Investigation to reduce students’ misconception in energy material

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Abstract. The purpose of this study is to analyse the misconception of Teacher Candidate of Elementary School (PGSD) on energy materials. This research is expected to be a common misconception in teaching and learning activities. One solution to overcome misconceptions is by investigation. This study uses qualitative research. The subject of this research needs 35 students. Data analysis is done by comparing the observation and test results. The results of this study is the result of students learning outcomes through cycle I and cycle II. The first cycle is due to overweight misconceptions of 18.57% and cycle II of 35.71%. Misconception can be caused by a procedural negligence. Students of PGSD Are examined to show if they understood in a simple movement problem which needs a neverse proportionality concept, to find out a way to prevent misunderstanding. The examination may consist of the question of energy materials by different representation for each student. The conceptual knowledge of the students show incorrectness because they feel confused of existing knowledge they got in their daily lives. It can cause scientific misunderstanding. The declining in student misconceptions is caused by investigation process. Search and data collection are helpful in improving their thinking skills.

1. Introduction

Today, the world of education is an interesting issue to learn. How to determine a good learning process, of course, becomes a challenge in itself. The learning process works best if it is supported by the resources that follow it [1]. Human resources are one important factor that supports the quality of education. PGSD students are human resources who are expected to have good quality in teaching elementary students in the future. That is why the quality of prospective elementary school teachers should be considered for the future. They are expected to be able to teach and deliver the subject matter well. However, it is not easy to convey the expected material objectives with real phenomena. One of the obstacles to material delivery is the misconception. Misconception is one of the important factors that indicates the lack of success in learning activities. Misconceptions often occur in the learning process of students. This condition occurs due to the neglect of students’ critical thinking that leads to misperception.

The cognitive ability has an important role in solving the problem of physics [2]. Among them can improve the ability to identify and interpret accurately the concepts and principles of physics. Students have ability to describe and organize the physics knowledge they acquire effectively. Interpreting and analysing physics concepts and principles becomes a challenge for students. In order to minimize the
existence of misconception, hence research this time, will applied learning which accompanied by activity of investigation of duty [3, 4]. Treatment of problem investigation is applied to the subject of Basic Concept of IPA on the subject of energy.

The purpose of this investigation process is that students are expected to be able to construct their knowledge about the concept of Energy, as well as to minimize misconceptions in learning. This activity includes a presentation activity that explains the results of tasks that have been done. Lecturers play a role to undo the concept that is still wrong in the explanation of students who have done [5, 6]. In this activity, teachers have more roles than students. The investigation carried out the task accompanied by the analysis of the problem. One of the developing abilities in investigative activities is analytical skills. An ability to analysis, solving the problem will be done well. Thus, investigative activities make it easy to find important information that is relevant and describe the problem [7]. The existence of at least information, causing obstacles in solving the problem of the problem faced. Some abilities that can develop here are the ability to analyze questions, express opinions, and cross-check opinion [8-10].

This study aims to produce diagnostic test instruments and is done through several major stages in the development of test instruments, namely: identifying curriculum, developing indicators of the ability to be achieved, compile learning continuum related to the competencies required to answer the test, compile test specifications, Test items, examine the test items, test the test, analyze the test items, improve the test, assemble the test, perform tests, and interpret the test results [11]. This investigative activity will produce a reasoning based diagnostic test device. The benefits are increasing understanding, and students' cognitive thinking ability. Based on predecessor studies, there are still many students who have learning difficulties and misconceptions. Identification of learning difficulties needs to be done to determine the causes of misconceptions occur, so that they can be addressed and repaired. If not addressed immediately, misconceptions will stick to the students until he graduates and becomes a teacher. Investigations made through multiple choices with reason can help in analyzing problem based on certain problems only. This investigative activity can also be used as a model for developing diagnostic tests for elementary school teachers [12].

2. Methods
This research is a study using descriptive research method. Data are obtained by using reasoned multiple choice to measure the consistency of the students’ argumentation. Natural science materials tested is about energy. Tested item used in the research is a result of validation of content from the expert judgment and also statistical calculation. This classroom action research involved 35 Students of S1 PGSD UNS in the 2015/2016 Teaching Year. This study is conducted in two cycles each cycle consisting of (1) selection of topics, (2) planning (3) investigations, (4) conclusions, and (5) presentations. The planning stage of the research consists of preparing the research preparation in the form of problems to encompass student misconceptions and other preparations to support the smoothness of the research. The misconception of student conceptions is identified through diagnostic test. Questions during the investigation include student opinions on the issues raised and the solutions. The questions asked in the investigation are (1) problems experienced by students in everyday life, (2) questions about why the problem can occur, and (3) what caused the problem to occur.

3. Results and Discussion
The misconceptions experienced by the students are identified through an analysis of the answers to the questions already undertaken. Some categories can be mentioned as follows: category 1: right answer, right reason; no learning difficulties and or misconceptions occur, category 2: right answer, wrong reason; learning difficulties and or misconceptions occur, category 3: wrong answer, right reason; learning difficulties and or misconceptions occur, and category 4: wrong answers, wrong reasons; learning difficulties and or misconceptions occur.

