Developing concepts and analytical thinking on force and pressure for elementary students using inquiry method

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Abstract

The purposes of this work were to develop instructional activities, to study relationship between the analytical thinking and concepts, and to compare the student analytical thinking between pretest and posttest by using an inquiry method on force and pressure. Twenty five grade-5 students of Ponduan School, Wanghin District, Sisaket Province were randomly selected during the first semester of 2014 school year. The research design was one group pretest posttest. Research instruments were experiment sets on force, friction, pressure, and buoyancy used in conjunction with the inquiry method. The advancement of learning was measured by using a normalized gain. The average normalized gain was 0.55 which was in a medium gain. The average achievement score of the student was increased with statistically significant level of .05 and students' satisfaction was in a high level

***Keywords*:** Inquiry Method, Analysis thinking concept, Force and Pressure

Introduction

It is generally believed that learners will learn more when taught less as the Minister of Education of Singapore embarked on "teach less, learn more" Ho., F.F., and Boo, H.K. 2007 [1]. This means that learners learn more when they do experiments and get trained or practiced by emphasizing on improving the quality of interaction between teachers and learners so that the learners can be more engaged in learning and better able to achieve desired outcomes of education. Many scientific and technological works are cooperative. The well-known learning pyramid by National Training Laboratories, Bethel, Maine, U.S.A., states that people will learn more and retain more their knowledge if the learning process involves doing, stimulating real experience, practicing, and immediate use. In addition, to understand physics and do physics, learners should have both knowledge in Physics and scientific skills. Learners will gain better understanding of Physics if they learn knowledge and skills in doing physics with appropriate coaching. They also should have right-positive attitude towards learning Physics [2], Redish, E. F.,Steinberg, R. N. Saul , J. M., 1998. In this paper, we report the design learning activities on Force and Pressure for elementary students so that the students can carry out experiments through cooperative learning. We will also probe the students' attitudes, and beliefs towards learning after taking the lesson.

Materials and Methods

The research samples consisted of twenty-five randomly selected grade-5 students of Ponduan School, Wanghin District, Sisaket Province. They studied in second semester of the 2015 academic year. The research design was one group pretest posttest. The instrument used in the work was the instructional activities mainly about force, friction, pressure, and buoyancy used in conjunction with the inquiry method [3]. It is a research-base multiple choice assessment that was designed for conceptual understanding and analysis. It consists of 30 questions. The students were asked to complete the test before and after instruction.

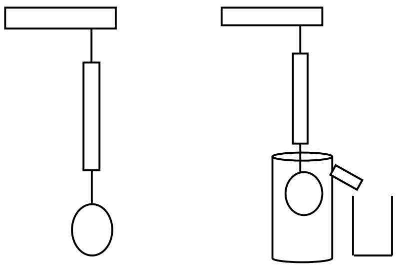

Figure 1. The experiment design of buoyancy

The samples of experiment were density and buoyancy. The students weighed an object in the air and in the liquid and obtained the buoyancy and density of the object. They compared the density of the object to compare with the density of the liquid.

The students were also asked to compare densities of modeling clay and water. By calculation the density is the mas divided by the volume; the students have learned that density of the clay is greater than that of water. This is the same the density of iron or steel is greater than that of water. The question asked why a boat made from steel float on water. The teacher (author) helped student to find out the answer by showing them model boats and toy boat. Finally the students discovered the answer that the boats were hollow inside. They have cavities inside that make volume of the boats large. This makes the overall density (the mass divided by the volume) of the boat is less than the density of the water. Thus, the boats float on the water. The students were asked to make a boat from modeling clay. The students were able to make overall density of modeling clay less than that of water by making boat hollow as shown in Figure 2. The students were very excited with this hands-on activity.

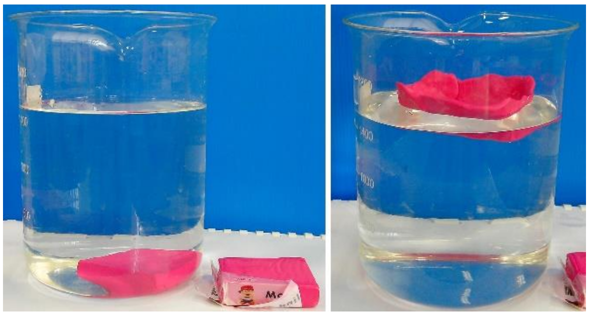

Figure 2. A model of a floating boat. Modeling clay sinks in water because its density of is greater than that of water. It floats on the water if it is made hollow inside so that its overall density is less than that of water.

