PREFACE

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PREFACE

The Fifth International Seminar on Science Education (ISSE 2019) carried theme about Industrial Revolution 4.0: Impacts, Challanges, and Strategies in Science Education to provide a platform for researchers, academics, students, education practitioners, and other stakeholders to share problems and their solutions on major science and science education trends. This seminar also aims to keep abreast of the current development and inovation in the area of science education. The Fifth International Seminar on Science Education (ISSE 2019) is the major opportunity each year to discuss the interaction among education sciences within Chemistry, Physics, Biology, Science.

This proceedings is the regular edition of the conference proceedings of the 5th International Seminar on Science Education held by the Graduate School of Chemistry, Physics, Biology, and Science Education Yogyakarta State University, Indonesia on 26 October 2019 Graduate School of Yogyakarta State University. The scope of our seminar that will be discussed is topic areas within Chemistry, Physics, Biology, and Science education. There are 108 papers that have been carefully peer reviewedAll papers in this proceeding were obtained from a selection process by a team of reviewers and had already been presented in the conference. This seminar is presented presented five invited speakers, which were Prof. Vaille Dawson (The University of Western Australia, Australia), Prof. Ozgul Yilmaz Tuzun (Middle East Technical University, Turkey), Prof. Hsin-Kai Wu (National Taiwan Normal University, Taiwan), Assoc. Prof. Dr. Mohd. Ali Samsudin (Universiti Sains Malaysia, Malaysia). The parallel session came from Indonesia researcher an aboard that present after the invited speakers present their articles.

The success of the ISSE 2019 conference series, because of the support of many people i.e. Steering Committee, Program Committee, Organizing Committee, authors, presenters, participants, keynote speakers, student committee, and people in other various roles. We would like to thank them all.

Finally, we would also like to thank IOP Publishing Company for their support in publishing the ISSE-2019 conference proceedings and this proceeding hopefully may contribute to all research education.

Yogyakarta, November 2019

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Analysis of critical thinking skills and scientific communication of students for SHM concepts assisted by Ispring quiz maker test instrument

Analysis of critical thinking skills and scientific communication of students for SHM concepts assisted by Ispring quiz maker test instrument

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Abstract. The purpose of this study was to determine: (1) Students' critical thinking skills taught using the Group Investigation and Direct Instruction learning model. (2) The ability of students to think critically in terms of students' scientific communication skills in physics, especially the concept of Simple Harmonic Motion (SHM) in springs after applying the learning model of group investigation (GI) and direct instruction (DI) assisted by Ispring Quiz Maker media. The experimental class is class X MIA 3 and the control class is class X MIA 4. The design of this study is the True Experimental Design type Pretest-Postest Control Group Design. The instrument consisted of: (1) formative critical thinking test (ispring quis maker test instrument), (2) observation sheet of scientific communication of students, and (3) documentation. Data in this study were analyzed using normalized gain values, one-party t-test, and analysis of students' scientific communication skills. The results showed that: (1) students' ability to think critically in learning using the Group Investigation model is better than Direct Instruction. (2) students who have high scientific communication skills are better at critical thinking.
Keyword: *group investigation, direct instruction, critical thinking, scientific communication, Ispring*

1. Introduction

Thinking skills very important skill in facing life challenges [1]. The skills in question include skills for critical thinking, creative thinking, and skills for problem solving [2]. Critical thinking is one of the abilities needed by someone to be able to solve problems in social and personal life [3], where this critical thinking skill requires a person to be able to make a decision that results in interpretation, analysis, evaluation, and inference, as well as exposure to using evidence, the concept, methodology, criteria, or contextual consideration in which the decision was made [4]. Critical thinking also requires complex processes that involve high-level cognitive information processes [5]. Critical thinking focuses on what is believed or done [6]. The ability to think critically includes basic clarification skills, a basis for decision making, inferring, providing further explanation, estimation and integration, as well as additional abilities [7]

This skill can be possessed by students because it is a habit to train the mind with intuition and imagination that must be considered in expressing new possibilities, opening new perspectives, and generating new ideas from an experience [8].

A student is said to have the ability to think critically when able to analyze and evaluate every information he receives correctly [9]. Critical thinkers are able to analyze and evaluate information, ask questions about vital issues, arrange questions and problems clearly, gather information and assess relevant information using abstract ideas, be open-minded, and communicate them effectively [10]. Critical thinkers are able to criticize, ask, evaluate, and reflect on the information obtained [11].

