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Interactive Conceptual Intruction with Virtual Laboratory to Increase the Understanding of Students the Concept of the Gas Kinetic Theory

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ABSTRACT

This study aims to determine (1) the effectiveness of the interactive conceptual intruction with the Virtual Laboratory. (2) increasing conceptual understanding between interactive conceptual intruction with Virtual Laboratory and interactive conceptual intruction without Virtual Laboratory. (3) comparison of concept understanding between students using Virtual Laboratory with interactive conceptual intruction and interactive conceptual learning without Virtual Laboratory. This research was conducted on students of class XI IPA using a randomized control group pretest-posttest design research design. The learning material discussed is gas kinetic theory. Understanding the concepts in this study consists of aspects of interpreting, giving examples, classifying, summarizing and comparing obtained from the results of the pretest and posttest using multiple choice questions which amounted to 20 questions. The results obtained in this study (1) the implementation of an interactive conceptual intruction with the Virtual Laboratory is very good with an average of 90% in the experimental class and 85% in the control class. (2) the students' understanding of the concept has improved after learning is applied, this is shown in the results of the "t" test with a significance level of 0.05 obtained the results of t arithmetic (26.62) ≥ t table (2.06) in the experimental class and t arithmetic (13.58) ≥ t table (2.06) in the control class. (3) the understanding of the concept of the experimental class is slightly higher than the understanding of the concept of the control class, this is indicated by the average results of the posttest score of the experiment (15.27) : control (14). Thus, an interactive conceptual intruction to the Virtual Laboratory can be an alternative learning used to improve students' understanding of concepts.

KEYWORDS: Interactive Conceptual Intruction; Virtual Laboratory; Concept Understanding; Kinetic Gas Theory

1. INTRODUCTION

In the 21st century, physics learning moves dynamically. The learning paradigm is changing, the origin of learning is only centered on the teacher (teacher center) to be centered on students (student center). Research on student center learning has been developed, Among them, the results of the study show that students consider their learning environment to be more cohesive when inquiry-based learning is used. Attitudes show more involvement in inquiry-based classrooms[1].

The development of science and information technology is currently growing rapidly so as to make work and information more easily accepted by using computer simulations. With the rapid development of information technology, it is possible to develop a new learning media. The media that can be developed in physics learning is the PhET Simulation. PhET Simulation can describe the real situation of scientific symptoms and can describe abstract concepts. Simulation can visualize physical phenomena into actual events so as to make it easier to understand abstract concepts. The virtual laboratory used in this study is the PhET Simulation.

The use of computer simulations has produced a lot of research, the results of which show that the use of computer simulations in learning can improve students' understanding of physics concepts and help as a medium in learning [2]. Virtual Laboratory-based learning (virtual lab.) Is one of the leading products from the progress of information technology and laboratories.

One of the big problems in learning physics is the lack of student involvement to be active in learning. Learning is currently much centered on the teacher and students only become subjects in learning, so learning and learning outcomes only depend on what the teacher says. Students do not process the information received and process it based on their understanding and knowledge. Research findings show that traditional learning is not effective in dealing with students' misconceptions. Traditional learning does not consider students' views. So it cannot change concepts and also cannot improve students' understanding of concepts [3]. The use of conventional methods has dominated the teaching and learning process in schools. The weakness of the conventional method is that teaching focuses directly on mathematical equations, any discussion of physics concepts too quickly involves mathematical concepts so that the teacher pays little attention to whether students really understand the

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concepts[4]. This is what causes students' perceptions about the concept of physics to seem very difficult and complicated. Though it could be the source of complexity found in the mathematical formulation not on the physical concept.

Based on the results of research that has been done, it is found that students are more motivated to learn the concepts of physics when accompanied by visualization of abstract concepts [5]. The most ideal virtual lab is run on the internet, so participants can experiment from anywhere and anytime. However, it can also be run in an intranet or stand alone computer environment. With the virtual lab building and physical lab tools converted into computers and virtual lab software [6]. Visualization of physical phenomena and concepts related to animation at the microscopic level, as well as simulations related to daily examples of students can increase students' knowledge visually and stimulate more students to achieve a high level of understanding of physical science concepts [7].

