Analysis of elementary school students’ misconception on force and movement concept

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Abstract. Mastery of students' science concepts reflects a basic understanding about science. Misconceptions occur because of a discrepancy between students’ conceptual understanding and the actual concept. The purpose of this study is to analyse the misconception of fourth grade students of elementary school on force and movement concept. Based on the results of field analysis, the researchers found data revealing that there was a misconception related to the force and movement concept of fourth grade students. The existence of students’ misconceptions will have an impact on misunderstanding in the next lesson. This research uses descriptive research type. Data were collected from 24 students using test instruments and interview. Based on the data analysis, the result shows that students have misconception on force and movement concept, especially about free fall movement, friction force, and force on a non-moving object. This shows that there is still a lot of students' understanding that has not been in accordance with the actual concept of science.

1. Introduction

One of the characteristics of science learning is the concept establishing in every discussion of the material. Concept is an abstraction based on experience, then someone's experience of something (stimulus) will produce conception [1]. Concept is one of many things that is crucial to note in learning. Every student who studies science has had their knowledge acquired from the outside, it shows that students have constructed their knowledge related to the concept of science before they gain learning in the classroom.

Learners’ new knowledge is created through their prior experiences. Self-directed approaches role in the learning process are the fundamental advantages of the constructivist theory [2]. The constructivist view of learning has been receiving a great deal of attention, because of its impact on science and mathematics education [3].

Based on these opinions, it is known that experience has a great influence in the students’ concept construction. The experience intended here can be an experience gained from the outside as well as the experience gained during the learning process. Those experiences will shape the conception of students, especially about the science concept. Because the conception that is formed from the experience is not always true, then it can arise misconception of a particular concept. The existence of students’ misconceptions will cause a continuous misunderstanding associated with students' understanding of
the science concept at the next learning level. Since the fundamental concepts are taught at primary school level, the concept of teaching in primary school is an issue that should be strictly emphasized. The most frequently faced problems of concept teaching are misconceptions [4]. Misconception is used as a label for synthetic concepts that do not match the accepted view and that form as students attempt to integrate existing knowledge with new information, before deeper conceptual change occurs [5].

Based on the background, the researcher intends to do the research about misconception. This study aims to analyse the misconception of elementary school students about force and motion. Through this research, the researcher hopes to get detailed information related to the misconception of students as a preparation to do the innovation of learning, so that students can master the science concept well and correctly.

2. Method
This study employed descriptive qualitative method to obtain information related to students’ understanding especially on the force and motion concept. Subjects in this study were the fourth grade students of SD Negeri Cikandan who have obtained learning materials related to the force and motion concept. Data were collected through tests and interviews. Multiple-choice tests were given to gain an overview of students' conceptual understandings. Furthermore, the interviews were conducted to investigate the students’ deeper understanding related to the concept being studied.

3. Result and discussion
3.1. Result
Misconception analysis was done on the material of force and motion. In this discussion, the researchers determined four basic concepts developed in test instruments and interviews. The concepts are free fall motion, friction force, force on the stationary object, and the influence of force. Test instruments were presented through 10 multiple choice questions with reasons. Inclusion of reasons in tests serves to analyse students' understanding in greater depth. The number of samples in this study is 24 fourth grade students of elementary school. The answers of each student were analysed and grouped into three categories: the students understand the concept, the students have misconception, and the students do not understand the concept. Students were considered to understand the concept if the answers and the reasons chosen were correct, the students were judged to have misconception if the answer was correct but the reason given was wrong and the student did not understand if the answer and the reason given were wrong. To know the depth of students understanding, the researcher conducted interviews to the students. The following are the results of the tests given to the students.

![Figure 1](https://example.com/figure1.png)

**Figure 1.** Average percentage of student’s misconception on each question.

Figure 1 shows the distribution of average percentage of students’ misconceptions about the four basic concepts of force and motion material. Based on the data presented then it can be seen that the
students suffered the most misconceptions on the number 2, 3, 4, and 6. Following the test results given, the researchers then provided further questions in the form of questions essay. This was done to facilitate the researchers in obtaining the depth of student understanding before conducting the interview. Problem number 2 discusses the concept of force occurring in a stationary object presented in the form of essays into question 3. Understanding the concept of students can be seen from the student answers in Figure 1 below.

