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Improvement of Learning Process and Learning Outcomes in Physics Learning by using Collaborative Learning Model of Group Investigation at High School (grade X, SMAN 14 Jakarta)

I Made Astra Citra Wahyuni Hadi Nasbey
Physics Department, State University of Jakarta, Jl. Pemuda, Jakarta - 13220

Abstract
The aim of this research is to improve the quality of physics learning through application of collaborative learning of group investigation at grade X MIPA 2 SMAN 14 Jakarta. The method used in this research is classroom action research. This research consisted of three cycles was conducted from April to May in 2014. Each cycle consists of planning, acting, observing and reflecting. Researcher discussed and coordinated with three observers before acting step. The instruments of the research are based on observation form, assessment sheet, and students worksheet. The result of this research in learning quality aspects – student-sudent interaction, teacher-student interaction, and learning outcome, are about 75%. According to the result, we can conclude that the application of collaborative learning model of group investigation can improve learning process and learning outcomes in physics learning.
Keywords: learning quality, collaborative learning, group investigation

• Introduction

Learning is a change in an individual's behaviour as a result of learning process obtained in gaining and understanding knowledge. Bloom divides educational objectives into three domains. They are cognitive domain, affective domain, and psychomotor domain. Those domains are important to be improved in order to give students experiences to develop their abilities and chances to interact each other in constructing their knowledge. It is important for teachers to understand that students should be involved actively in learning. Some teachers thought that they can efficiently and accurately deliver what they had learnt as long as they communicate the knowledge to students. Whereas, students should complete their assignments through building connection and organizing the lesson into meaningful concepts by themselves.

Physics learning process in schools were teacher-centered. students were not involved actively and teachers directly transferred the information to students in one way interaction. We found that condition of grade X MIPA 2 SMAN 14 Jakarta when observing the process of physics learning were lack of interest and participation in physics learning. Students used to learn individually and acquire the information directly without good learning process.

Those were caused by some factors: implementation of traditional learning model, teacher-centered learning, using abstract examples in explanation, using teaching aid rarely, and giving a little chance for students to participate.

Furthermore, experiments which should be integrated in learning were implemented infrequently. it makes students get used to not solve problems and acquire the information actively. Students were rarely treated to learn in groups, so they learn individually. Individual learning makes a remarkable gap in learning outcomes at the classroom. some students have very great achievement but the others have bad achievement. This condition caused the class stood at the lowest rank among classes of tenth grade in SMAN 14 Jakarta. Besides, the average score of midterm exam for this class was 55,94.

The learning outcomes and learning process which were low can be improved by implementing various learning models. Collaborative learning model is one of them (Tan, We Chuen, 2008) . Marjan and Ghodsi (2011:1) state that collaborative learning is an education approach in learning process which involve students to work together in solving problems, completing assignments, and creating products. In this learning model, teachers play roles as facilitator in group discussion, consultant when conflict occur, and observer in group progress.

There are many strategies in collaborative learning models. They are discussion, reciprocal teaching, problem solving, infographic managing, and writing. Based on the students condition, the strategy that can be used to overcome the learning problems above is problem solving strategy. Specifically, the technique used in this strategy was group investigation.

In group investigation, Slavin (2009) states that students should plan, solve, and report the solution together. Students participate in problems or project discussion with their friends and teachers. Students can also gain some experience in giving or receiving arguments. Those activities let the students to learn a topic

intensively and extensively. By using this technique, we expect that students understanding in the meaning of discovery can be improved. The aim of this research is to improve quality of physics learning through application of collaborative learning of group investigation.

- **Research Method**

The subject of this research is students of grade X MIPA 2, SMAN 14 Jakarta in academic year 2013/2014. The reason of choosing this subject is due to the low quality in learning process and outcome that we observed. Students used to acquire information directly, learn passively, and learn in group infrequently. There are 36 students, which consist of 14 boys and 22 girls at the classroom. Classroom action research is conducted through some steps – planning, acting, observing, and reflecting. There are three cycles in this research. Each cycle consists of two meeting

- **Result and Discussion**

Cycle I

At the first meeting, teacher divided the students into seven groups, each group consists of five to six students. This grouping was only done once when the learning model implemented in order to build good teamwork. Students demonstrated an experiment in front of the class by reading the student worksheet that had been given. It can be seen that the students have not used to do investigation. The learning process was observed and evaluated by using observation form which had been prepared and validated by observers. Besides doing demonstration, students also had discussion, and gathered information about the question in the student worksheet. When students were having discussion, teacher went around to supervise the discussion on each group. The discussion were ineffective because students were nervous and worked individually. The discussion were continued at the next meeting because all groups had not completed their student worksheet.