One learning intruction that is designed with a focus on instilling concepts among students is interactive conceptual learning (*interactive conceptual instruction*, ICI). This intruction has 4 main characteristics, namely focusing on the conceptual aspect, prioritizing classroom interaction, using research-based teaching materials, and using text [8]. Interactive conceptual instruction is able to enhance creativity, problem solving, reflective thinking, originality and discovery which are important ingredients for the development of science and technology[9]. The results of research conducted related to the implementation of this intruction, shows that the use of this learning intruction can significantly improve students' understanding of concepts compared to the use of traditional learning. In this intruction, in the introductory and concept excavation sessions a props (demonstration) are used to show various physical phenomena related to the concepts being studied, for example a demonstration of the characteristics of an ideal gas, gas cannot be explained using physical demonstrations. cannot explain the movement of gas molecules if the room temperature is heated and made cold. But such props have limitations, which can only show macro symptoms, for example, cannot describe how the ideal gas moves in the container, cannot explain the amount of pressure, volume, and temperature that can affect each other. The limitations of the use of teaching aids, more or less can limit the achievement of optimal concept planting.

To overcome these limitations, there are currently many computer simulation-based media developed. This development was made possible by the rapid development of computing technology in both the hardware and software fields as well as the supporting devices [3]. Virtual Laboratory in learning can be used as a means to sharpen the explanation of the phenomenon demonstration activities by using teaching aids, or even replacing the role of teaching aids especially those that are not possible to be carried out clearly in front of the class, either because the equipment is difficult to construct or because the tools are very expensive and rare.

The concept being reviewed in this study is the kinetic theory of gas. The kinetic gas theory concept is an abstract concept and cannot be seen with laboratory experiments. The concept of kinetic gas theory is also a prerequisite for the next physics concept, Thermodynamics. Therefore, this concept requires a good understanding for students. The effort to improve understanding of the kinetic theory concept of gas is the PhET Simulation. The advantage of PhET Simulation is that it can show gas behavior or gas properties in a room that cannot be observed in laboratory experiments.

2. METHODS

The research method used is an experimental method. The design used in this study was randomized control group pretest-posttest design. The representation of the randomized control group pretest-posttest design as described in [10-13] is shown in the following table.

Table 1. Research Design

Class	*Pretest*	*Treatment*	*Posttest*
Ekperiment	O_1	X_1	O_2
Control	O_1	X_2	O_2

Information:
O_1: Pretest
X_1: Treatment, namely the implementation of interactive conceptual intruction learning with Virtual Laboratory .
X_2: Treatment, namely the implementation of learning with an interactive conceptual intruction without Virtual Laboratory .
O_2: Posttest

The population studied was the entire class XI of MAN 3 Tasikmalaya, totaling four classes with 104 students. The sample to be selected for research uses simple random sampling [11]. One class is sampled with 26 students. The sample in this study, was given the treatment of applying an interactive conceptual intruction with Virtual Laboratory 3 times. To find out the initial knowledge, the sample was given an initial test in the form of a pretest. Then proceed with treatment in the form of the application of an interactive conceptual intruction with computer simulation media, then given a posttest with the same instrument as a pretest.

The type of data taken in this research is quantitative data and qualitative data. Overall, the data obtained in this study are:

a. Quantitative data consists of (1) the percentage of learning achievement, (2) the score of the concept understanding test, and (3) the score of the worksheet results.
b. Qualitative data in the form of description comments obtained from observation sheets of the implementation of the learning process using an interactive conceptual intruction with Virtual Laboratory.

3. RESULTS AND DISCUSSION

The results of the study are related to the interactive conceptual intruction with the Virtual Laboratoryin improving the understanding of high school student concepts in the kinetic theory of gas material which includes:
a. The implementation of an interactive conceptual intruction with the Virtual Laboratory

Based on the results of the analysis of the implementation of the activities of teachers and students in the experimental class and control class has increased every meeting, this can be seen in the table below.

Table 2 The Implementation of The Activities Teachers And Students of the Experimental Class and the Control Class.

	Percentage of performance (%)		
Meeting to-	Experimental class	Control class	Criteria
2	80	70	Good
3	90	90	Very good
4	100	95	Very good

From the table above, it can be seen that at the first meeting the percentage of student and student activity implementation shows 80% in the experimental class and 70% in the control class of the ideal percentage. And the second meeting the percentage of implementation of teacher and student activities is equal to 90% of the ideal percentage. The 3rd meeting the percentage of the implementation of the activities of teachers and students amounted to 100% and 95%. From these data it can be concluded that the implementation of the activities of teachers and students in the experimental class showed improvement with good and very good criteria.

b. Increased understanding of concepts.

To make it look significant in improving students' understanding of concepts before and after using an interactive conceptual intruction with the Virtual Laboratory which is represented in the pretest and posttest scores, normality and hypothesis testing are used.

