Implementation of cooperative learning group investigation to improve students self-efficacy and learning achievement on statics fluid

G A R Tirta*, P Prabowo and S Kuntjoro
Program Studi Pendidikan Sains, Universitas Negeri Surabaya, Jl. Ketintang, Surabaya 60231, Indonesia

*gustitirta16070795047@mhs.unesa.ac.id

Abstract. Learning physics requires complex aspects of the students, not only the skill for achieving a task but also their beliefs of about their ability in overcoming the difficulties in achieving the purposed targets. In this case, students’ self-efficacy takes an important role in determining their success to improve their learning achievement. This research aimed at improves students’ self-efficacy and learning achievement with cooperative learning group investigation on statics fluid. A one group pre-test-post-test design was implemented to the sample of 75 students with three-time replications. This research was conducted at Senior High School 3 Singaraja-Bali in the odd semester of the academic year of 2017/2018. Research data were collected by using questionnaire, observation, and test. The N-Gain score and qualitative descriptive analysis were applied to analyze data. The results indicate that: (1) there is an increase in students’ self-efficacy with a high N-Gain score, (2) there is an increase in students’ learning achievement with a high N-Gain score and (3) the students’ response is positive to the learning activity. The conclusion is that the implementation of cooperative learning model group investigation can facilitate students to improve their self-efficacy and learning achievement on learning physics, especially for statics fluid.

1. Introduction

Learning physics is not only about writing formulas and plugging the value of a given quantity but also understanding the basic concepts and relating them to solve a problem in our daily life. This is the reason of how do Indonesian students have been feeling difficult in learning physics. Students find difficult to understand the physical meaning of each problem furthermore to understand the physical concept that applied in the real context problems. Somehow, students are being used to learn physics just by memorizing the formulas without efforts to understand deeply the physical concepts behind the phenomena. According to the level of scientific knowledge, in general, Indonesian students are still emphasized in the context of knowledge but lack of understanding. Learning physics needs a deep comprehension as well as good conceptual understanding. Furthermore, students who have been mastering the basic concepts will able to communicate their solutions with relevance scientific facts, logic, and ideas. Students who have these competencies will get a higher learning achievement in physics [1]. Unfortunately, in general, Indonesian students still have low learning achievement in physics according to data Program for International Student Achievement (PISA) year 2015. The
Another fact of the low physics learning achievement owned by Indonesian students comes from the result of a study which was conducted by [3]. In this study, the researchers showed that students have low physics achievement due to students become passive during the learning process. Students feel unwilling to learn physics with a deep understanding. Hence, learning physics in the classroom was still dominated by teacher and students just become a passive learner without process for constructing the knowledge. Students have not engaged actively in learning in the classroom so that they become boring and lack of motivation to learn.

In other to get higher learning achievement in physics, students are not only forced to master the basic concepts, furthermore, students must also be guided to develop their beliefs of about their ability in overcoming the difficulties in achieving the purposed targets during learning. One of the psychological states of students relating to their belief is self-efficacy. Bandura [4] defines self-efficacy as a belief in the ability of students to be able to organize and implement a series of activities. Self-efficacy affects students' physics learning achievement. Self-efficacy is a strong predictor of learning achievement [5]. Self-efficacy has a positive effect on student achievement [6]. Therefore, students who have higher self-efficacy then they will have higher learning achievement.

In the case of students’ self-efficacy, students of grade XI MIPA Senior High School 3 Singaraja, Buleleng-Bali were identified have low self-efficacy so that they perform low achievement in physics. The facts are students prefer to follow much remedial activity rather than trying to learn the basic concept via comprehension due to in the classroom students were constantly educated by conventional learning method which they just become a passive learner. These conditions were supported by evidence of their results for the physics examination. About 78% students didn’t success to achieve the standard score according to minimum criterion standard of 75. Hence, the facts also showed that students have lack of self-efficacy to believe their competence. Students felt doubt about their self-ability. This is very serious problems to be solved in improving students learning achievement.

With regards to the solution above, one thing can be taken into consideration, such as designing a good learning atmosphere to facilitate students in other to be able to improve their self-efficacy as well as learning achievement. The use of innovative learning model such as cooperative group investigation (GI) will able to conduct students learning according to the constructivist paradigm [7]. Cooperative learning group investigation model provides an opportunity for students to construct their knowledge independently (self-directed) and also being mediated by peers (peer-mediated instruction). Hence, the learning activities where students can interact with other can be a scaffolding to improve their belief about their competencies.

