THE EFFECT OF COOPERATIVE LEARNING MODEL USING PHET SIMULATION ON PHYSICS STUDENT'S ACHIEVEMENT

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ABSTRACT

The purpose of this study was to measure students' academic skills using a group survey model using Phet.. These skills can be acquired by adopting an appropriate learning model in terms of mastery of materials and skills.. A survey was conducted at Senior High School and information was obtained that students' learning results still needed to be higher. Students' learning outcomes can be improved by using learning models and media. The solution that can be done is to apply the GO type cooperative model using PhET simulation. This research is pseudo-experimental, posttest-only design. The population of this study were all XI science classes of Senior high scholl , registered in the 2022/2023 academic year. Sampling was done using a purposive sampling technique, grade XI IPA 1 and grade XI IPA 2 classes were selected as samples. The instruments used were posttest questions for knowledge-skills observables for attitudes and skills-skills, and the research hypothesis was tested using the t-test. Research results using t-test lead to the conclusion that in students' knowledge competency, the value of T_{counts} 5,279> T_{table} 1,994437. Regarding attitude competency, the value of T is 11,89> T_{table} 1,994437. In the skill competency, the value of T_{count} is 3,3580> T_{table} 1,994437. This shows that the hypothesis is accepted. So, motivating in the form of a posttest can improve the learning outcomes of physics students in Class XI IPA at Senior high school in the 2022/2023 school year.

Keywords :Group Investigation Cooperative Model, PhET Simulation, Physics Learning Results.

I. INTRODUCTION

The rapid development of technology certainly affects all fields, including education. In the education field, technology's influence lies in the learning process known as 21st-century learning [1]. The focus of 21st century learning is on students' capacity for critical thought, knowledge application to the actual world, command of information and communication technology, and teamwork. Applying the proper learning models connected to knowledge acquisition and skill development will help you develop these skills [2]. Improvements to the 2013 Curriculum continue to be pursued. So the 2013 Curriculum was revised in 2017, which contains several important points as the main objectives of the government, namely character education, 4C skills (creative, critical thinking, communication and collaboration), literacy and higher thinking skills (HOTs) [3]. . The application of 4C skills in 2013 curriculum learning will have a remarkable impact on the nation's next generation in facing the challenges of 21st-century life. In the 21st century, developments in the field of Science and Technology ("IPTEK") especially in the field of education, it is increasing rapidly and now is the age of knowledge. Learning activities should be tailored to the needs of the knowledge period. Materials should also offer a more authentic design that encourages students to work together to find solutions to their learning problems. [4].

PhET (Physics Education Technology) is an open-source software application to help students and teachers understand math and science education (physics, chemistry, biology, earth). This PhET simulation is free to use

by simply downloading the online application available at http://phet.colorado.edu. PhET is a research-based interactive simulation of physical phenomena that combines real-world phenomena with the underlying science to increase students' interest in understanding and learning [5]. This PhET simulation is in the form of moving images or interactive animations designed like a game where students can learn directly by exploring topics given by teachers at school. Simulations emphasize the compatibility between natural phenomena and computer simulations, then present them in a physical conceptual way that is easy for students to understand [6] [7]. The learning process is a communication process, the transfer of ideas and knowledge from educators to students. The role of the educator provides conditions that encourage students to actively participate in the learning process in the classroom. The educator's role, therefore, is to structure each learning material in a way that encourages student learning, comprehension, communication as a learning goal, and simulation practice [8].

Learning is an interactive activity that takes place in a learning environment between teachers and students while utilizing learning resources. In a learning environment, learning is the interaction of students with teachers, learning materials, teaching methodologies, and learning resources [9]. A collaborative learning model places students in small groups of 4-5 peers with diverse group structures to study and work together. Group structures with various educational backgrounds, genders, races, and even nationalities are examples of heterogeneous notions in this context. This is relevant in teaching pupils to value diversity and collaborate with friends from other backgrounds [10]. Student planning is included in group investigations (GI), including topic selection and investigation-based learning. Students who use this method must have strong interpersonal and group-processing skills. Group splits can also be based on friendship or shared interest in a particular topic. After studying various selected sub-topics in detail, students will select a topic to study, write a report and present it to the whole class.[11]. One effective arrangement is an inquiry-based group learning paradigm based on PhET. Both stimulate more active learning among students. Encourage pupils to engage more fully in their classroom activities. Models of group learning provide pupils greater opportunities. They can pace themselves in the learning process by taking ownership of what they learn. the pupils themselves. Phet is one of the learning tools that can give instructors ideas for lesson plans. By eliminating abstract explanations from what students can actually accomplish, PhET is one of those learning resources that may offer actual examples of the subject teachers are presenting. This makes learning more pleasurable and encourages students to be more engaged in educational activities. [12].

