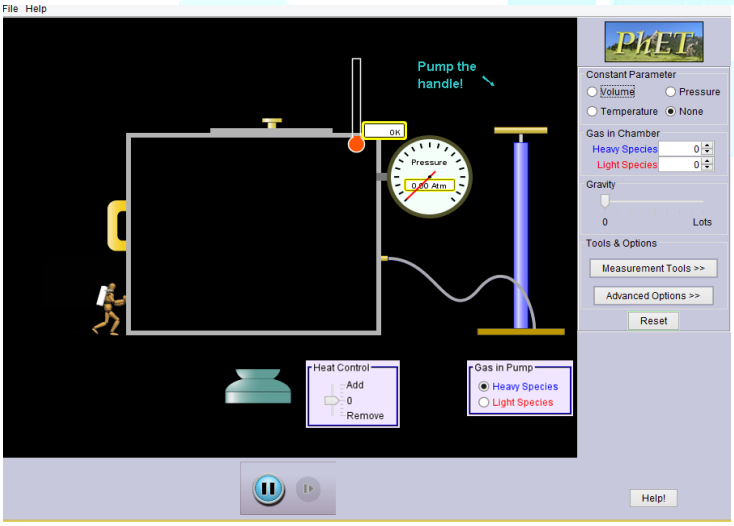


Learners observe by pressing the word "DITEKAN (press)" and " DIREGANGKAN (stretched)". Thus the participants cannot be constrained to write a hypothesis.

3) Stage of the Reflective Observation. The teacher checks the facilities for supporting experiments in each group. Besides the teacher encourages students to observe carefully and meticulously in accordance with the subject either individually or in groups. The teacher gives problems about the particle motion in an enclosed space and record questions from learners to be tested through a

learning process. In this process, the teacher assesses each learner and give guidance.

4) Stage of Experiment and Organizing Data. At this stage, the learners make the observation of the phenomenon of particle motion in closed containers that are changing the pressure, volume, and temperature. Teachers accompanying students conduct experiments to get an explanation of the phenomenon that has been drafted. Teacher directs and accompanies the retrieval of data to be recorded in the worksheets provided. Learners are required to observe the animation phenomenon closely with experimental data recorded by pressing the buttons on the animation below.



The teacher inspires to explain something abstract into real or explain the concrete experience to the learner. Of these activities are expected that the learners are able to associate the data with theoretical observations ever learned.

5) Stage of Observation Phenomenon. In the stage observation of phenomena, learners are guided more and motivated to find other facts that may arise when

conducting activities/experiments in the previous stage. Guidance and motivation are done by the teacher by coming in each group, and the learners are given the opportunity to ask on things that are relevant to the activities carried out. The teacher inspires to explain something abstract into concrete or explain the experience concretely.

6) Stage of Phase Collecting, Analyzing data and Summarizing. Stage of collecting data is done after the entire process of observation, identification, and classification, as well as the possibility of finding new fact. The data found are written and analyzed by each group then drawn the conclusion of the discussion. The teacher asks a representative of the group to present the results of the activities and present it to the class.

METHOD

This study uses a classroom action research design (classroom action research), which is described as a cycle of planning, action, observation, and reflection (Kemmis & McTaggart, 1988). This cycle will be repeated so as to form a self-reflective spiral as shown in Figure 1.

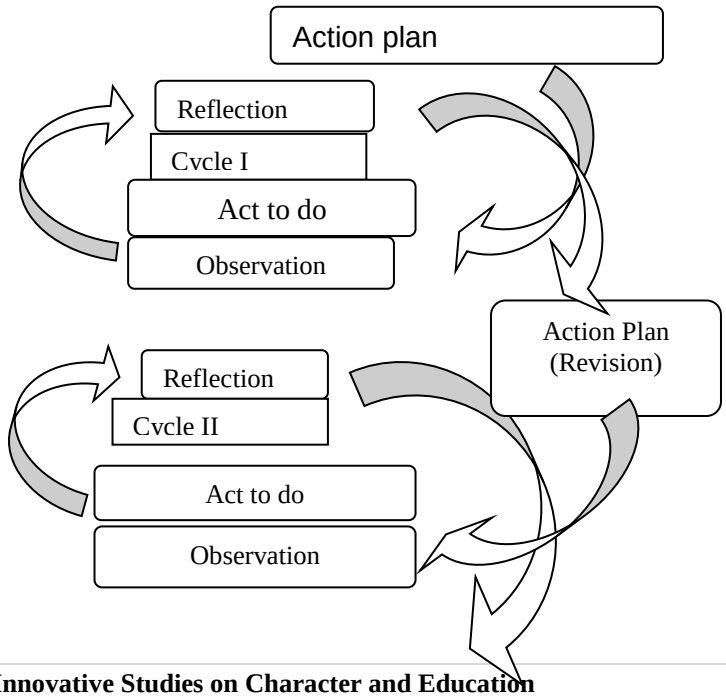


Figure 1. Flow Diagram Design models PTK Kemmis and Mac Taggart (Source modification of Sanjaya, 2009)

