Scientific Attitudes Mapping of Students after using PhEt Assisted Group Investigation Models

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Scientific Attitudes Mapping of Students after using PhEt Assisted Group Investigation Models

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Abstract. This study aims to observe the effect of the use of PhEt Group Investigation (GI) – based on learning models of students' scientific attitudes. This type of research is quasi-experimental. There are two classes in this study, namely the modelling class and the implementation class. Both classes are given the same treatment which is the use of PhEt assisted Group Investigation (GI) learning models in physics learning. Data collection instruments applied are questionnaires obtained from students to assess the scientific attitude of their group friends. Scientific attitude questionnaire sheets have been validated with valid categories. The result shows that the average questionnaire of scientific attitudes of each modelling class students and the implementation class is in the very high category. This indicates that learning which uses the PhEt assisted Group Investigation (GI) model shows a positive impact on students' scientific attitudes.

Keywords: Group Investigation (GI); PhEt; Scientific attitude; Physics.

1. Introduction

Technological advances affect all aspects of life including economic, political, and even educational aspects. Innovation in education's world is needed to be done for the advancement of education and schools. Innovations are carried out not only in the field of curriculum, infrastructure, but overall innovation by using technology in school learning activities. The use of computers or laptops is one of the best uses of technology in learning. At present, some educational institutions use computers in the field of physics [1]. Computers or laptops are used in laboratory experiments that cannot be practiced directly. Experiments carried out on laptops and data can be directly collected and analyzed. The intended learning can be carried out using simulation [2]. Simulations are designed to facilitate teaching and learning through visualization and interaction in understanding the concepts of physics clearly. [3-5].

Students do not understand the concept of physics if there is no direct demonstration through which they observe. Some students prefer to learn based on experience rather than just learning to use textbooks [6]. Physics subjects can be understood with the help of simulations. Experimental activities that are difficult for students to understand will be simpler and easier to understand with the help of simulations. Simulation offers an ideal, dynamic, visual representation of existing phenomena and makes physics experiments easier without being done in a school laboratory [7]. The simulation shows a simple version that can focus students' attention in real terms according to the desired phenomenon [3-5]. There are differences in the use of textbooks with learning using simulations. The benefit of students in learning through simulation is they can systematically explore hypotheses, interact directly with the system, and

solve problems in a realistic learning environment without stress [8]. The use of simulations on physics subjects will be more enjoyable and will not make students bored in monotonous learning. Physics learning using technology helps students significantly increase the knowledge of teachers and students. [3]. Research on the use of technology in learning has developed rapidly and made learning becomes more challenging. [9] [10] Some researchers claim that the success of learning using simulations in the field of science can develop students' questioning and reasoning skills [11].

Physics emphasizes on giving direct experience to develop competencies, so that students can explore and understand the natural surroundings scientifically. The basic competencies that the students have are abilities or skills [12]. Competencies that must be achieved by students consists of 3 aspects, namely knowledge competence, attitude competency, and skill competency. These three competencies can be achieved through quality learning. Quality learning depends very much on the motivation of students and teacher creativity [13]. The characteristics of quality learning are learner-centered learning, learning that trains students to process their mind in finding knowledge.

Classroom learning activities should be inspiring, interesting, challenging and can motivate students to participate actively in order to create creativity and independence of students [14]. Therefore, a learning model is needed to be able to make students becomes more active in classroom's learning activities. The expected learning is learning that assigns students in groups which encourage yhem to be more independent [15]. Learning systems that require students to be more active in learning and provide opportunities for them to work together and solve problems in structured tasks are cooperative learning systems [16].

Cooperative learning is one of the learning models with the division of a small team or grouping system consists of 6 students who have different academic backgrounds (heterogeneous). A good type of cooperative learning to make students becomes independant is the using of Group Investigation (GI) model. Based on its name, the GI model is a model that deals with the acquisition, analysis, and synthesis of information to solve problems [17]. GI models can improve student learning outcomes as they can actively involve students in the learning process in the classroom. The GI model can direct students regularly to solve physical problems. Students are trained in harmony according to the syntax in the GI model. In addition, the GI learning model can provide enthusiasm for initiative, creative and active learning. In this model the teacher begins by giving a problem that must be solved. The teacher provides problems that must be solved by students through simple discussion and practicum activities [18]. Through practicum activities, it is expected that there will be an influence on students' scientific attitudes.

Scientific attitudes include aspects of physics learning that direct students to be positive or negative towards an object and in certain situations. Interestingly designed learning will affect students' behavior because students are actively involved in learning. By using the Group Investigation (GI) model in learning, students are required to investigate the problem, carry out an investigation through a simple practicum that makes students challenged and interested in learning. Students express difficulties in understanding physics representation in carrying out experiments since in certain material physics cannot be done directly [19]. Yet with the simulation, students can understand a little about physics subject matter. The PhEt is a good alternative in understanding physics material because it allows students to understand the physical system and phenomena better [20].