In the study of physics, natural phenomena are covered. Since it deals with the behavior and structure of objects, physics is the most fundamental branch of science [13]. The scientific field of physics is concerned with determining the most fundamental concepts. Students find it difficult to understand the many abstract concepts in physics [14]. The learning strategy, including the lesson objectives, the stages of the learning activity, the learning environment, and the course management, is referred to as a learning model. The function of the learning model is to guide the instructional her designer and teacher in the practice of learning [15]. Elasticity refers to physics as a property of materials that can change size and shape after being subjected to external forces. However, the object returns to its original size and shape after the external force is removed. Hooke's law states that in an object's elastic region, the length increase is proportional to the force acting on the object [16], [17]. Based on the above description, the research conducted is entitled "The Effect of Group Investigation Tipe Cooperative Learning Model Using PhET Simulation on Physics Learning Results in Class XI Senior High School

II. METHOD

Experimental studies are the type of research done. The unit being studied will receive therapy as part of experimental research. Under regulated circumstances, the experimental research approach is used to investigate how a treatment affects others [18]. A posttest-only control design was the method utilized in the investigation. There are two groups in this research design, and each was chosen at random. (R). The study was carried out at Senior High School. The study was carried out in class XI IPA, which was enrolled in the second semester of the academic year 2022/2023.

The research procedure is outlined in the following diagram the following diagram.
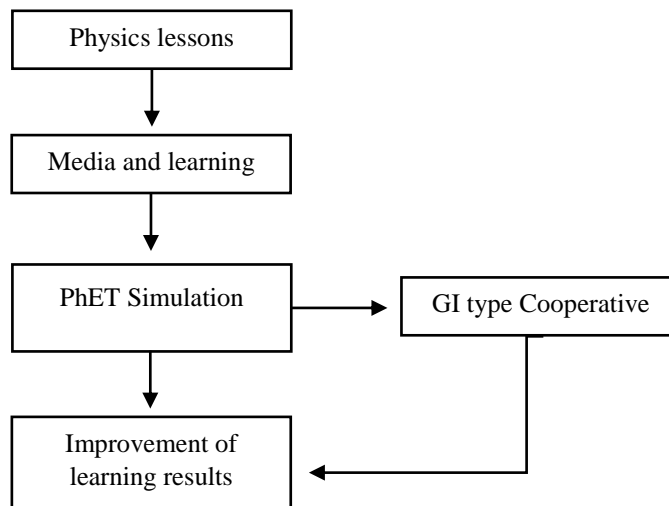
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Fig 1. Thinking framework

This research design is a simple experimental design (Posstest Only Design). The population of this study consisted of all students in the three classes that make up class XI of Science class senior high school. The grade XI sciecne 1 class was obtained as the experimental class and the grade XI science class was obtained as the control class thanks to the sampling approach of Cluster Random Sampling. The control class received a scientific model of learning, while the experimental class received a cooperative learning model of Group Investigation type employing PhET. This research design is shown in Table 1.

Table 1. Posttest-Only Control Design

Groups	Treatment	*Posttest*
Experimental	X	O_2
Control	-	O_2

(Source: Ref [18])

Descripton:

O_2 = Posttest (final test) given after the application of treatment, given to both groups (experimental and control).

X = The treatment given to the experimental group, namely by using the GI type cooperative learning model using PhET Simulation.

Data collection in this study was carried out by the test method using a multiple choice test of 25 questions that had been selected according to the instrument test analysis criteria, including validity analysis, reliability, difficulty level, and differentiation of questions. Therefore, the post-test is intended to determine student learning outcomes on learning materials after learning activities. Data analysis of post-test results includes normality test (Liliofors test), homogeneity test (Variance Test), and hypothesis testing. Normality test is used to determine the normality of data to determine statistical tests in hypothesis testing. Homogeneity test to determine whether the two samples have a homogeneous variance or not, for it is done the F test. Hypothesis testing is done to determine the effect of cooperative learning model type group investigation using PhET simulaition on physics learning outcomes of class XI senior high school.