This study applied two cycles were completed during September-October 2016. In each cycle, a strategy of structured science experience inquiry learning aided by the virtual laboratory is applied. Here are the steps that have been made in the research:

Before carrying out the research, it is necessary to do a preliminary study conducted as a basis to determine the problems experienced by learners and teachers in the implementation of learning during this time. Things were done during the preliminary study are as follows: (a) describing information about learning physics, (b) describing the information about the ability of learners in solving physics problems, (c) conducting observation in the classroom to determine the extent of cognitive ability and process skills students in solving physics problems, (d) analyzing and formulate problems and (e) determining the appropriate strategy in solving the problem.

This classroom action research consists of two cycles; each cycle includes :

- Planning

Here are the activities in the planning stages: 1) Developing a Lesson Plan, 2) Developing Worksheet Students, 3) Developing a matter of cognitive tests learners multiple choice, 4) Developing observation sheet activities of teachers and learners , 5) Preparing sheets response and attitude of students towards learning models, 6) to coordinating with the observer about the tasks that must be implemented in observations and discuss the sheet LKPD, and 7) Preparing the tools of documentation and other devices that will be used for research

- Action

During the implementation phase of this action, things implemented are as follows: 1) implementing physics learning activities in accordance with the lesson plan compiled and 2) giving the test after the action

- Observation

The observations focus on learners and teachers during teaching-learning process using observation sheet and unbiased indicators that were observed. Teacher observation sheet used to obtain images of the stages of the practice of structured science inquiry learning

with the help of a virtual laboratory that has been designed are already performing well or not. While the observation sheet is used to observe the students during the learning activities in a non-aptitude (aspects of attitudes and skills).

- Reflection

Implementation reflection aims to rethink the implementation of measures that have been implemented and the results are obtained by recording observations, notes, findings, events in the learning process for the sake of improvement in learning. This stage is intended to assess the overall cycle that has been carried out based on the data collected, and then be evaluated. The implementation phase includes analysis, synthesis, and evaluation of observations or cycles that have been implemented.

The subjects were all students of class XI MIPA-10 SMA Negeri 1 Malang. The number of students is 31, with details of 11 boys and 20 girls.

Instruments used in each study variable can be described as follows.

The data implemented a structured science inquiry learning experience with the help of virtual laboratory is obtained through observation sheets that are used as a tool to describe the suitability implementation learning activities by teachers and learners with learning scenario contained in the RPP. The data of teachers and students are gained through the observation during the learning activities take place. Scoring for the observations is obtained by giving a score on range 1-4 in the learning scenarios (Jihad and Haris, 2009).

Tests conducted twice after the actions are the post-test in the first cycle and the second cycle. Tests were performed to determine the extent of the cognitive abilities of learners in the learning of physics to the concept of kinetic theory of gases. The form of the post-test questions is multiple-choice of 20 items.

Assessment of skills aspect is done after the students perform virtual practice from formulating problems and hypotheses, data collection, data analysis, and conclusion. Virtual practice activities are carried out four times for the first and second cycles.

The data of attitudes assessment of the students are gained from teacher observation sheet and questionnaire sheet during learning. The technique of assessment

is the teacher helped by the observer is taking a note on the learners' attitudes that include: honesty, self-reliance, responsibility, curiosity, respect, and communication/socializing.

The observation in this study is direct observations done by seven observers during the implementation of learning by completing the observation sheet consisting of observation sheet activities of learners and teachers. The observation sheets contain the aspects that were observed during the study. Teacher activity observation sheet is to determine the efficiency and effectiveness of learning. Learner activity observation sheet is used to determine the extent of the activity of both mentally and physically in solving the concept of the kinetic theory of gases.

Questionnaire responses of students on the application of structured experience inquiry learning with the help of virtual laboratory are questionnaires distributed to the students to determine the response of students on the learning model as well as to determine the attitude of the learners during learning.