In addition, the teacher did an experiment to demonstrate the principle that allows a submarine to dive. First, an empty bottle of drinking water was filled up with water almost full. Then, a medicine dropper was added some water by squeezing the bulb just a bit to allow only enough water into the dropper so that it just almost sinks, but still floats at the top of the water. After that, the dropper was placed in the bottle. Make sure that the dropper just floats. Finally, we close the bottle with the cap by screwing the top on tightly as shown in Figure 3.

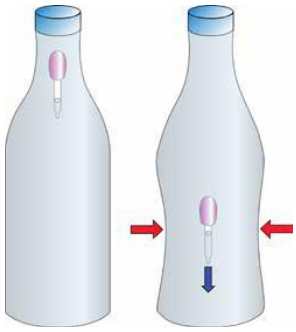

Figure 3 Demonstration of a submarine float and drive.

When you squeeze the bottle hard, the air in the bottle is compressed so that it pushes water to the dropper and make dropper sink. When you leave it go, the air is no longer compressed, the water come outside, the density of the dropper decreases, and the dropper has enough buoyancy to rise to the top. In a submarine, tanks are filled with water to make it sink. The water is blown out to make it rise.

Results and Discussion

The results of the pre-test and post-test are shown in table 1. The average pre-test scores for five clusters ranged from 34.40% to 48.80%. The average post-test scores in each cluster were greater than that of pre-test scores. The highest average post-test score was in the friction cluster.

The normalized gain, <g>, a measure of the advancement of students' learning in scores between pre-test and post-test was expressed as a fraction of the range of possible score increase and was also calculated by,

$$< g >= \frac{[(\%post - test) - (\%pre - test)]}{[(100\%) - (\%pre - test)]}$$

There were 3 classes of normalized gain corresponding to high gain high gain (<g> $\geq$ 0.7) medium gain (0.7< <g> $\geq$ 0.3) and low gain (<g> < 0.3) [4]. Table 1 shows the average normalized gains which were medium gain (0.54).

Table 1: Mean score, average normalized gains, and t-statistics on the pre-test and post-test

Cluster	Pre-test(%)		Post-test(%)		normalized gain <g>	t-value
	Mean	S.D.	Mean	S.D.		
1. Force	48.80	0.48	80.00	2.35	0.61	6.29*
2. Air pressure	47.20	2.17	75.20	3.90	0.53	6.67*
3. Fluid pressure	34.40	2.12	68.00	4.85	0.51	4.52*
4. buoyancy	40.00	3.00	68.00	3.00	0.47	9.90*
5. friction	42.00	2.07	75.33	2.48	0.57	16.85*
	42.48	9.84	73.27	16.58	0.54	44.23*

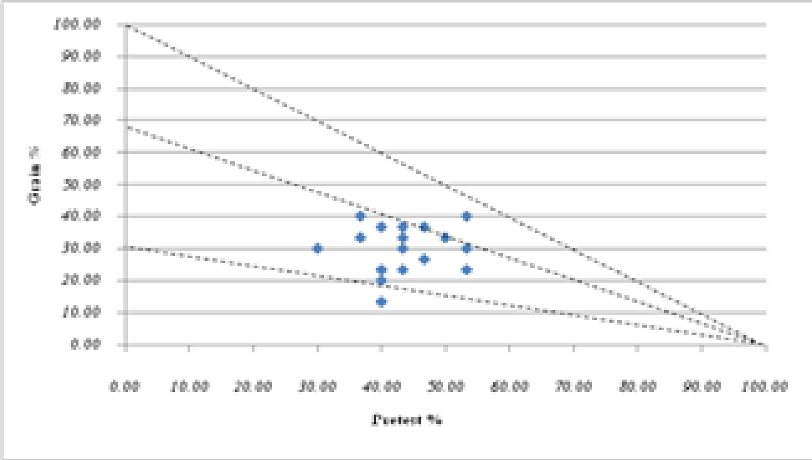

Figure 4. This is graph the individual progress of students in the class latter has been learning by using inquiry method.

The data analysis is shown in Figure 4. The progresses of learning in all aspects indicate that students have a better understanding about the science, force, pressure, and buoyancy. After learning, the students gain higher learning achievement scores and the advancement of learning at 0.55 which is in the medium gain. The students have embarked on action by themselves by building knowledge and gained better understanding and experience.

Conclusions

We have developed concepts and analytical thinking on force and pressure for elementary students using inquiry method learned by means of Inquiry (5E) force and pressure. The advancement of the class is considered that the learning outcomes of the group was increased with the average normalized gain <g> = 0.49 (medium gain). After obtaining experiments and hands-on activities in conjunction with inquiry method, the average achievement score of the students was increased with a statistically significant level of .05. The students were very satisfied with the activities and have positive towards learning science.

References

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