The implementation of cooperative learning GI for students of grade XI MIPA Senior High School 3 Singaraja for a topic of static fluid is performed in this research. Statics fluid is one of physics concept which is mostly applicate in the daily life. Therefore, the implementation of this learning model will allow a teacher to manage students’ learning toward discussion, experiment, investigation, and presentation in which students are engaged to construct their own understanding [8]. Students are actively participating in their own group. Regardless this consideration, students will gain a higher learning achievement. The last, this research aimed at improves students’ self-efficacy and learning achievement with cooperative learning group investigation on static fluid.

2. Method
This research was conducted at Senior High School 3 Singaraja-Bali in the odd semester of the academic year of 2017/2018. A one group pre-test- post-test design was implemented to the sample of 75 students with three-time replications [9]. The research instruments are self-efficacy questionnaire and achievement test. The self-efficacy questionnaire was used to determine the increase of students’ self-efficacy before and after the model was implemented. This questionnaire is a Likert-like questionnaire with 5 scales. In each given statement there are five choices answer which has to be chosen by students. The student achievement test was used to measure students’ achievement in the
context of cognitive level. The increase of students’ achievement and self-efficacy between pre-test and post-test were analyzed by using N-Gain score with equation 1.

\[
G = \frac{S_{post} - S_{pre}}{100 - S_{pre}}
\]

The interpretation of N-Gain score is: 1) low category (0 < G < 0.3); 2) medium category (0.3 ≤ G < 0.7) and high category (0.7 < G) [10]. Students’ responses were analyzed both descriptively and quantitatively. Quantitatively, the percentage response was calculated by comparing the number of students’ response and the total response than multiplied by 100%.

3. Result and discussion

3.1. Self-efficacy

The self-efficacy questionnaire was done twice within three replications i.e., before and after the learning model was implemented. The increase of students’ self-efficacy dimension was identified according to their N-Gain score and the result is presented in Figure 1.

Figure 1 shows the average N-Gain score of students’ self-efficacy for each dimension. Students who follow the GI model perform high category of the improvement of their self-efficacy. The average pre-test score for each dimension of students’ self-efficacy among three replications was 42, 41 and 45 successively for level, generality and strength dimension. These are still in the low category. However, the average post-test score for each dimension was 84, 86 and 82 successively for level, generality, and strength in the high category. This shows an increase in an average N-Gain score for students’ self-efficacy during learning static fluid which was facilitated by GI model.

A cognitive social theory suggests that self-efficacy can help students to determine their choices, their effort to solve the problem when faced difficulties. Self-efficacy is also able to help students in overcoming their anxiety and associating their experiences [11]. In the context of GI model, students are allowed to experience their learning so that they have an opportunity to do inquiry activity. Toward the implementation of GI model, students will be provided with good learning environment so that they can freely express their scientific ideas according to their understanding of the phenomena and basic concepts. Students can freely increase their self-confidence as an individuals and able to develop their communication skill within the group activities [5]. Furthermore, students will able to improve their capacity in believing their self-competence so that their achievement in learning physic can be guaranteed improved [12].
The improvement of students’ self-efficacy among three replications was analyzed by using paired t-test between pre-test and post-test score. The analysis was performed by using SPSS 19.0 for Window. The results are presented in Table 1.

**Table 1.** The paired t-test result of student’s self-efficacy among three replications.

| Replication | t     | df | Sig. (2-tailed) |
|-------------|-------|----|----------------|
| Replication I | -74.334 | 24 | .000           |
| Replication II | -126.715 | 24 | .000           |
| Replication III | -131.143 | 24 | .000           |

Table 1 shows a significant increase in students’ self-efficacy for the three replications (α < 0.05). These inform that there is a significant difference on students’ self-efficacy before and after the GI model was implemented. Increased students’ self-efficacy can improve their cognitive performance, their interest in pursuing a deep understanding of the relevant physics concepts, therefore their learning achievement is consistently improved [13].

### 3.2. Students learning achievement

The students’ learning achievement in studying statics fluid was gathered for both before and after the GI model implemented. The impact of the implemented GI model on students’ achievement can be known after the three meeting sections were taken. Students’ learning achievement involves six dimensions [14] i.e., (1) knowledge: recall of specific information, (2) comprehension: lowest level of understanding, (3) application: application of a rule or principle, (4) analysis: breaks an idea into component parts and describes the relationships, (5) synthesis: puts the parts together to a form a new whole and (6) evaluation: makes judgements about materials and methods. The resulted data analysis can be presented in Figure 2.

