Implementation of small group discussion as a teaching method in earth and space science subject

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Abstract. In Physics Department Universitas Negeri Semarang, Earth and Space Science subject is included in the curriculum of the third year of physics education students. There are various models of teaching earth and space science subject such as textbook method, lecturer, demonstrations, study tours, problem-solving method, etc. Lectures method is the most commonly used of teaching earth and space science subject. The disadvantage of this method is the lack of two ways interaction between lecturers and students. This research used small group discussion as a teaching method in Earth and Space science. The purpose of this study is to identify the conditions under which an efficient discussion may be initiated and maintained while students are investigating properties of earth and space science subjects. The results of this research show that there is an increase in student’s understanding of earth and space science subject proven through the evaluation results. In addition, during the learning process, student’s activeness also increases.

1. Introduction

Generally, science educations have higher difficulties than the other subjects. Many physics students do not find physics interesting and many of them take the physics courses even at university level without an acceptable conceptual understanding of physics. The problem of this difficulties related to the gaps in their conceptual understanding that could still persist even after the completion of several courses in physics. One of the teaching method that usually used in physics is conventional learning. Conventional learning lies in the presentation of the material, which comes out of textbook and lecture notes. A traditional lecture is nearly always delivered as a monologue in front of the students. Only exceptional lecturers are capable of holding students’ attention for an entire lecture period. It is even more difficult to provide adequate opportunity for students to critically think through the arguments being developed [1]. In previous research, the stages of the Cognitive Apprenticeship-Instruction (CA-I) model consisting of modeling, coaching, reflection, articulation, and exploration have been applied in mathematical physics subject. Nine out of ten indicators of reflective thinking abilities in solving mathematical physics problems have been adequately trained using these stages, although their achievements are not yet optimal. One remaining is the ability to accurately analyze the problems of mathematical physics still cannot be improved significantly [2].
To overcome these difficulties, researchers suggest the use of group discussion to help students develop a better understanding of physics [3]. In discussing with peers, the students may receive help to clearly express their ideas about a phenomena in physics and compare to the others, and may become aware of the gaps in their misunderstanding of a concept in physics. The discussion as a verbal interaction among many persons that meet together to exchange their ideas and their experiences on a theme or a problem that they have collectively chosen in order to understand this theme or to solve this problem. When discussion is used in the classroom to arrive at learning objectives, it is called the discussion method [4].

Small-group learning seems to promote both interest and understanding of physics. It showed in a meta-analysis that students in undergraduate course in science, mathematics, engineering and technology who learn in small group have a greater academic achievement that have been taught in a more traditional setting [5]. There are some problem-solving in small groups in introductory courses in physics at university level. Students worked in groups of two to four. The problems were similar to those in textbooks focusing on conceptual and problem-solving skills. She presents that the students during the group discussion raise questions that have been identified in the literature as important difficulties for students, often overlooked by texts and instructors [6]. Trudel et al [7] defined that the conditions under which an efficient discussion may be initiated and maintained while students are investigating properties of physics phenomena was identified. His results showed that, despite the complexities of the science classroom, some simple rules can be followed by teachers that are very effective to do so.

One particular domain presenting difficulties to students in the field of earth and space science. In this research, we investigate the effectiveness of small group discussion to improve students’ understanding in earth and space science. Recently, in some countries, there has been an increased interest in the development of outdoor and adventure education programmes [8].

2. Methods
In this study, we introduced group discussion in our earth and space science class at Department of Physics Universitas Negeri Semarang. Students worked in groups of six to seven and the group member took on roles as writer, presenter, leader, blog developer and questions responders. Firstly, we divided the materials of earth and space science subject into 6 themes and introduce some problems of each theme. One group discussion has one theme to discuss about. They have to discuss about the content of that theme from textbook and lecture notes and try to solve several problems that appear. In our learning process, each group discussion presented their theme to the other students with interactive media. The other groups have to give an assessment according to the instruments already provided by the lecturers to the group that presented their material that day and give some questions and problems. Each group have about one hour to describe their theme and one hour to discuss and solve the problems that appear. These problem solutions were then given back to the students with comments. During the group discussions the teacher is present the whole time and intervenes when necessary. The groups are free to ask the teacher for help and advice whenever they need. As the outcome project of this method, each group must develop a blog media which the content of that media is the theme they have discussed in the whole class. The media should be interactive and give some alternative problem solving that appear in their theme.

In the classroom, some conditions of discussion may be satisfied easily, but others, not so well. For example, the necessity in the discussion to impart to every participant an equal status is more difficult in the school context, since one of the student has more experience and knowledge than the others. To overcome these difficulties, we constructed groups with six to seven students based on the theme we made and formed the groups so that they were composed of students of different abilities. With these different abilities, it hopefully will make every student in the group have their own job.

We started analyses by looking through the assessment of the students from the group discussions. We also take the evaluation test and compare the result to the other class in the
previous semester. As the last analysis, we observed through the content of the blog they have made as an interactive media.

3. Results and Discussion
The group discussions found some problems in earth and space science. From the assessment given to the students during the discussion we found that the problem in earthquake, volcanos and tsunami was seen as the most interesting theme. On the other hand, universal gravity is the most difficult theme from which they learned the most. The other themes were judged to be rather interesting and difficult but less so than that themes. From the evaluation test, the average result of the students is 77.03. And from the combination of evaluation test and the assessment result, most of the students, 25 students, got B on their final result and pass the earth and space science subject well. The blog media they have made also consist of very good and easy to understand material. They also insert interactive video about the theme they have discussed in that blog. There are some problems in their blog about the related theme and they give several solutions of the problems based on their discussion before. During the learning process in the class, this method can increase the students’ activeness. It can be seen from the discussion process among the groups and the question-answer session (Figure 1).

For the group discussions to function well the students have to be rather well prepared on the subject. They can look in the textbook when they found some problems. The students need some knowledge of relevant physics concepts and principles when they start to solve problems in small group discussion. The group discussion are effective opportunities for learning and understanding physics concepts and principles [4].

![Figure 1. Situation of earth and space science class with small group discussion method](image)

But, in the learning process with discussion method, there are some problems appear. When one group presented their theme to the other groups, not all of the member of group can active during presentation. It can be happen because too many students in one group. An ideal group may consist of three to four students so every student has an equal status and job description. Moreover, it is the lecturer who chooses the theme of the discussion because the lecturer is responsible for the learning of the students. As a consequence, it may happen that the lecturer selects a theme that doesn’t interest the students. These difficulties, if not overcome, may lessen the discussion efficiency or even prevent it from actually taking place in the classroom, thus preventing students to engage in authentic inquiry.
4. Conclusion
From this study, we found the group discussions around earth and space science problems can lead to stimulating and learning discussion in physics. The students discussed earth and space science concept and principles and evolved their knowledge gradually. From the evaluation test, the average result of the students is 77.03 and pass the earth and space science subject well. During the learning process in the class, this method can increase the students’ activeness. It can be seen from the discussion process among the groups and the question-answer session. Despite the complexities of the earth and space classroom, some simple rules and efficient group can be followed by lecturers that are very effective to do so.

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