Table 3. The pretest, posttest and N-Gain scores of the experimental class

Pretest		***Posttest***		**NG**	
Rata-rata	SD	Rata-rata	SD	Rata-rata	SD
6,92	1,59	15,27	1,51	0,64	0,10

Based on table 3, the average score of concept comprehension in the experimental class increased, from a score of 6.92 to 15.27 with an average N gain of 0.64. As for the data is converted into the following form of figure:

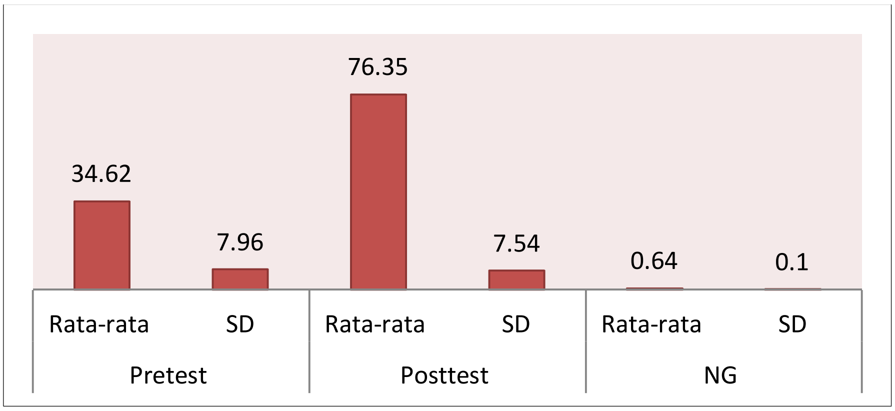


Figure 1 bar chart comparison of the average percentage average pretest, posttest and N-Gain scores of the experimental class.

Based on Figure 1, the average percentage of students' pretest scores was 34.62% of the ideal scores. Furthermore, the average percentage of students' posttest scores was 76.35% of the ideal score. Average N-Gain acquisition of 64% is in the medium category. Testing increased understanding of the concept using the "t" test because the pretest and posttest data of the experimental class were normally distributed. The results of the experimental class t test showed tcount itung ttable, 26.62226 ≥ 2,060. The results of the pretest, posttest and N-Gain scores of the Control class are presented in table 4.

Table 4. Pretest, Posttest and N-Gain Score Control class

Pretest		***Posttest***		**NG**	
Rata-rata	SD	Rata-rata	SD	Rata-rata	SD
7,38	2,19	14	2,15	0,52	0,14

Based on table 4, the average score of concept comprehension in the control class increased, from a score of 7,38 to 14.00 with an average N gain of 0.52. As for the data is converted into the following form of figure:

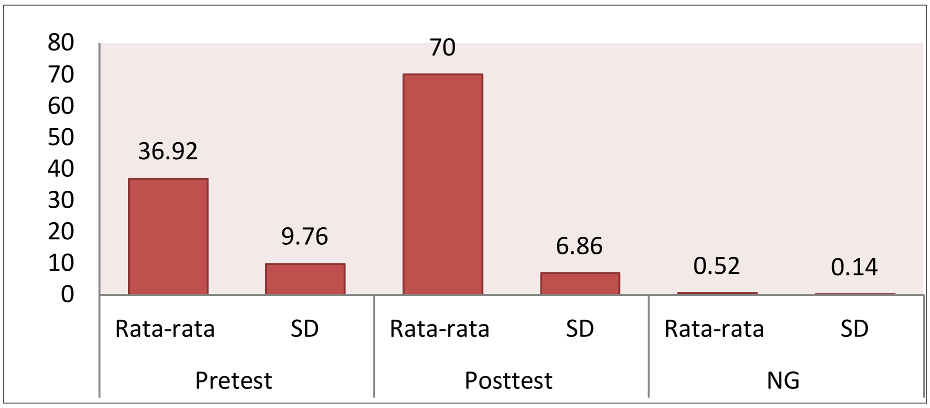


Figure 2 bar chart comparison of the average percentage average score of the pretest, posttest and N-Gain control class.

Based on Figure 3 the average percentage of pretest scores of students was 36.92% of the ideal score. Furthermore, the average percentage of students' posttest scores was 70% of the ideal score. Average N-Gain acquisition of 52% is included in the medium category.

Testing increased understanding of the concept using the "t" test because the pretest and posttest control class data were normally distributed. The results of the experimental class t test showed that t ≥ t table was 13.58 ≥ 2.060.