At the second meeting, teacher asked the students to continue the discussion and complete the student worksheet. Discussion (investigation) and completing of student worksheet (organizing) took a long time, around 45 minutes, some students complained to the teacher due to a lot of questions. Teacher asked three students from three groups to present their discussion result. They looked not confident when presenting the result. The process of giving opinion was ineffective, no one delivered their opinion. Then, teacher stimulated students until a student give his opinion. In evaluation step, teacher and students discuss the result together. Teacher delivered a short explanation about phase changes and expansion. Teacher gave evaluation form to measure the learning outcome.

Cycle II

Teacher started the class by informing students about the topic –heat transfer, and learning objectives. In order to motivate students, teacher asked a question about equipments related to heat transfer and definition of conduction. Teacher asked all groups to delegate one representation and make a demonstration. According to the reflection on cycle I, the demonstration should be held at the middle of the class to catch students attention. All representation made demonstration helped by the teacher and the others observed the demonstration. After demonstration, students discussed in their groups about the data collected from demonstration. Three students from different groups randomly chosen presented their result. Some students asked questions and gave opinion about the presentation. In order to measure students understanding, teacher asked some students to give conclusion about conduction concept. Generally, students could explain conduction concept and factors affecting the conduction.

At the second meeting, teacher started the lesson by motivating students and asking question about the difference among conduction, convection, and radiation. Some students could not answer specifically. In order to broaden students' understanding, teacher presented three videos related to the topic. While showing videos, teacher explained the concept. Then, teacher asked students once more about heat transfer. Students gave a better answer after watching the videos. At the core activity, teacher gave a short explanation about the topic. After that, teacher gave jump question that should be finished in ten minutes to all students. students were enthusiastic to look for information and have discussion. Some students feeling curious demonstrated the question. All groups presented the result. Their answer were various and creative. The learning was closed after students completing evaluation assignment and gave a conclusion.

Cycle III

Teacher started the learning by informing the topic - Black's principle, and learning objectives. In order to motivate students, teacher ask the students about application of Black's principle in daily life. Teacher informed students that there would be a Black's principle experiment. The experiment was done in agroup collaboration, adjacent groups. Based on observation, there were groups that could not work together so teacher reminded the importance of teamwork. Students discussed to complete the worksheets. We found that students were confused

with new physical quantities. It indicated that students were not interested to find information. Teacher asked students to read the textbook and worksheet. After completing the assignment, every representation of each group presented their result and the others addressed question to other groups. Students could give better question and answer. Many students participated more actively. In evaluation step, teacher and students discussed the experiment and the discussion result. Teacher explained Black's principle concept and the quantities related to the principle. Then, teacher asked the students to summarize Black's principle according to the experiment. Students could explain the concept well. They knew heat loss and heat gain according to the experiment. Some students had also already known about the differences between heat capacity and specific heat. At the second meeting, teacher asked the students about the concept of Black's principle that they had not understood yet. We found some students were still confused on the differences between heat capacity and specific heat. Then, teacher explained again to students about the concept and gave jump questions that should be finished in ten minutes. Groups discussion worked well. Students showed better teamwork. The representation of each group presented their discussion result. There was debate due to different answer from groups. Teacher reminded students to appreciate other and criticize in a good manner. Teacher confirmed the right answer to all students and asked students to give opinion about the learning. At the end of learning, teacher gave evaluation.

Data about learning process in the form student-teacher interaction and student-student interaction are shown on table I and table II

Result of analysis in affective domain was shown on table III.

Result of analysis in psychomotor domain was shown on table IV.

Result of analysis in cognitive domain was shown on table V.

According to the result of analysis, we found that learning outcome get better. Application of collaborative learning model of group investigation can improve learning process. Learning process that was not interesting can be improved by using this learning model. Although the score are not very high, students average score are around 75% at the last cycle. Students involved actively can improve learning process well. Goodsell (2010) states that collaborative learning can help student to learn from knowledge, abilities, and experience.

Affective domain is behaviour involving someone's emotion and sense. Assessment of affective domain shows students' sense, interest, and attitude in learning process. The improvement of affective outcome occur due to students involvement. This improvement is accordance with research conducted by Evin (2009). That research states that application of collaborative learning model can improve affective outcome. Students are more interested and enthusiastic to follow the learning process. Students will get real problem so they can understand learning concept.