The Group Investigation model will be maximally used in learning with the help of the PhEt application. The PhEt simulations provide dynamic access to multiple representations, make investigations, and allow safe and fast access to multiple experiments, while engaging and fun for learners and teachers [21]. This application also makes students practice independently and investigate solving problems that have been given by the teacher. The PhEt is designed to support learning needs. It also helps class learning activities and supports interactive discussions. The PhEt's design features support the exploration and involvement of students in learning. It also supports the dynamic role of the teacher to provide unique opportunities to explore and illustrate concepts in responding to students' real questions [22-23].

Group Investigation (GI) learning model has 6 phases, which include focusing students' attention, identifying topics as well as dividing learners into several groups, planning assignments, making investigations, and presenting the results of investigations that have been compiled into a report and evaluating learning that has been taken place. For the phase of focusing students' attention and making an inquiry, students are assisted to use PhEt, while for the phase of planning assignments and presenting the results of the report, students are assisted with LKPD designed according to the syntax of the Group Investigation (GI) learning model. The purpose of this study is conducted to see the effect of the use of Phet Group Investigation (GI) type of cooperative learning model on students' scientific attitudes

The rest of this paper is organized as follow: Section 2 presents literature review. Section 3 describes the proposed research method. Section 4 presented the obtained results and following by discussion. Finally Section 5 concludes this work.

2. Literature Review

Behavioral changes that occured then last a long time or in the capacity to behave in certain ways, and resulting from practices or other forms of experience are called learning [24]. The effort to teach students and the learning process as a new knowledge relationship with the cognitive structure that students already have are called learning [25]. Learning is the process of interacting students with teachers and the resources used during teaching and learning takes place. Learning must involve as many students as possible, so they can explore to form competencies by exploring various potentials, and scientific truths [26].

Learning objectives are to provide knowledge and train students to think about achieving their competence. Learning objectives are to provide knowledge and train students to think. Therefore, the involvement of students is very important in learning to find knowledge obtained by direct observation and experience that can develop students' thinking ability. Physics is not just a collection of facts and principles, but physics also discusses how to get facts and principles along with the attitude of physicists in acting [27]. So physics learning means an effort that can help students to find physical concepts or principles with their own abilities so that the concept or principle can be explained.

Physics discusses natural phenomenon that is found in everyday life so that it can develop students' analytical thinking skills in solving problems related to the events encountered in their lives. The success of physics learning is determined by the ability of the teacher, students, facilities, strategies, methods, tools and media that have been provided in the learning environment. In the learning process, it requires active students as the priority [28]. The use of learning models can make learning activities in class become active and communicative and help teachers in the learning process. Learning model is something that is considered by the teacher and the important thing is to make the design of the teaching and learning process so that the objectives to be achieved can be fulfilled optimally. The learning model provides a framework and guidance for teachers to teach [29]. Characteristics that must be included in the learning model are: a) the existence of a theoretical foundation related to the learning model, b) there is a learning model of syntax, c) the existence of a classroom management system in the learning process, d) the existence of a principle that the teacher must do in the learning process, e) there is a design of learning objectives as the results of the on-going learning, whether the objectives that have been done are achieved,

Combination of learning strategies with discussion in groups and academic processes in the form of researching or investigating is a GI (group investigation) learning model [30]. The focus of the GI model is to involve students in the real problem through group investigations that involve students to design and solve the problem. Group investigation cannot be applied in learning if there is a lack of interpersonal social interaction in the classroom. Communication and interaction between good friends in the classroom will help group investigations to be carried out in small groups. Teachers and students must be able to build good communication and social interaction in the classroom.

In general, the implementation of group investigations begins with the teacher making a broad topic, then the students divide the topic into subtopics. This subtopic is the result of the development of students' wishes in the exchange of ideas. Students learn together with small groups, help each other,

conduct investigations to solve problems [31]. Students seek information from various sources, whether in books, the internet, or outside the classroom. Other supporting sources such as institutions and people who offer their ideas, opinions, data, solutions related to the problems to be investigated. The role of the teacher when the GI model is used is as a facilitator to help students in in doing te investigation smoothly. So, GI model learning is a model that instructs students in several groups that later students will investigate according to the sub-material that has been divided. The step of the GI model in learning consists of 6 syntaxes, namely: [32] a) Identifying Topics and arranging students into Groups. b) Planning Learning Tasks. c) Carrying out investigations. d) Preparing the final report, e) Presenting the final report, f) Evaluation.