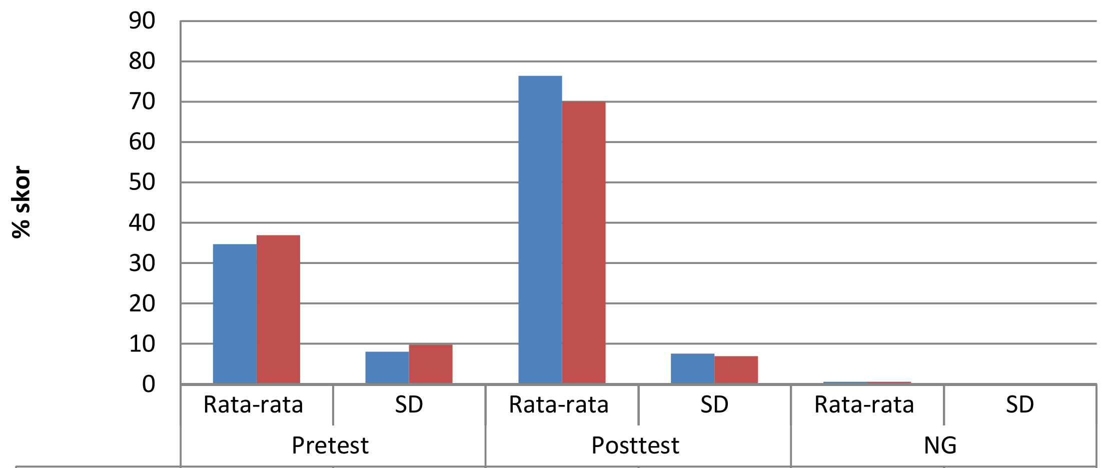
From the LKS results it can be seen that students can answer the problem about the kinetic gas theory concept. The results of the average score of students in each group per meeting are as follows:

Table 5 LKS scores for each meeting.

Kelompok eksperimen	**Pertemuan**			**Rata-rata**	**Interpretasi**
	1	**2**	**3**		
1	80	75	85	80	Tinggi
2	70	75	85	76,7	Tinggi
3	75	80	85	80	Tinggi
4	75	80	80	78,3	Tinggi
5	75	75	80	76,7	Tinggi
6	70	80	75	75	Tinggi
7	70	70	80	73,3	Tinggi
8	75	75	85	78,3	Tinggi
Kelompok Kontrol	**Pertemuan**			**Rata-rata**	**Interpretasi**
1	70	70	75	71,6	Tinggi
2	75	70	75	73,3	Tinggi
3	70	70	80	73,3	Tinggi
4	70	75	80	75	Tinggi
5	80	80	70	76,6	Tinggi
6	70	80	70	73,3	Tinggi
7	80	80	70	76,6	Tinggi
8	75	80	75	76,6	Tinggi

c. Comparison of increasing understanding of concepts

Improved understanding of the concepts of the experimental class and the control class when compared to the experimental class was slightly superior to the control class. Comparison of the average score of pretest, posttest and N-gain understanding of the concept of kinetic gas theory between the experimental class and the control class as a percentage can be seen in the following figure 3:



	Pretest		Posttest		NG	
	Rata-rata	SD	Rata-rata	SD	Rata-rata	SD
eksperimen	34.62	7.96	76.35	7.54	0.64	0.1
kontrol	36.92	9.76	70	6.86	0.52	0.14

Figure 3 bar diagram of the pretest, posttest and N-gain average score.

Based on Figure 3 the percentage of the average score of the pretest of the experimental class was 34.62% and the percentage of the average score of the pretest of the control class was 36.92% of the ideal score. Furthermore, the acquisition of posttest average score for the experimental class was 76.35% and the percentage of posttest control class average score of 70% of the ideal score. The average N-gain score for the experimental class was 64% and the average N-gain for the control class was 52%. The average N-gain for the two classes is in the medium category, but the N-gain for the experimental class and the control class shows a difference. That is a little larger N-gain experimental class.

4. CONCLUSION

Based on the results of data analysis, the findings and discussions that have been made can be concluded as follows:

a. The implementation of the interactive conceptual intruction with the Virtual Laboratoryis going well, this is evident from the percentage of the activities carried out by teachers and students by 90% in the experimental class and 85% in the control class.
b. Interactive conceptual intruction with Virtual Laboratoryor without Virtual Laboratoryon learning can significantly improve students' concept understanding, with N-Gain experimental class by 64% showing medium category and N-Gain control class by 52% with medium category.
c. Increased understanding of the concepts of students who get interactive conceptual learning with Virtual Laboratoryis higher than students who get interactive conceptual learning without Virtual Laboratory . Evidenced by the average possttest score of the experimental class by 76.35 higher than the control class that is equal to 70.

5. SUGGESTION

Based on the results of the analysis, the authors suggest an interactive conceptual Intruction with a Virtual Labolatorium can be an alternative learning used to enhance students' understanding of concepts.

a. In connection with the advantages of virtual laboratory activities, it is necessary to have a good enthusiasm for learning to use computers in learning.
b. Students are expected to be more active in implementing learning using an interactive conceptual Intruction.
c. the depiction of physics learning animations in particular the kinetic theory of gases can describe the behavior of gas molecules based on temperature, pressure, and volume as well as the ideal gas equation.

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