III. RESULTS AND DISCUSSION

Based on the research objectives, the main results of the research that have been carried out can be obtained, namely the first research results of the assessment of the attitudinal aspects obtained through observation. The second is the assessment results of the knowledge aspects obtained at the end of learning through written tests. The third research result is the results of the assessment of the skills aspect, where what is assessed is practical skills in the laboratory and PhET Simulation. The results on this aspect of skills are obtained when students do the practice. For the experimental class, students do laboratory and virtual laboratory practice

with the help of android / mobile phones using Phet Simulation. As for the control class, students practice in the laboratory using the practicum tools and materials provided by the laboratory.
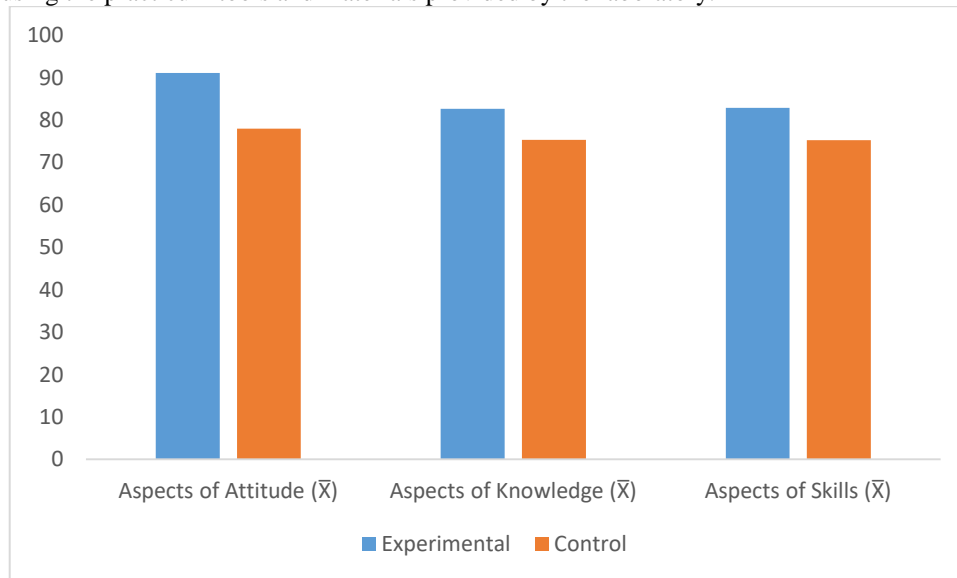

Fig 1. Values in Aspects of Attitude, Knowledge, Skills

Data analysis based on Figure 1 revealed differences in learning outcomes in knowledge skills between students using the PhET simulated group-based collaborative learning model and students using the scientific model. However, before testing hypotheses, we first perform normality and uniformity tests on attitudes, knowledge, and skill competencies.

1. Attitude Competency

The findings from the observation sheets of the experimental and control courses, which looked at several aspects of attitude in the learning process, are shown in Table 2.

Table 2. Data on Attitude Competency of Experimental and Control Classes Attitude Competency

Component	Attitude Observation Sheet Results	
	Experiment Class	Control Class
Number of Students	36	36
Highest Score	97	83
Lowest Score	83	70
Average	91,11	77,97
Standard Deviation	4,921	25,1
Normality Test Results	Normal	
Homogeneity Test Results	Homogen	
Hypothesis Test Results	Tcount> Ttable Ho is rejected and Hi is accepted	

Table 2 shows the mean value ($\overline{X}$), standard deviation (S), and variance (S2) of learners' skill competency data for experimental and control classes obtained statistically. Based on this table, it is clear that the experimental class's average attitude competency score is higher than the control class's average score on this metric. It was then discovered that the data from the two samples passed the Liliofors test's normality test. Homogeneity results obtained both sample classes are homogeneous, Hypothesis results show that the H0 acceptance area with a real level, and value t (0.025) (70) = 1.757. Since the value of This outside the Ho acceptance area, then Hi is accepted.

2. Knowledge Competency

The results of the study on the knowledge aspect in the form of tests, Table 3 displays the outcomes of the tests conducted following the test of the experimental class and the control class.