Physics Education Technology (Phet) is an interactive simulation of physical phenomena, based on free research. With a research-based approach that combines the results of previous research allows students to link real-life phenomena and the underlying science, ultimately deepening understanding and increasing their interest in physics. Research results Simulations in Phet are very useful in learning physics in class [33]. The results of this research showed that 62% of respondents said that it was very useful in learning in class and 22% of respondents said it was beneficial.

Attitude (attitude) is a structured tendency to think, absorb, feel and behave towards a cognitive object [34]. The tendency to behave in a certain way towards objects of attitude such as objects, people, locations, ideas, groups or certain conditions [35]. Scientific attitude is a combination of a number of mental habits or habits of acting in a certain way towards a problem [36]. Physics learning must be developed referring to the characteristics of physics to educate and train students to develop attitude, experiment, and scientific competence [37]. Aspects of scientific attitudes that can be developed in learning include attitudes toward assignments given, attitudes toward oneself, attitudes toward science, and attitudes toward the environment [38]. Aspects of scientific attitude in research conducted are a) curiosity, b) Respect for Data and Facts, c) Think critically, d) open thinking and collaboration, e) sensitive to the environment, and f) perseverance.

The Phet applied in this innovation research is the subject of Momentum and Impulse which is focused more precisely on the subject of perfect resilient collisions, partial resilient collisions, and non-resilient collisions. Student worksheets are made using the Group Investigation syntax's learning model on the subject of collision that has been applied.

3. Proposed Method

This research is a quasi-experimental research. Quasi-experimental research is also the development of a true experiment. The research design used is non-equivalent Control Group Design. The researcher was unable to control external variables that influenced the results in this quasi-experimental study. The study was conducted at SMA Negeri 1 Banguntapan, Yogyakarta, Indonesia. The study was conducted in April 2018 with 1 meeting in each class. The population in this study is all students in class X of SMAN 1 Banguntapan. As for the sample classes needed are as many as two classes including class X MIA 3 and X MIA 4. Class X MIA 3 as a modelling class and class X MIA 4 as an implementation class. Both classes were given the same treatment using Phet-assisted investigation group learning model on collision material. In learning, the Phet application is used using a laptop, in which one laptop represents a group to discuss and conduct experiments. The difference between the modelling class and the implementation class is that the modelling class is carried out by the researcher, while the implementation class is carried out by the teacher concerned.

In the implementation of the GI learning model, RPP and LKPD were first designed so that the implementation of learning went well. RPP and LKPD of students before being used in learning have been validated in advance by experts. Data collection was carried out by using questionnaires to assess the scientific attitudes carried out by peers in groups. Data analysis techniques using manual calculations with percentage score techniques that can be calculated using the equation:

$$S = \frac{R}{N} x\ 100\%$$

The calculation results will be categorized based on the percentage of the score achieved. The categories of students' scientific attitudes can be seen in Table 1.

Table 1. Categories of students' scientific attitude in the learning process

No	Percentage (%)	Category
1.	80,1 – 100	Very high
2.	60,1 – 80	Height
3.	40,1 – 60	Medium
4.	20,1 – 40	Low
5.	0,0 – 20	Very low

4. Results and Discussion

The scientific attitude of students in this innovation practicum is measured by using an assessment through a questionnaire filled by students. This questionnaire aims to find out the scientific attitude among students when discussing and conducting experiments. The student questionnaire assessment sheet has been validated in advance by experts. Validation results obtained 3.42 with very valid categories. Furthermore, if it is valid, the student questionnaire sheet can be used and filled by students. The results of the questionnaire analysis of the scientific attitude of each modelling class and implementation class are obtained in Figure 1.