Through the identification of students’ difficulties, knowledge of science that can be mastered and the ability to make decisions in finding the best solution. Student success can be influenced by the ability to solve problems. One form of learning that has aspect of collaboration is a learning-oriented model of
cooperative learning conducted cooperatively [13-15]. The basic concept of IPA, especially on Energy material can be conducted using investigation done in a group/cooperative [16, 17]. The activities undertaken together will facilitate the students in solving difficult issues alone. Investigation conducted will cooperatively facilitate students in solving learning problems through social interaction [18]. Learning difficulty is a problem related to the understanding and ability of a person to learn and solve a particular problem. In addition, it can also be difficulties of a person in communicating with others.

Based on the results of the study, there are still many undergraduates of PGSD who have difficulty in learning. This is usually related to disruption of one's internal condition when receiving, absorbing, and communicating information. This difficulty is not easy to be seen because it is disguised with other conditions. Students with this problem will still grow up with this learning difficulty. Learning difficulties experienced by a person vary widely, including inability to read, write, math, talk, hear, and think logically. Learning difficulties are a general term relating to a child or a student who has difficulty with learning. The research shows that 10-16% of children demonstrate academic difficulties and skills development in problem solving. Investigations are therefore needed to understand the resolution of the problems being faced in various activities [19, 20]. One of the abilities that are expected to develop in solving problems is the ability to think critically. The problem examples energy material is shown in Figure 1.

![Figure 1. Problem Example Energy Material](image)

Figure 1 showed an example of a question of energy material. The results obtained that most students are confused by the problem being done. More than 50% of students respond to chemical energy only in leaves alone if chemical reactions observed occur throughout the plant. Not only in the leaves alone, but in stems and fruits also occur chemical reactions. Leaf is the main place of photosynthesis. In the leaves, there is useful chlorophyll in the process of photosynthesis. However, chemical reactions occur throughout the plant. In addition, through the investigation found misconception can be overcome by comparing the questions and answers are linear in each issue. Further questions will be discussed.

The investigation activities based on the diagnostic tests applied to the group of students in a particular class were analyzed. A revision was made on some of the questions that have not met the validity standards. This diagnostic test during the trial undergoes improvements after having generated test devices that already qualify for validity. Based on data collecting research done on student S1 PGSD gained misconception many happened at indicator which appointed in Table 1.
Table 1. Energy Competencies and Indicators

| Competencies | Indicators |
|--------------|------------|
| Examine the nature and changes of matter and energy | The influence of the mass on free falling objects, the influence of altitude that affects the energy of the sleigh movement, determine the influence of mechanical energy conservation law at a certain height, the effect of the passage on the business by conservative forces on systems that meet the laws of mechanical energy conservation. Understanding the concept of potential energy relations, kinetic energy, and mechanical energy when influenced or not influenced by non-conservative style. |

The following are the results of the identification of learning difficulties and misconceptions experienced by students on each subject studied. Learning difficulties experienced by most students (over 50%) on the subject of Business and Energy, are as follows: Students still have a lot of misconceptions about the influence of the period on free falling objects, it still does not give the effect of different heights on the energy of the sled movement. In other side, there is a misconception when determining the effect of mechanical energy conservation law at a certain height. From this case, it shows that misconception of trajectory affect a system that meets the law of mechanical energy conservation. Students have difficulty in understanding the concept of potential energy relations, kinetic energy, and mechanical energy when influenced or not influenced by non-conservative style.

Misconceptions are experienced by most students who are subjected to research. Based on the results of identification, learning difficulties in the form of misconception is still difficult for students to understand, analyze problems, and solve problems. The difficulties encountered are mostly the difficulty of understanding the concepts of physics. However, based on the results of the study mentioned that learning difficulties and misconceptions are casuistic, meaning that they cannot be equal to other research sites. In other words, not necessarily students in other schools also experience exactly the same thing, so it cannot be generalized. Misconceptions can be minimized through investigations which are conducted in two cycles. In cycle 1, the implementation of Investigative learning has not been carried out as maximal and effective. Based on observation not all students are active so that group discussions and presentations are less effective. Thus, it takes one more cycle to fix it.

The second cycle of conception is related to inertia and law of action and reaction (Cycle II). Early comprehensive students vary greatly. Implementation of the investigation on this material is through the presentation of various representation questions to reduce student misconceptions [13]. The two-cycle difference is not significant if one standard deviation is below one standard deviation $\sigma$ "sigma"; one sigma $\sigma$ is assumed here to be the root of the number of Students. The results were tested for significance by a $\chi^2$-test, leaving out the students who failed to answer. The different before and after cycle are shown in Figure 3.
Figure 3 shows the diagram before and after the investigation cycle. Cycle I showed a decrease of misconception, that is 18.57%. The decrease in student misconception is caused by the investigation process to help the students to understand the learning in more detail. Search and data collection are helpful in improving their thinking skills. In the second cycle students are quicker to understand the problems. They are faster because they have previous learning experiences. In the second cycle showed an increase of 35.71%. This decline is also due to the fact they have more complete data from a more improved experience.

4. Conclusion
Most of the students who were subjected to the study are still experiencing learning difficulties, especially related energy materials. Most of the students who were subjected to the study still experienced misconceptions about some concepts of physics, especially those that have a very close relationship, both functionally and similar terms. Learning by investigation has a positive impact to reduce student misconception, that is cycle I (18.57%) and cycle II (35.71%). The application of the investigation has a positive influence, which can improve students’ ability to analyze the subject matter that has been accepted so far, with the marked decreasing misconceptions about energy discussion.

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