One of the main goals of education is to teach students critical thinking [12]. As an educator, a teacher must create learning that is able to practice the ability of students to think critically find learning information independently and actively create cognitive structures in students [13]. The existence of interactive classes is a prerequisite for efforts to form optimal student critical thinking skills, students are thinkers not someone who is taught, and the teacher acts as a mediator, facilitator, and motivator that helps students in learning not teaching [14]. This study aims to analyze students' abilities in critical thinking [15]. This is important as an input for teachers to be able to improve students' critical thinking skills through appropriate learning designs [16].

The learning process of Group Investigations (GI) can provide problem solving skills and communication skills to students. This group investigation (GI) is based on the theory of constructivism [17]. The learning context in this learning model can help students acquire analytical thinking skills and problem solving thinking, students generate new knowledge from real world problems [18], where Group Investigation (GI) begins by introducing relevant problems at the beginning of the instruction cycle and to provide context and motivation for students to be able to follow the learning process [19].

Some research shows that learning outcomes and student motivation can be improved by using e-learning in learning. In addition, the use of e-learning can overcome the limitations of space and time between students and teachers, students and students, and students with material [20].

In line with these problems, one method applied in this research is to apply e-learning in assessment, which uses the learning model GI (Group Investigation) and (DI) Direct Instruction assisted with the iSpring Quiz Maker test instrument, where this study aims to analyze the skills critical thinking and scientific communication of students in the experimental class as well as in the control class for the concept of simple harmonic motion on a spring. In this study, 5 aspects of critical thinking skills are used, namely: explaining simply, connecting the facts related, comparing and distinguishing information obtained, the information is analyzed and evaluated, and a new conclusion is made of the problem given. In this study, researchers integrate critical thinking skills in the learning process, through planning learning activities for students to formulate questions and problems, gather relevant information, take action to solve problems, consider alternative ideas openly, and communicate results and solutions.

In addition to critical thinking skills, researchers also analyze students' scientific communication. In this study, the scientific communication under study covers the realm of verbal scientific communication, where interactions occur verbally between the teacher and students when the learning process is ongoing. In this study, researchers also used the iSpring Quiz Maker test instrument as a tool to evaluate students' critical thinking levels.

Ispring Quiz Maker is software that is able to facilitate students in assessment activities and evaluation of learning. Before the study was conducted, researchers first observed in SMAN 1 Prambanan, Sleman as a research school. This observation activity aims to have the researcher have a clear picture of the learning process that is taking place as well as the completeness of the facilities and infrastructure that support the learning process, so that it can be known whether the method to be applied in this study is appropriate.

2. Research method

This type of research is a quasi-experiment. In this study, all class X MIA of SMA Negeri 1 Prambanan, Sleman, Yogyakarta were taken as population. The sampling technique used is simple random sampling. This sampling technique requires 2 classes, each class consists of 30 students. The research design used is True Experimental Design with Pretest-Postest Control Group Design. Homogeneity test with two variance similarity test and normality test with chi squared are used to show that the object of research is homogeneous and normally distributed.

Table 1. Research design.

Group	Pretest	Treatment	Posttest
Experimental Class	O_1	X_1	O_2
Control Class	O_1	X_2	O_2

Information in table is experiment class that is class X MIA 3 using Group Investigation learning model, control class is class X MIA 4 using Direct Instruction learning model, O_1 is pretest for experiment class and O_2 is pretest for control class.

The scientific communication skills measured in this study are oral communication skills which include verbal and nonverbal communication. Six aspects assessed in student communication skills include: (1) organizing presentations; (2) delivery of content; (3) attitudes, methods and expressions of the body in conveying material to; (4) sound clarity during presentations; (5) time efficiency; and (6) responding to audience questions. Scientific communication skills are known from observation sheets. The ability to think critically is known by using tests (ispring quiz maker test instruments) namely pretest and posttest.

The research flow consists of three stages, namely: the stage of preparation before carrying out research, including making research instruments, testing research instruments, determining populations and samples. In the preparation phase, the researcher tests the homogeneity of the sample class. Furthermore, in the implementation phase, researchers apply the "treatment" that has been designed by applying a learning model which is oriented to problem solving on the concept of Simple Harmonic Motion (SHM) in springs. Learning with this model, students are asked to form groups and conduct experiments, discussions and presentations in groups based on student worksheets provided, before learning takes place, students are given a pretest to find out initial knowledge, then after learning given a posttest to find out the knowledge obtained during learning. Scientific communication is observed through observation during learning takes place.