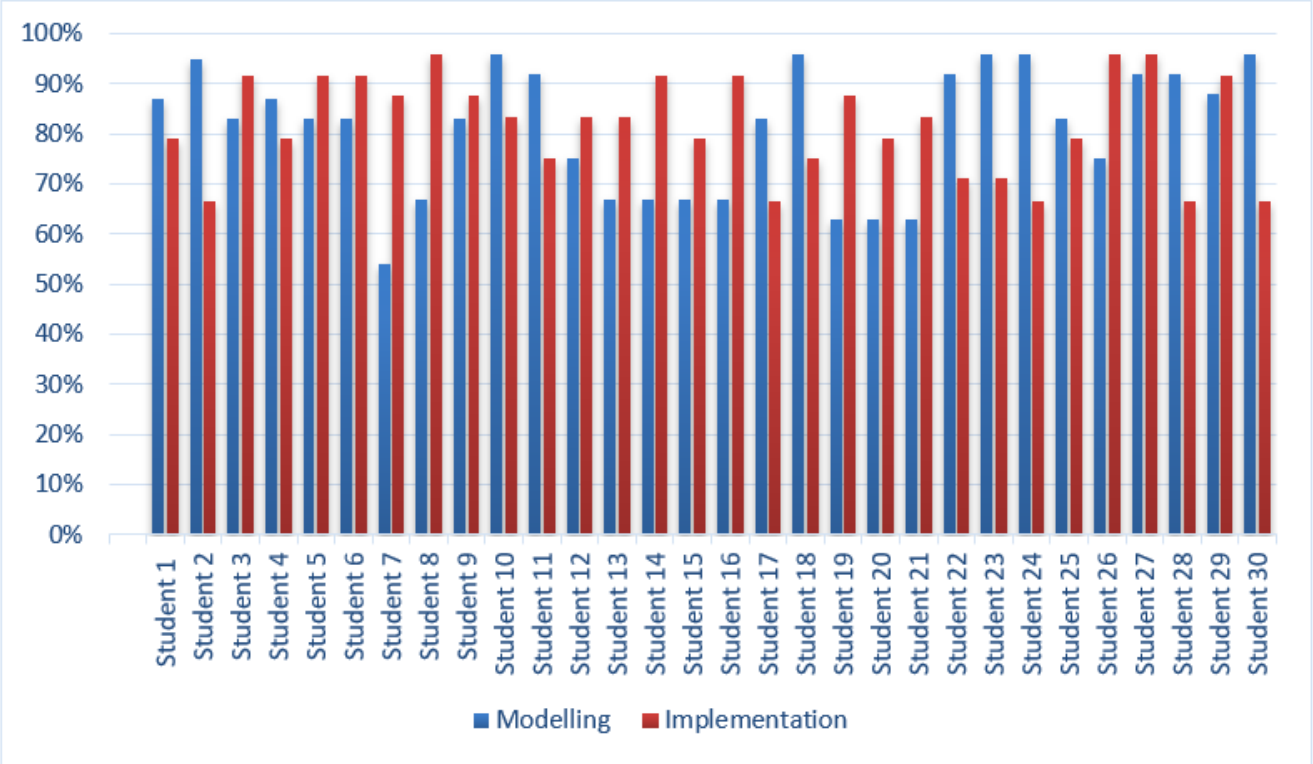

Figure 1. Students' scientific attitude

Indicators of the scientific attitude of students that are valued are curiosity, respect for data and facts, critical thinking, open mindedness and cooperation, caring for the surrounding environment and perseverance. Learning using the GI model requires students to work in groups. Each class is divided into four groups. Learning using the GI type cooperative model shows the good scientific attitude of students [32]. Learning is said to be good because the discussion runs smoothly and each group is able

to complete the task until it is completed. Learning using the Phet-assisted GI model is fun. Students discuss with their group members to complete the investigation. The PhEt can be run using a laptop to see the demonstration you want to learn. The PhEt also helps students in taking investigative trial data in accordance with the purpose of the investigation. Students have good curiosity and think together in groups. Students share tasks in the group to complete the investigation on time.

The questionnaire results show the scientific attitude of students in the modelling and implementation classes is in the very high category. The GI type model in this study was assisted by Phet simulation which made it easier for students to discuss [19]. Learning takes place in a fun and effective way in physics learning which makes student will not feel bored during the learning process in school. [3]

Students are able to discuss well with group members. Obstacles in the study are the lack of communication between teachers and students to carry a laptop. Supposedly in practicing, each class is divided into 5 or 6 groups. But at the time of the study only 2 students brought laptops. Laptops are needed to run Phet in practicing. However, the problem can be overcome using the teacher's laptop and a research laptop. The average result of the questionnaire's scientific attitude sheet for each modelling class student is 82% with a very high category. While the average results of the questionnaire on the scientific attitude of each implementation class students were 82.75% in the very high category. This indicates that learning using the Phet-assisted GI model shows a positive impact on students' scientific attitudes.

5. Conclusion

This paper has presented scientific attitudes mapping of students after using PhEt assisted group investigation models. The use of the cooperative learning model of Phet-assisted GI type shows good results for the scientific attitude of students. The GI model helps students to solve problems with the group. During the discussion which applying the syntax of the Phet-assisted GI model, each student showed a good scientific attitude including attitudes of: a) curiosity, b) respect for data and facts, c) thinking critically, d) open thinking and collaboration, e) sensitive towards the environment, and f) perseverance. The PhEt-assisted GI model on physics lessons is good to be applied in learning as it is difficult to be implemented in the laboratory. The results of the assessment of the scientific attitudes of students in both research classes using the Phet-assisted GI model in learning are in the very high categories.

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