

# Surveying an understanding about buoyant force: A case study of high school student

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## Abstract

The understanding students' conceptual background after the traditional teaching for studying static fluid is one of the most essential keys to design effective teaching activities. The conceptual understanding of 245 high school students in the topic of buoyant force act on the object in liquid was investigated by using 10 questions conceptual understanding test, the questions were divided into 3 conception groups, asked to compare the buoyant force act on the objects which have different mass, volume and density in the same liquid and different liquid were observed. The most misconception of student in these topics is the effect of liquid's density to buoyant force which has about 49.75% of misconception.

**Keyword:** Buoyant force, Students' understanding

## Introduction

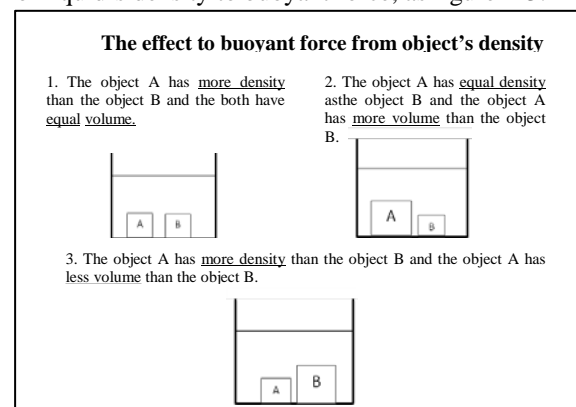
Conceptual understanding tests has important role in many works of teaching development. Its meaning is not only for understanding students' background knowledge before learning in a class, but also for evaluating knowledge after learning[1]. Testing done using the multiple choices, the close-ended-tests, the open-ended-tests and fill in a short word. In physics, there are many important contents that students need to learn. Buoyant force is one of the topic is interested in a high school physics curriculum. This is the difficult part to understand, especially the factors that affect the buoyant force acting on the object in the liquid. Such as reason has motivated researchers to engage a project to develop learning modules that will increase the effectiveness of instruction on buoyant force.

As a part of the main project, this study was held to explore students' prior knowledge about buoyant force acting on object in liquid. The tests were designed by the researchers for high school students. The questions are asked to compare the buoyant force acting on the object in liquid.

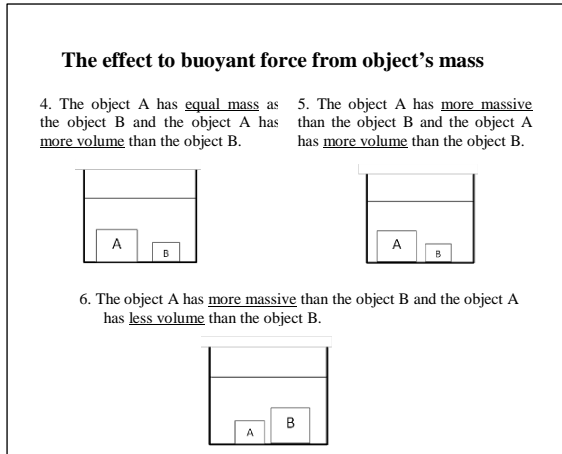
## Methods

In a study understanding of students about buoyant force acting on the object in liquid, the researchers surveyed 245 Matayomsuksa6 students' understanding of Panaspittayakhan School in Chonburi who have learnt about buoyant force in

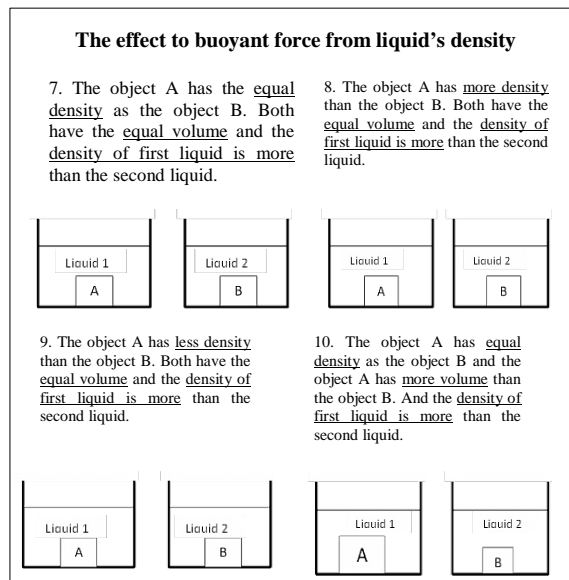
liquid. These groups of students have different knowledge and achievement in physics. The researchers surveyed by using 10 questions conceptual understanding test about buoyant force in liquid. The questions are asked to compare the buoyant force acting on the object in liquid in the three forms of choices as 1) the buoyant force acting on the object A is more than objects B 2) the buoyant force acting on the object B is more than object A and 3) the buoyant force acting on the both objects are equal. Then the researchers had grouped the questions into 3 concepts. At first, the effect of object's density to buoyant force. Second, the effect of object's mass to buoyant force. Finally, the effect of liquid's density to buoyant force, as figure 1-3.



**Figure 1.** Questions ask to compare the buoyant force acting on the object in concept: The effect of object's density to buoyant force.



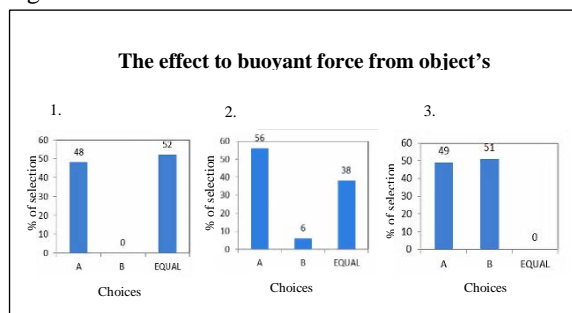
**Figure 2.** Questions ask to compare the buoyant force acting on the object in concept: The effect of object's mass to buoyant force.