Data analysis includes analysis of HOTs and analysis of scientific communication of students. To analyze students' HOTs used pretest and posttest data obtained, then scores were tested with one-party t-test and normal gain to analyze HOTs obtained by students. To analyze the scientific communication of students the researchers used observation sheets, where this data was used to see the percentage of students' success on each indicator.

3. Results and Discusion

In this research, the results of HOTs skills and scientific communication skills of students before and after the learning process for the concept of simple harmonic motion on a spring. These results can be seen in table 2.

Table 2. Results of HOTs skill analysis and scientific communication of students for the concept of simple harmonic motion on a spring.

Class		Indicator	Pretest	Postets	T count	T table	Description	Normal (gain)
Experiment	Critical thinking	Highest score	60	90	3,82	2.00	Significance (high)	.76
		Lowest score	10	80				
		Average	35	85				
	Communication Scientific	80.12% (Very Good)						

Control	Critical thinking	Highest score	60	80	3.82	2.00	Significance (moderate)	.68
		Lowest score	10	50				
		Average	35	65				
	Communication Scientific	74.10% (Good)						

From the data presented in table 2, the results show that the average N-gain value of students in the experimental class is higher than the average N-gain value of students in the control class. This means that the selection of the group investigation learning model is very appropriate and very effective to be used to improve students' critical thinking skills. This result can be seen from the calculation of the statistical data presented in Table 2, where the average value of N-gain of students in the experimental class was 0.76 and the value of N-gain of students in the control class was 0.68

One of the factors that can improve HOTs skills is to apply the Group Investigation learning model in the learning process, where this learning model requires all students to play an active role in the learning process [5]. The student activeness in question is an active student in finding information, investigating problems, analyzing, discussing, and presenting findings. By implementing group investigations that are used as learning models, students can increase their activities and participation in finding material (information) by using the help of various learning resources such as relevant learning books and using the internet. Reading various references can directly enhance students' knowledge, so as to encourage critical thinking skills.

The syntax in the Group Investigation learning model makes students accustomed to working with group members, where each student feels responsible for the results obtained so that students are motivated to work together in gathering facts from various sources to analyze a topic of problems to get more learning outcomes well. This is in accordance with the opinion [1] that each student is responsible for using their abilities intensively in researching, searching for, and finding solutions to a problem, and playing an active role in discussion, so as to make the focus of students' thinking become more directed to examine and find solutions from a problem, and makes students think more critically.

In the Group Investigation learning model, the investigation stage is the most important stage because each student must collect facts from a variety of reliable sources to analyze a problem topic. After all the necessary materials have been collected, group members exchange opinions, discuss, clarify and analyze all ideas and facts they find. It was also expressed by [2] that conducting investigations can improve critical thinking skills because students get a lot of information from the references they get.

3.1. Critical thinking skill

Obtained the results of the analysis which showed that students' critical thinking skill in the concept of simple harmonic motion in springs in the experimental class using the Group Investigation learning model were higher than the control class using the Direct Instruction learning model. Increasing students 'critical thinking skills with the Group Investigation learning model is due to the Group Investigation learning model having systematic completion steps in Group Investigation learning can improve students' critical thinking skills. The results of the gain test analysis showed an increase in the critical thinking skills of the experimental class and the control class. The gain score category for this experimental class is high and for the control class it is medium. HOTs of students, both the experimental and control classes have increased, where the analysis shows that the increase in HOTs in the experimental class is better than the control class.

Analysis of the results of the hypothesis test shows that the average HOTs of the experimental class students through the Group Investigation learning model, is higher than the average HOTs of the control class students. The results of the analysis of the gain test are inversely proportional to the results of the test of the significance of the average increase in critical thinking skills which shows no significant increase in the experimental class. The atmosphere in learning Group Investigation requires students to

be active during learning, which is active in finding solutions to problems creatively, actively interacting with other groups through investigative activities, group discussions, and class discussions, and presenting to the class. Student involvement in learning has a positive impact in increasing students' critical thinking skills [15].