Data and data sources of this study include: 1) data of observation implementation inquiry learning experience science structured aided virtual laboratory, the data source is two observers, 2) Data cognitive test results of students in the form of post-test carried out after the action for each cycle, resources Data are teachers, 3) the performance data of students in the group, the data source is a teacher, 4) data of observation, the assessment and response learners during learning, the data source is a teacher and seven observer, and 5) the data on the observation of the activity of participants learners during learning, data source is seven observers.

The technique of data analysis in this study is using the following guidelines.

The qualitative data are in the form of observations of events for all the learning activities that take place through observation sheets and collected through field notes.

This data includes the assessment of learning outcomes of cognitive, skill aspect, as well as aspects of the attitude of learners, success indicators, and enforceability of action learning for learning activities take place.

Cognitive learning outcomes data were analyzed with the following conditions

- Determine the class average:

$$X = \frac{\sum \text{Students score}}{\sum student}$$

- Determine individual minimum passing grade:

$$Ki = \frac{\sum \text{ scores achieved}}{\sum \text{The maximum score}} x100\%$$

- Counting classical completeness:

$$Kk = \frac{\sum \text{students who completed}}{\sum students} x100\%$$

If the first cycled to the individual minimum achievement grade has not reached a value ≥78 and classical completeness has not reached 85% then there will be active in the second cycle.

- The data from learning the skills are analyzed by determining the average grade. The formula to determine the individual minimum achievement grade is the same as the way to analize cognitive value. The individual is said to be complete when the value achieved ≥ 80.
- The data attitude of learning outcomes is described in descriptive aspects derived from the observation of the teacher and the observer through a questionnaire sheet learners.
- Accomplished Learning

The stage syntax of structured science experience inquiry learning with the help of virtual laboratory consists of three activities, namely: 1) introduction (X), 2) main activity(Y), and 3) closing (Z). The results of observations of learning are implemented in the percentage using the following formula:

$$P = \frac{10\% x X + 80\% x Y + 10\% x Z}{Q} x100\%$$

FINDINGS AND DISCUSSIONS

Observations Activities Students

Implementation of phase observation is made in the first cycle and the second cycle during the learning process takes place, in this case, the researcher is assisted by

seven observers. The entire observer is the teacher of overripe. Each observer to observe the activity of learners with a note on the observation sheet for each group. The observer is not allowed to speak or draw attention to the learners. Data recording starts from the current activity learners make observations to the presentation stage.

Findings activity of students in the first cycle is mostly great learners can carry out the learning activities, both physically and mentally. While the media provided can be used optimally. There are few obstacles technically device (notebook), but not influences the activity of learners. There are 5 learners are not fully active when discussions with the group. Learners are no absences 1, 19 and 28 that did not give an opinion, just writing alone from the discussion. Learners are no absence 3 and 6 are not enthusiastic and just complain. Actions taken by the teacher is to go to such learners by providing motivation to actively discuss, Mass with the teacher asked to learn the material benefits of the kinetic theory of gases in everyday life. No. 18 and 22 absent uncomfortable with the members in the group, so that they are less than the maximum in the following study.

Findings activity of students in the second cycle is no. 21 absent, less able oscillated with group members, the interaction of the same gender friends (no. 25 and 27 absent), no. 28 absent lagging write formulation of the problem and the hypothesis being busy with his own activity, no. out 11, 15, 18 and 27 passive during the discussion, no. absent 1 and 5 have not been a focus for discussion, they were busy with another simulation view.

Actions taken by the teachers of record 7 observers is to come learners who have problems, how to provide motivation to be active discussion, reminded that no other activities besides discussing described sub-materials studied, asking concepts been previously studied the subject matter of the kinetic theory of gases and ask benefit study material kinetic theory of gases in everyday life.

Teacher Observations

Event teacher observation to know the response of learners after learning activities, through a questionnaire on the extent to which understanding of the sub-materials studied for the cycle I and II.

In the first cycle, there are 11 students who have not mastered the material for the sub-Boyle-Gay Lussac law and the characteristics of the gas. The causes are: 1) not all learners bring a notebook, 2) has not been maximized work on the problems/tasks of teachers, 3) there were not comfortable with the group members, 4), the participants are not ready mentally for the implementation schedule after the hour of learning the sport, and 5) class situation is less convenient due to occupy another class. The rest 20 other students who have mastered the material sub-Boyle-Gay Lussac law and the characteristics of the gas. They are happy with the models and methods of scientific inquiry learning experiences structured with the help of virtual laboratory, comfortable with members of the group and is not affected by the environmental situation around the classroom learning.