Table 3. Data on Knowledge Competency of Experimental and Control Classes Attitude Competency

Component	Results of Knowledge Observation Sheet	
	Experiment Class	Control Class
Number of Students	36	36
Highest Score	92	72
Lowest Score	84	68
Average	82,67	75,33

Standard Deviation	6,625	5,01
Normality Test Results	Normal	
Homogeneity Test Results	Homogen	
Hypothesis Test Results	Tcount> Ttable Ho is rejected and Hi is accepted	

Table 3 shows the mean value ($\bar{X}$), standard deviation (S), and variance (S2) of learners' skill competency data for the experimental and control classes obtained statistically. Based on the table, it can be seen that the average value of the attitude competency of the experimental class is higher than the average value of the attitude competency of the control class. Then for the normality test using the Liliofors test, it was found that the data of the two samples were normal. Homogeneity results obtained both sample classes are homogeneous, Hypothesis results show that the H0 acceptance area with a real level (α) = 0.05 obtained $-t_{\left(1\frac{1}{2}\propto\right)} < th < t_{\left(1\frac{1}{2}\propto\right)}$ with degrees of freedom dk = (n1 + n2) - 2 so that t (0.025) (70) = 1.757. Since the value of Th is outside the H0 acceptance area, Hi is accepted..

3. Skill Competency

The results of research on the skills aspect in the form of a rubric for performance assessment obtained based on the results of observations during practicum activities, the results of the experimental class and control class performance assessment can be seen in Table 4 below.

Table 4. Data on Skill Competency of Experimental and Control Classes Attitude Competency

Komponen	Skill Observation Sheet Results	
	Experiment Class	Control Class
Number of Students	36	36
Highest Score	95	68
Lowest Score	95	58
Average	82,94	80,34
Standard Deviation	8,963	10,316
Normality Test Results	Normal	
Homogeneity Test Results	Homogen	
Hypothesis Test Results	Tcount > Ttable Ho is rejected and Hi is accepted	

Table 4 shows the mean value ($\bar{X}$), standard deviation (S), and variance (S2) of learners' skill competency data for the experimental and control classes obtained statistically. Based on the table, it can be seen that the average value of the attitude competency of the experimental class is higher than the average value of the attitude competency of the control class. Then for the normality test using the Liliofors test, it was found that the data of the two samples were normal. Homogeneity results obtained both sample classes are homogeneous, Hypothesis results show that the H0 acceptance area with a real level (α) = 0.05 obtained $-t_{\left(1\frac{1}{2}\propto\right)} < th < t_{\left(1\frac{1}{2}\propto\right)}$ with degrees of freedom dk = (n1 + n2) - 2 so that t (0.025) (70) = 1.757. Since the value of th is outside the H0 acceptance area, Hi is accepted..

Among the strategies for inquiry-based group learning are 1) grouping (splitting students into a number of diverse groups), 2) planning (the teacher asks students to choose themes to There are various steps, one of which is outlining the behaviour guidelines. 4) organization (the instructor facilitates conversation), 5) attendance (the group leader presents the findings of the discussion), and 6) evaluation (The teacher explains and concludes). [19] [20]. Perkins' findings further demonstrate the value of Phet simulations for physics instruction. His poll found that 62% of respondents believed it aided their learning in the classroom, while 22% claimed it didn't [21]. Suparmi said that one of the cooperative learning models is the Group Investigation (GI) kind. In this learning model, students are actively involved in meaningful activities developed based on the theory that students will better find and understand complex concepts if they can discuss these problems with their friends. In this learning model, students are actively involved in learning activities. Then students must learn to work together with other members in one group. This learning model requires students to interact with other group members regardless of background [22].

The results of the study show that the results of data analysis of attitudes, final tests (posttests), practical and virtual laboratory performance, and activities during the learning process are the averages of student learning in attitudes, knowledge, and skill competencies. said to show positive results. Students achieved better learning outcomes in High School Physics Class XI IPA using a group-investigative collaborative learning model using her PhET simulations of Elastic Materials, Hooke's Law, and Static Fluids. This conclusion can be drawn from the students' typical learning outcomes for the gained attitudes, knowledge, and abilities. Based on the findings of the research, it appears that students are more engaged in their [23]. Education when collaborative learning models like group surveys are used in conjunction with PhET simulations..

IV. CONCLUSION

Based on the calculation of student learning outcomes using quasi-experiments and t-tests, it can be seen that the results reject Ho and accept H1. Thus the learning outcomes of students proposed with the Group Investigation (GI) Type Cooperative Learning Model using PhET Simulation on Physics Learning Results Class XI of senior high school are higher than those taught with a scientific learning mode. Investigation group type cooperative model is learning carried out in groups with the guidance of educators so that students can interact actively to exchange opinions, knowledge or experiences, find problems, solve problems, and hypothesize. so that this learning model is very suitable to be used to improve learning outcomes.

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