3.2. Scientific communication skill

Table 2. shows the percentage of scientific communication skills of students in the experimental class and students in the control class. The average score of scientific communication skills of students in the experimental class is higher than the average scientific communication skills of students in the control class. The aspect of voice clarity when presenting in the experimental class has the highest percentage compared to other aspects, the percentage of sound clarity when presenting in the experimental class is higher when compared to the control class, so it can be seen that the ability of the experimental class students in voice clarity when presenting is better than control class. The experimental class uses a learning model that emphasizes the process skills in problem solving, the researcher is limited to guiding students and then through group discussion, students try to communicate their creative ideas to solve problems. The argumentation stage, requiring students to play an active role in groups, is different from the control class that uses the Direct instruction learning model, where in this learning students still have a dependency on the teacher in solving a problem, so the expression of opinions in the control class is still low. The low score of students in the fourth aspect of both the experimental and control classes is caused by students not yet accustomed to doing presentations in front of the class. Students tend to be shy in delivering the contents of the presentation material. Nearly 30% of students still do not dare to make eye contact with an audience (peers) and present their presentations in a way that is less interesting to follow.

The Group Investigation learning model provides the broadest opportunity for students to find information and facts as much as possible from reliable sources, expressing their creative ideas to solve a problem [11], [12]. In Group Investigation learning, there are stages of expressing ideas, which frees all students to express their opinions, the teacher is only a facilitator, where the teacher's task is to collect and listen to students' opinions and give a good appreciation for each student's opinion, must not evaluate each other's opinions - students. The application of the Group Investigation learning model can increase student activity [13]. Increase in scientific communication skills verbally in students who follow learning by the discussion method [14].

The HOTs measured in this study can be seen from the normalized gain (N-gain). The use of the Group Investigation learning model in the learning process is said to be effective in increasing students' critical thinking skills if more than 75% of students achieve a gain index with "medium" to "high" criteria. N-gain was obtained from the pretest and posttest results of students in the field test. Analysis of N-gain of students' pretest and posttest results. For the translation of the N-gain results can be seen in the graph figure 1.

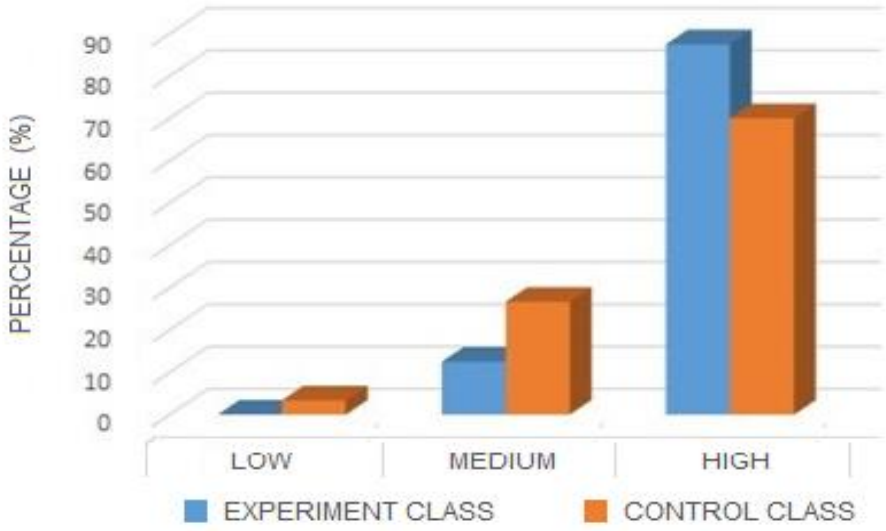

Figure 1. Comparison of the percentage of students' critical thinking skills in the experimental class and the control class.

Based on figure 1. it can be seen that the average N-gain in the experimental class is 88% with high gain index, 12.50% with medium gain index, and 0% with low gain index. The average N-gain in the control class is 70% with high gain index, 26.67% with medium gain index, and 3.33% with low gain index. Based on the results obtained it can be seen that the N-gain with a high and moderate gain index of more than 75%, it can be said that the use of the Group Investigation learning model in the learning process is very effective in increasing students' critical thinking skills.

In general, the level of critical thinking of experimental class students (class X MIA 3) after participating in the learning process with Group Investigation as an applied learning model, has increased from the results of the pretest and posttest scores. This can be seen from the percentage of critical thinking skills of class X MIA 3 students presented in the graph in figure 1.

The increase in the results of students' level of thinking after applying group investigation and direct instruction used as a learning model in terms of scientific communication skills in the experimental class is better than the control class. Figure 2 shows the average N-gain of the HOTs in terms of scientific communication skills.