Notes from the second cycle are that there are five students who have not mastered energy equipartition sub-materials, energy, effective speed, and the contribution of the average kinetic energy of the degrees of freedom. The causes are: 1) less intense to learn, 2) have not been up work on the problems/tasks of teacher, 3) takes a long time to understand it, 4), the participants are not ready mentally for the implementation schedule after the hour of learning the sport, and 5) less like the model and methods of learning, especially the activity of gallery walk. The rest 26 students have mastered and are masters of energy equipartition sub-materials, energy, effective speed, and the contribution of the average kinetic energy of the degrees of freedom. They are happy with the models and methods of scientific inquiry learning experiences structured with the help of virtual laboratory, comfortable with members of the group and is not affected by the environmental situation around the classroom learning.

A number of students who have trouble learning in the second cycle of decline compared to the first cycled (11 students). The condition shows that the majority of learners were able to overcome the obstacles of internal factors, physical factor (physiological), psychological factor, physical condition factor, external factor, and situational factor (W. S. Winkel in his Purwanto' articles, 2010).

The results of observations Implementation Learning

Learning is performed for two cycles using a structured inquiry science experience with the help of a virtual laboratory. The observation of the implementation observed by 2 observers to fill out a learning implementation observations of teachers and learners. More results implementation first and second cycles of learning can be seen in Table 1 and the percentage increase in Graph 1.

Table 1. Percentage of implementation of Learning Improvement Cycle I and Cycle II

Cycle	Percentage who have implemented (%)
I	91
II	95

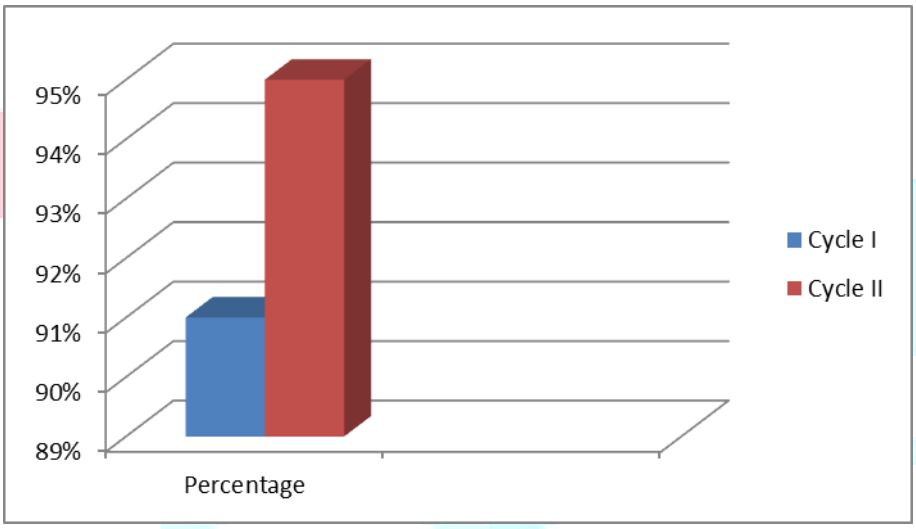


Figure 1. The Percentage of The Improvement of Learning Implementation In Cycle I and Cycle II

Percentage implementation science inquiry learning experiences structured with the help of virtual laboratory on the second cycle increased by 4% in the final stage. I cycled the final stage is different from the second cycle. An increase in the final stages of the second cycle are worksheets in each group exhibited through the media timetable. Furthermore, the work of each group display, while the other members go to see, read and then give a response in the form of questions or suggestions in the media note sticker to be attached in the timetable. When other members around, there is no finding that learners are asked directly and then answered by the group attended. So the discussion is more lively than in cycle I. The teacher gave the name of this work is the gallery walk.

The students enthusiastically participated in the discussions to conclude. Thus the teacher with the help of notes from the observer, able to overcome learning obstacles from both internal and external factors. External factors e.g. by technical constraints of the device supporting the learning process, while internal factors Mass of the physical and mental condition of learners. It concluded that scientific inquiry learning experiences structured with the help of virtual laboratory can foster trust, emphasis on self-monitoring and the responsibility of learners, able to organize themselves, be more active in developing itself able to motivate themselves. These measures are a mix between meta-learning and strategic meta-knowledge basic opinion of Novak (1998).