**Figure 2.** Students’ achievement within six indicators in the three replications

The average N-Gain score of students’ achievement for each indicator is in the high category. The highest N-Gain score takes place for the indicator 1 and the lowest takes place for the indicator 6. The N-Gain score of students’ achievement becomes smaller along with a higher cognitive skill is required for the learning achievement dimension. This fact confirms that most students in this research still keep their mind on the paradigm that learning is just only for achieving knowledge. The ability to apply concepts and basic rules are still minimum what else the ability for analyzing, synthesizing, as well as evaluating the problems to provide a solution. This is the reason of why students feel difficult when they have been faced with real-world physics problems. Regarding this finding, the implementation of GI model is considered appropriate to facilitate students in improving their capability to learn physics with higher self-efficacy.
The effectiveness of the implementation of GI model in improving students’ achievement can be identified based on the result of paired t-test for both their pre-test and post-test score. The analysis was performed by using SPSS 19.0 Program for Windows. The results are presented in Table 2.

**Table 2.** The paired t-test analysis for students’ learning achievement.

| Replication | t        | df | Sig. (2-tailed) |
|-------------|----------|----|-----------------|
| Replication I | -33.567  | 24 | .000            |
| Replication II | -35.831  | 24 | .000            |
| Replication III | -26.949  | 24 | .000            |

The Sig. (2-tailed) value is .000 ($\alpha < 0.05$) for the three replications. These mean a significant increase in students’ achievement. Throughout teaching and learning activities via GI model, so students can cultivate their ability to take responsibility for doing learning. A student can be an active learner and their belief about their competence will automatically increase. The positive impact for this condition is that students feel free to develop their self as well as they want. They will able to take responsibility for self-learning in lesson process [5]. In addition, GI model also provides an opportunity for students to develop their social skill through communicating their idea in their own group. Their communication skill will be improved instantaneously. Toward discussion section and work-group, every student won’t feel doubt to communicate their idea because they feel that they aren’t alone. Their idea is constructed throughout the discussion and has been agreed by other students. Every student will be motivated to learn in advance because they have to able to contribute to their group work. Regarding this condition, the learning process will take place optimally and meaningfully [15]. The GI model occupies a significant place in education [16].

3.3. *Student responses*

The profile of students’ response to the implementation of GI model can be figured out in Figure 3. Here, the response can be classified into six components i.e., (1) component interest, (2) understanding component, (3) component renewal, (4) interest to apply GI model, (5) self-efficacy improvement and (6) answering the items. It can be concluded that students give positively respond to the implementation of GI model.

The positive response is due to teacher ability in managing and designing a learning environment for students. In teaching physics, a teacher has to be able to involve many activities that give an opportunity to students develop their scientific process skill. Learning via GI model is a solution which can accommodate students need to explore their interest on the topic of statics fluid. In addition, teacher readiness and creativity in designing task, lesson plan according to GI model, as well as assessment system are very important to pull students’ positive response. Teacher’s personal attitude and positive motivation to the students’ learning achievement is also important to be considered in the classroom [15].

![Figure 3](image-url)
4. Conclusion
Cooperative Group Investigation (GI) is an effective way of designing physics lesson in the classroom. The implementation of GI model has proved to be able to improve both students’ self-efficacy and learning achievement in a physics lesson. The GI model provides an opportunity for students to develop their belief about their self-competencies. This is very important in the learning process because students can take responsibility to learn by their self through interaction with others. The last, students perform a positive response to the implementation of GI model in a physics classroom.

Acknowledgments
Authors would like to thank the principle of Senior High School 3 Singaraja for his kind to give permission in doing this research.

References
[1] Wasis, Rahayu Y S and Sukarmin 2014 Hots & Literasi Sains Konsep dan Penilaianannya (Surabaya: Unesa University Press)
[2] OOECD 2015 PISA 2015: Result in Focus
[3] Aritonang S, Harahap M B and Sinulingga K 2017 Journal of Education and Practice 8 190-197
[4] Roof D J 2015 The Online Journal of New Horizon in Education 5 103-108
[5] Zhu Z 2007 International Education Journal 8 204-212
[6] Balami, Y G 2015 International Journal of Education and Practice 3 80-84
[7] Akçay N O and Doymuş K 2012 Journal of Educational Science Research 2 109–123
[8] Ulfa S and Sugianto 2015 Unnes Physics Education Journal 4 63-66
[9] Prabowo 2011 Metodologi Penelitian Sains dan Pendidikan Sains (Surabaya: Unesa University Press)
[10] Hake R R 1998 American Journal of Physics 66 64–74
[11] Bandura A 2001 Psychologi Review 52 1-26
[12] Jamaldini M, Baranzehi H, Farajpour N and Samavi A S 2015 International Journal of Review in Life Sciences 5 41-45
[13] Pajares F 2005 Charlotte 339-367
[14] Kemp E J, Morrison G R and Ross S M 1994 Designing Effective Instruction (The United State of America: Macmillan Collage Publishing Company)
[15] Martinez and Diana 2015 Teaching and Educational Research International 10 46-59
[16] Dharwadkar A A and Mohanthy S 2015 International Journal of Scientific Research and Education 3 2917-2923

6