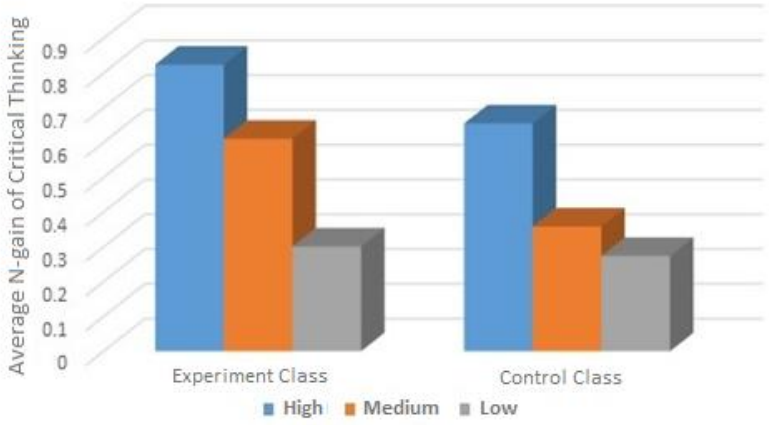

Figure 2. Average N-gain critical thinking skill judging from scientific communication skills.

From the results of the graph data in figure 2 shows that for the overall average N-gain value of the experimental class is better than the average value of the N-gain control class, where for HOTs the experimental class is in the higher category inversely proportional to the average value of the N-gain control class. Similarly, the average N-gain value of the scientific communication skill results for the experimental class was higher when compared to the control class, even though the two sample classes were both in the moderate category. This can occur because students who have good scientific communication skills will be easier to understand the learning material and easier to convey ideas / ideas and easier to discuss with friends, so that the learning outcomes achieved will be better [8]. The results obtained in this study are in line with the results of research conducted by [9] which states that high scientific communication skills will facilitate students in discussing, finding information, analyzing and evaluating data and making reports, so that it can affect learning achievement, so there is a correlation between these two variables, where the higher the scientific communication skill, the higher the HOTs, conversely the lower the scientific communication skill, the lower the critical HOTs [10].

To find out the correlation between students HOTs and scientific communication skills with the group investigation and direct instruction used as a model in the learning process in class, it can be seen by testing the average data increase in students' critical thinking skills (N-gain).The average student gain data obtained was tested first with the Kolmogorov Smirnov test, this is so that researchers know whether the data obtained are normally distributed. Obtained results from the Kolmogorov Smirnov test for each sample class, namely 0.914 and 0.826 with criteria for the value of asymp.sig (2-tailed) ≥ 0.05, so that the gain data in both sample classes are normally distributed. The N-gain data is then tested by homogeneity test, to find out the similarity of variance in the two sample classes. Kolmogorov Smirnov test results show the value of sig. greater than 0.05 which is 0.925, which means the gain data is homogeneous in both sample classes.

Table 3. The average n-gain value of critical thinking skills in terms of students' scientific communication skills.

Student scientific communication	Average N-gain of critical thinking	
	Experiment class	Control class
High	.8241	.6547
Medium	0.6105	.3584
Low	0.3010	.2738

The difference in the average gain value of student learning outcomes is due to the use of different learning models in the experimental class and the control class, where the group investigation model is used in the experimental class, and the Direct Instruction model is used in the control class. The results obtained are in line with the results of research conducted by [5], where the value of students taught by the group investigation model is better than students taught by the Direct Instruction learning model. The results obtained in this study are in line with research conducted by [6] where the learning outcomes obtained by students are very significant differences, due to the applied group investigation model [7], where the group investigation model provides an opportunity for students to gather reliable facts [8], develop the ability think logically, analytically, systematically, creatively, and critically, which ultimately results in maximum learning outcomes [9]. Students' scientific communication skills have three criteria: high, medium, and low. Criteria for scientific communication skills of students against the average gain value of critical thinking skills are presented in Table 3.

From the results of table 3 presented, it can be seen that students who have high scientific communication skills criteria, the HOTs that they acquire will also be high. Scientific communication skills possessed by each student will affect the results of critical thinking skills achieved. The results obtained in this study are in line with research conducted by [7] where there is a significant influence between scientific communication skills on student achievement. There is a positive correlation between scientific communication skills on learning outcomes, which if students have high scientific

communication skills, the learning outcomes obtained are also better than students who have low scientific communication and critical thinking skills.

4. Conclusion

From the results of the data analysis that has been done, several conclusions can be drawn, including: (1) HOTs skills of students can be improved by using Group Investigation. (2) students' scientific communication skills can also be improved by using Group Investigation.

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