Figure 2. Student's answer to question number three about the concept of force on a stationary object.

Figure 2 shows that students have an understanding that force occurs only on moving objects, whereas non-moving objects do not exert force. Furthermore, the teacher conducted interviews by providing further questions to confirm student answers. Based on the results of interviews conducted, the researchers obtained suitability between the answers given through the questions and answers given at the time of interview. This shows that students really have that understanding. The third question discusses about the free fall motion which would be discussed further in the fourth question in essay form. The correct concept of free falling motion of an object is influenced by the magnitude of the friction force of an object with the air around it. However, this is different from the conception that students have. Results of follow-up answers from the tests given students can be seen in the figure below.

Figure 3. Student's answer to question number three about the concept of free fall movement.

Figure 3 is the result of students 'answers that show students' understanding of the motion of free falling of an object. Students have an understanding that affects an object to the ground first when dropped is the weight of the object. Furthermore, interviews were conducted based on student answers. Based on the results of interviews conducted, students argue that the heaviest object will touch the ground first rather than the lighter objects. This shows the compatibility between the answers to the questions and answers during the interview. Based on the results of student answers, it can be analysed that students experience misconception on the concept of free fall motion of an object.

The questions number 4 and 6 discuss about the friction force presented in question number 5 on essay which explores students' conceptual of friction force. Results of student answers can be seen in the figure 4 below:
Figure 4. Student's answer to question number three about the concept of friction force.

Based on the Figure 4 above can be seen that the student's answer is in accordance with the concept of friction. However, the researcher conducted the interview by giving a deeper question as follows:

Researcher: What is your opinion about “Aldo tries to push a car, but the car does not move” if it is connected with the frictional force?

Student: The car does not move because of the car’s friction force towards the road is bigger than the force that Aldo did.

Based on the answers above, the students argue that the magnitude of friction that occurs on an object is greater than the magnitude of force deployed by someone who gives the force. It shows a misconception on the concept of frictional force. The correct concept is that the amount of friction that occurs in the car and the road is equal to the magnitude of force issued by someone who gives the force. If the magnitude of the friction that occurs in an object is greater than the magnitude of force deployed by a person who gives the force, then the car will push the person.

3.2. Discussion
Based on the results of data analysis, the results show that students have misconception on the material and motion, especially in the concept of free falling movement of an object, the force on the stationary object, and the frictional force. Results of student answers through multiple choice tests provide an overview to researchers about the sections in which many students experience misconceptions. Furthermore, researchers conducted an interview that begins with a provision of essays. This is done as an alternative in facilitating students who have difficulty in explaining the understanding of the concept. In addition, the researcher can gain a depth of student understanding and appropriateness between the answers given on essay questions and interviews. The analysed data about the reason for student's answer shows the existence of misconception on three concepts namely free fall motion of an object, friction force, and force in silent object.

The misconceptions that students experience can be caused by various factors. Students come up with a variety of impressions and concepts about their own life. Many of these impressions and concepts might be misleading. For an influential science teaching, it is initially required that prior knowledge of students must be activated and new information must be linked to students’ prior knowledge. Thence, the importance of the level of student information and the misconception that students have arises. In addition to this, it should not be overlooked that the failure of teachers and course books in configuring the targeted conceptual changes might lead to different kinds of misconceptions in students [6]. Other reason for these misconceptions might be related to teaching approach. If teachers give more importance to procedural understanding, their students absolutely might not have conceptual understanding. Therefore, it can be suggested that teachers should show an effort to provide students with conceptual understanding firstly and then they should develop teaching strategies [7].

4. Conclusion
The fourth graders of elementary school face the misconception of force and motion in terms of three concepts: (1) free falling motion of an object, (2) force on a stationary object, and (3) frictional force. The result of student misconception analysis is expected to be the teacher’s consideration in doing the improvement.
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