Psychomotor outcome in every cycle improve significantly. The improvement of psychomotor outcome is related to students activity in learning process. Assessment of psychomotor outcome in this research includes observing, questioning, associating, and presenting. At the first aspect, students are demanded to focus on learning process. Students should pay attention to the demonstration and teacher explanation, and also collect the data accurately. At the second aspect, students are demanded to address question to friends or teacher actively in the class. At the third aspect, students are demanded to discuss, analyse, solve problems, and work together. At the last aspect, students are demanded to prepare and present presentation well. Those conditions are accordance with psychomotor domain in Curriculum 2013.

Mager in Haryati and Mimin (2007) states that subject in psychomotor group is subject involving physical and hands-on activities. This hands-on ability shows someone's ability in solving assignments. The success of psychomotor domain is caused by the learning process involving students participation through activities planned to improve students ability and understanding. Those activities are experiments integrated with learning process and using simple teaching aid supporting the learning process. This learning process is accordance with curriculum 2013.

According to the analysis, it is known that concept understanding or cognitive outcome increase. Students participation in learning process causes increasing of concept understanding and understanding of importance of discovery. It is accordance with Elizabeth (2005) stating after finishing group investigation, students understanding in importance of discovery can be increased. Besides, Gokhale (1995) states that collaborative learning shows a better result in significant number at critical thinking test than students learning individually. Application of collaborative learning model of group investigation gives students chance to think logically and systematically in solving problems. The improvement of learning outcome is also caused by implementing demonstration and experiment at the classroom. In that condition, students can experience what they have learnt by themselves, follow the procedure, observe all objects, and analyze the data.

Table I. Result of student-teacher interaction

Aspect	Cycle		
	Cycle I	Cycle II	Cycle III
Pay attention to the information given by teacher	54,86	64,58	77,08
Answer teacher's question	45,14	64,58	77,69
Follow teacher's instruction	45,14	64,58	77,69
Give quick response	54,86	65,28	77,08
Average	50	64,76	76,39

Table II. Result of student-student interaction

Aspect	Cycle		
	Cycle I	Cycle II	Cycle III
Teamwork	61,11	65,97	76,39
Giving information each other	45,14	64,58	75,69
Giving opinion	45,14	64,58	75,69
Listening to friends' opinion	45,14	64,58	75,08
Average	49,13	64,93	75,87

Table III. Result of Affective domain

Aspect	Cycle		
	Cycle I	Cycle II	Cycle III
Curiosity	61,11	65,97	76,39
Teamwork	45,14	64,58	75,69
Dicipline	45,14	64,58	75,69
Responsibility	45,14	64,58	75,08
Care	49,13	64,93	75,87
Respect	61,11	61,8	75
Active and Responsive	54,86	59,03	68,06
Appreciation	61,8	61,8	75,69
Average	57,55	61,63	70,225

Table IV. Result of Psychomotor Domain

Aspect	Cycle		
	Cycle I	Cycle II	Cycle III
Observing	61,11	65,97	76,39
Questioning	45,14	64,58	75,69
Associating	45,14	64,58	75,69
Presenting	45,14	64,58	75,08
Average	49,13	64,93	75,87

Table V. Result of Cognitive Domain

Cycle	Average Score
Cycle I	65,19
Cycle II	78,19
Cycle III	79,44

Finally, students can conduct simple research and develop scientific procedure. Hirca (2012) states that treatment of experimental learning can not give significant impact to scientific process skill in some indicators – observing, predicting, investigation conducting, and result presenting. However, it correlates with students' ability to prepare experiment. Implmentation of demonstration method can also improve students' outcome. Venneman, et all (2011), who implemented demonstration method in chemistry learning, states that this method correlates with students' learning outcome. The using of student worksheet also give good effect. Serene S.Y. et all (2011) states that using students worksheet can improve learning outcome, although it is insignificant. Besides, teacher also gives jump question to support the understanding and deepen the concept.

It is accordance with Masaaki's work (2012) . He states that efforts to improve skill for weak students is not sufficient to show qualified learning. The assignments given to students as a learning to jump depend on

each school. Teachers should know students ability to give them appropriate assignments. The difficulty of level depend on students ability. It is such unique condition. Therefore, teacher should observe student comprehensively.

- **Conclusions**

According to the result and discussion, we can conlude that application of collaborative learning model of group investigation can improve physics learning process and learning outcome.

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