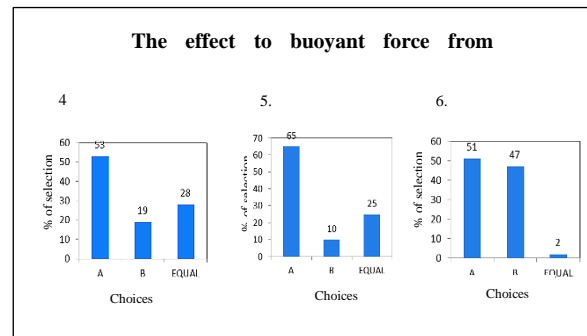
**Figure 3.** Questions ask to compare the buoyant force acting on the object in concept: The effect of liquid's density to buoyant force.

## Results and Discussion

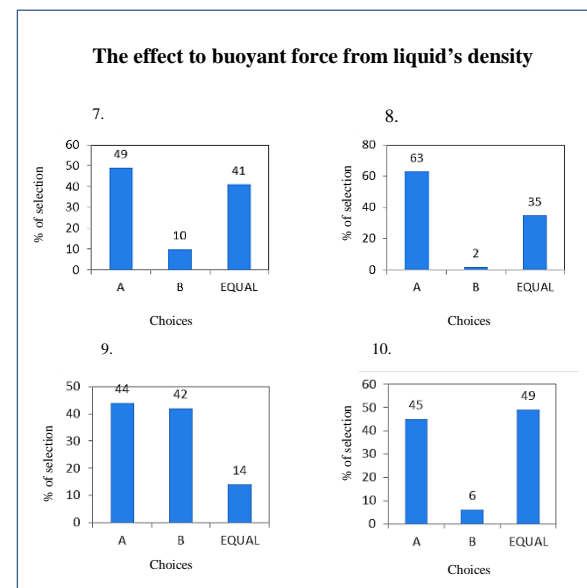
The surveying of students' understanding about buoyant force in liquid, the results are shown in figure 4-6.



**Figure 4.** Percentage students selecting in concept: The effect of object's density to buoyant force.



**Figure 5.** Students' percentage selected in concept: The effect of object's mass to buoyant force.



**Figure 6.** Students' percentage selected in concept: The effect of liquid's density to buoyant force.

The researchers analyzed students' response who misunderstood on three parts. Questions 1-3, when the objects have a different of density and volume affect to the buoyant force acting on an object. Questions 4-6, when the objects have a different mass and volume (which affects the density of the material) affect to the buoyant force acting on the object. And questions 7-10, when the objects have a different of density and volume in different liquid affect to the buoyant force acting on the object.

### 1. Misconceptions about the effect to buoyant force from object's density.

For the question 1, 118 students (48%) answered the buoyant force acting on the both objects are equal. This is the correct answer. While 127 students (52%) or about 1/2 answered the buoyant force acting on the object A is more than objects B. It is the wrong answer. This shows the students have misconception that the density of object will affect the buoyant force acting on the object. But in fact, the object's density do not affect to the magnitude of buoyant force. Questions 2 and 3 had similar results.

## 2. Misconceptions about the effect to buoyant force from object's mass.

For the question 4, 129 students (53%) answered the buoyant force acting on the object A is more than objects B, it is the correct answer. While 47 students (19%) answered the buoyant force acting on the object B is more than objects A and 69 students (28%) answered the buoyant force acting on the both objects are equal, it's the wrong answer. This shows the students have misconception that, the mass of the object will affect the buoyant force acting on the object. But in fact, the object's mass do not affect to the magnitude of buoyant force. Questions 5 and 6 had similar results.

## 3. Misconceptions about the effect to buoyant force from liquid's density.

For the question 7, 119 students (49%) answered the buoyant force acting on the object A is more than objects B, it is the correct answer. While 24 students ( 10%) answered the buoyant force acting on the object B is more than objects A and 102 students (41%) answered the buoyant force acting on the both objects are equal, it's the wrong answer. This shows the students have the misconception that, the density of liquid does not affect the buoyant force acting on the objects. But in fact, liquid's density is important factor affecting the magnitude of the force acting on the object are very supportive. In questions 8, 9 and 10 had similar results.

These are some parts of misunderstanding held by this group of students relate to pass researches such as the most students have misunderstandings about the densities of the objects [2], the placement of objects with different density in the liquid [3] and the complex problems of buoyant force in the liquid[4] which need to be clarified in class. The most misconception of student in these topics is the effect of liquid's density to buoyant force which has about 49.75% of misconception.

## Conclusions

In this report, some results selected from a surveying understanding's conceptual about buoyant force acting on the objects are discussed. The survey was collected from high school students. Students' prior understanding in buoyant force was evaluated by using 10 questions conceptual understanding test before learning activities. The results reflect many common misconceptions about buoyant force in three concepts. At first, the effect to buoyant force from object's density. Second, the effect to buoyant force from object's mass and finally, the effect to buoyant force from liquid's density. It shows that, if we have better teaching process and learning module, it can reduce students' misconception understanding. Therefore, the results of this research become a guide to design the learning activities and modules in class to improve students' understanding. The most

misconception of student in these topics is the effect of liquid's density to buoyant force which has about 49.75% of misconception.

## Acknowledgments

The researcher would like to thank the lecturers at the Department of Physics, Faculty of science, KMUTT, Thailand who helped with the test validations and gave useful suggestion.

And this survey cannot be completed without the scholarship from the Project for The Promotion of Science and Mathematics Talent Teacher (PSMT), the Institute for the Promotion of Teaching Science and Technology (IPST), Thailand.

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