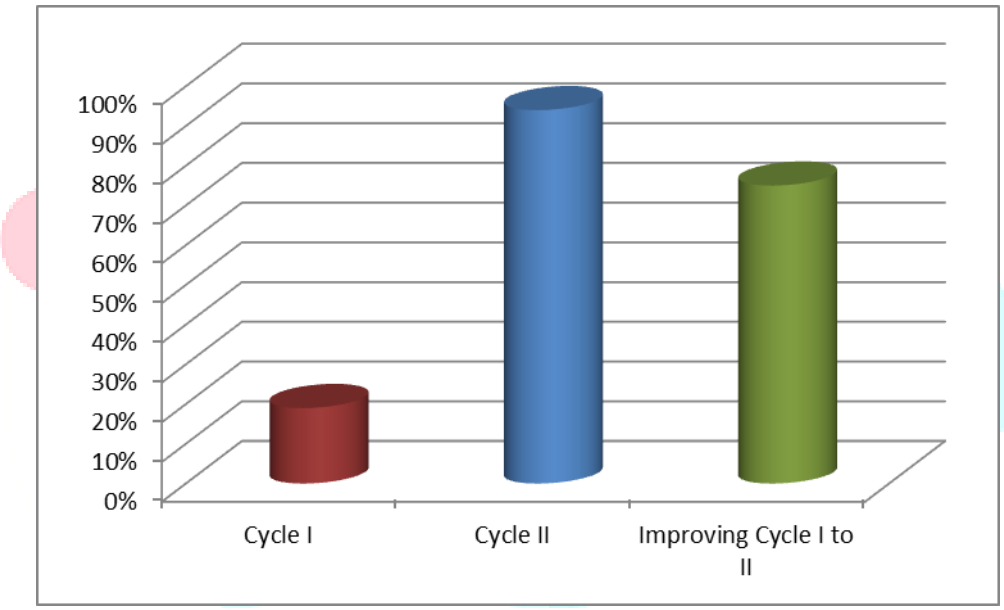
Cognitive Aspects of Learning Outcomes

In the first cycle, students study the sub-legal material Boyle-Gay Lussac and characteristic gas. Implementation of the study carried out during four meetings and each meeting 2x45 minutes time allocation. A number of students who completed is 6 so that the classical completeness 19%.

In the second cycle, the students learn the material sub-effective speed, degree of freedom, equipartition of energy, momentum, kinetic energy, and the energy in the gas. Implementation of the study carried out during four meetings and each meeting 2x45-minute time allocation. The number of learners who completed is 29 so that the classical completeness 94%. Learn the cognitive learning first and the second cycle can be seen in Table 2, and the percentage increase in Graph 2.

Table 2. The Improvement of Students' Cognitive Learning Outcomes of Cycle I and Cycle II

Aspects	Cycle I	Cycle II	Improvement Cycle I to II
The number of students who reached minimum passing grade	6	29	23
The percentage of the classical completeness	19%	94%	75%
The average grade of the class	73,7	85	11,3



Graph 2. The Percentage of the Improvement Classical Cognitive Grade

Based on Table 2 and Graph 2, that increased cognitive learning outcomes on the second cycle because the learners are able to overcome learners the obstacles of learning from both internal and external factors, as proposed by Ridwan (2008) that learning achievement is achieved is influenced by three factors, namely internal (e.g interests of is the driving factor), external factors (such as the mental preparedness of learners), and physical factors (e.g health condition of students).

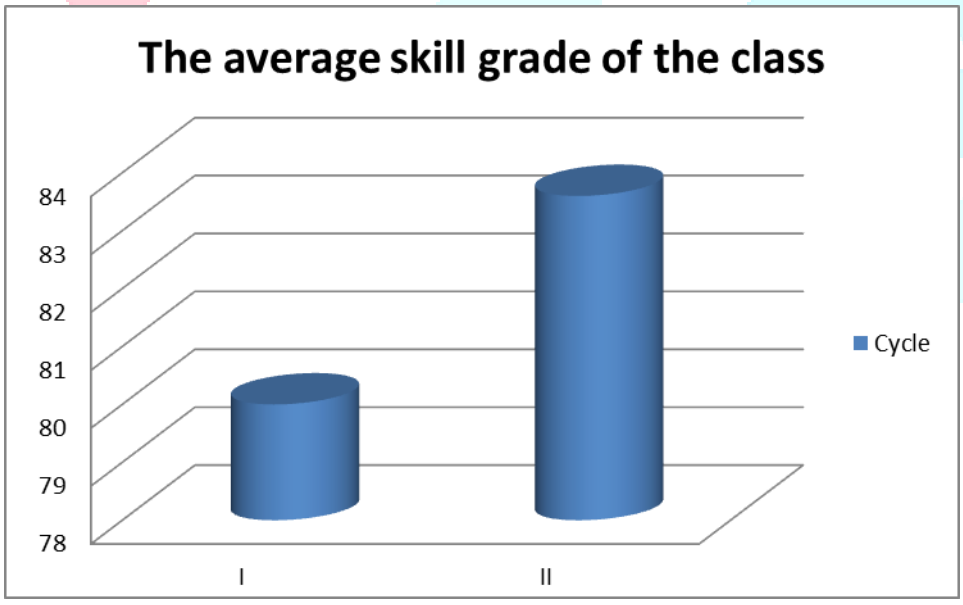
Aspects of Learning Outcomes Skills

The students conduct virtual experiments through a laptop in each group. practice the first cycle associated with sub-legal matter Boyle- Gay Lussac and

characteristic gas and the second cycle practice sub-material effective speed, the degree of freedom, equipartition of energy, momentum, kinetic energy, and the energy in the gas. The stages of activity practice first cycle and the second cycle of each group include: 1) the stage of defining or formulating the problem (and formulates hypotheses) and ask questions that are relevant, 2) phase of planned activities/experiments, 3) the stage of the experiment, 4) the stage of observation of phenomena, 5) collect, analyze, interpret data, and concluded. Each learner works in the worksheet. Improvement the value of the average grade is presented in Table 3 and Graph 3 below.

Table 3. The Improvement of The Average Skill Grade of The Class

Cycle	Class Average
I	80
II	83,6



Graph 3. IncreaseThe Average of The Class

Assessment of writing skills is an accumulation of problem formulation, hypothesis writing, and discussion questions from the analysis of observational data. Table 3 is based on an increase in the average grade of the first cycle to the second cycle is 3.6. The results of the analysis and observation of teachers, that learners have no

trouble understanding the sentence about the discussions related to the ability to understanding each simulation presented by the teacher.

Learning with the virtual experimental method is more flexible because students can experiment in a dorm or at home at any time. Learners become more independent to learn abstract concepts into real concepts by conducting observations and experiments repeated that is not limited by time and space. Besides the laboratory Virtual developed with the ideal state that does not allow any data anomalies (Resmiyanto, 2008). So that students are able to associate to form mathematical concepts (formulas).

Aspects of Learning Outcomes Attitude (Affective)

The observations made by the teacher to the learner attitude response, obtained from the attitude assessment questionnaire. The results of the first cycle are most learners earnestly carry out experiments, write data, to be honest, work in teams, responsible for the task given by the chairman of the group, and have the curiosity High to study the phenomenon of gas particles in the container closed. However, there are some students who behave not have the curiosity to the phenomenon of gas particles in a closed container for no. out 11, 15, 17, 29, and 30, are not serious in doing practice no. missed 15, 17, and dishonest with data obtained no. absent 1, 6, 12, 13, and 20. The observation of others, namely in the activity of presentation, each group responded to the findings of the group renderers. The response in the form of suggestions and questions written on the sticker note and then placed in each page of a worksheet to groups present.

The results of the second cycle of observation were not much different from the first cycle but the number of learners section cycled both the nature of curiosity more than the first cycle. Conditions such properties arise from the students because of the phenomenon of particle kinetic theory of gases are often found around our daily lives so that students are more interested and motivated to learn. Benefits of studying the concept of kinetic theory of gases are perceived by learners, so it's not just glued to memorize formulas. In addition, learners become more open to express his feelings when experiencing difficulties.

CONCLUSIONS AND SUGGESTIONS

Based on the analysis and discussion, the conclusion as the answer to the problem formulation has been determined, namely:

> "The percentage implementation inquiry learning experience aided structured virtual laboratory science increased 4% and the impact on learning outcomes of cognitive physics with classical completeness percentage increased to 75%, the aspect of skills (psychomotor) class average increased 3.6, and aspects of attitude (effective) learners become more active discussion and time to respond, more confident, more respect the opinions of others, curiosity is higher and more responsible for what was done. "

Experience science inquiry learning model is structured with the help of virtual laboratory alternatives that can be applied in teaching physics to other concepts and abstract, as well as for any other subject. This model is proven to encourage students to be more actively participate in the learning impact on improving learning outcomes. If teachers want to adopt this model, which need to be prepared is planning time to be really good, the post-test should be designed with the best, so when compared to the learning model of lectures, learning by inquiry experience science structured with the help of virtual laboratory does not require much the longer and more learning centered on the learner.

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