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Problem-Based Learning with Argumentation Skills to Improve Students' Concept Understanding

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Abstract. Understanding students' concepts can be achieved well, one of them is by applying Problem Based Learning. With Problem Based Learning, students can be actively involved in learning. This article discusses the Problem Based Learning that applies argumentation skills to improve understanding of the buoyant style concept of high school students. With the right learning steps in accordance with the syntax of Problem Based Learning, understanding of concepts will be achieved in students. Besides that, it involves students' skills in the cognitive, affective, and psychomotor domains. One of the skills analyzed is argumentation skills. In this study, the argumentation skill in problem-based learning is high, which is 0.639 which means that the relationship between the skills of argumentation in problem-based learning is very good. Each activity is expected to facilitate students to develop an understanding of students' scientific concepts such as observing, concluding, predicting, asking questions, constructing hypotheses, designing experiments, applying concepts, and communicating. Problem Based Learning with argumentation skills can improve students' understanding of concepts.

1. Introduction
In Science education that is applied in the curriculum in Indonesia is expected to build an understanding of concepts, thinking skills, and student skills. The implementation of learning in Indonesia currently refers to the 2013 curriculum (K13), which requires students to be able to learn independently to obtain meaningful learning. Learning by using K13 uses a scientific approach by following the steps of learning that include observing, questioning, associating, experimenting, and networking [1]. The scientific approach can be integrated into several learning models [2]. The learning process is expected to develop three aspects of education, namely attitude, knowledge, and skills.

A concept can help students to understand new experiences by connecting experiences we already know. A good understanding of a concept can help students in planning and providing solutions in solving problems [3]. In physics learning, students are expected to have a good understanding of concepts so that they can solve problems from phenomena that exist in everyday life. The findings show that many students still have alternative conceptions and some students cannot clearly explain the meaning of the concept [4]. These difficulties can affect students' understanding of how to apply the concept to other problems.

A good understanding of concepts can improve students' skills such as remembering, explaining, finding facts, mentioning examples, generalizing, applying, analogizing, and expressing new concepts in other ways. Understanding concepts can help students to develop science and technology in society. But most teachers only focus on mathematical completion rather than understanding the concept.

One learning model that can improve students' concept of understanding is the Problem Based Learning (PBL) model. In physics learning, encourages students to conduct scientific investigations in
order to obtain scientific knowledge. This can be done by integrating knowledge, attitudes, and skills. This model is expected to improve the knowledge of students’ understanding of concepts better. One way to integrate knowledge, attitudes, and skills in order to improve the knowledge of students’ understanding of concepts is better with Problem-based learning problem-based learning using experimental methods [5]. The findings of the study revealed that a PBL approach is more effective than the traditional teaching methods in improving students’ conceptual understanding [6]. The PBL helps students to develop flexible knowledge, effective problem-solving skills, self-directed learning, effective collaboration skills, and intrinsic motivation [7]. Besides being able to improve students' conceptual understanding, PBL models can be achieved well if the teacher is able to integrate the three realms of education with the skills of argumentation in the PBL model.

Problem Based Learning requires students to be more active in the learning process because students do not only rely on the teacher as a source of information but also utilize other learning resources. Facts show that problem-based learning can effectively facilitate students' argumentation skills, control variables, and theoretical reasoning skills [8]. With examples of phenomena and a problem, students actively discover existing concepts. The use of good Problem Based Learning will empower a better understanding of concepts. In classrooms where problem-based learning models are used, students learn new knowledge by providing problems that must be resolved, so that student attitudes such as problem-solving, critical thinking, group work, and argumentation are obtained from sharing information both from group discussions and online media [8].

Problem-based learning is learning that presents authentic and meaningful situations or problems to students, which can serve as a springboard for investigation and investigation. The problem-based learning model is one example of a student-centered learning model. Benefits Problem based learning for students is to be able to develop the ability to think about important issues that are contextual and train students to become independent individuals. This is in accordance with the formulation of the problem based learning according to the Ministry of National Education which states that Problem based learning makes students as independent learners, meaning that when students learn, students can choose an appropriate learning strategy, skilled in using these strategies to learn and be able to control the learning process, as well as motivated to complete the study. Based on the results of a study [9], student performance scores with PBL models have increased because PBL models provide hypothetical-deductive reasoning methods and opportunities to practice skills, one of which is argumentation skills. One of the purposes to apply argumentation in science classes is to improve students' conceptual understanding [3].

2. Research Method
The research method used is descriptive qualitative. The study was conducted at SMA N 1 Mojolaban class XI in physics subjects the subject of buoyant. The sample used was 32 students who were selected by means of simple random sampling. Argumentation skill data were obtained based on the results of observations, where observations were made in each group with 1 group consisting of 4 to 5 people. Data on student learning outcomes are obtained by the test technique, where the test results learn to adopt from national exam questions. The results of validity analysis were obtained by means of expert judgment involving 3 Raters, obtained by the content validity of 0.87. This shows that the questions used have a good level of validity. As for the reliability of items tested with KR-20 Technique, an obtained a reliability coefficient of 0.65. This shows that the reliability of the problem is in the medium category.

3. Result and Discussion
The Problem-Based Learning Syntax
Problem Based Learning which has stages or syntax in its implementation consists of five phases. By playing an active role in the learning cycle, it is expected to develop students' understanding of concepts. Researchers examining the impact of PBL on student outcomes have found that when well implemented, problem-based learning can lead to greater conceptual understanding and problem-solving skills[10]. The five stages the learning cycle include orientation, students describe various important information, and students are motivated to be involved in solving problems. The role of Problem Based Learning (PBL) by implementing five steps of strategy or syntax can improve students' conceptual understanding [11]. Organization, students define and organize information related to the problem. The Investigation,
students get the right information, carry out experiments, and find explanations and solutions. Development, students plan or prepare appropriate work as a result of problem-solving. Evaluation, students reflect or evaluate the problem-solving process.

(1) Orientation
The orientation phase is expected to train students' skills in observing, concluding, predicting, and asking questions. The teacher prepares tools and materials to provide motivation and initial information before conducting experiments. With tools and materials such as large containers containing water, wooden beams, nails, balls, and plasticine. Each wooden, iron and ball beam had been wrapped in plasticine by the teacher. Then the three plasticines were put in water, apparently, there were floating and drowning. Students are given the opportunity to observe activities, such as placing plasticine in water and observing the buoyant force that occurs in plasticine. Then students are asked to open plasticine dots on observing objects inside that can cause floating and sinking.

The teacher assigns students to conclude the observations. With the direction of the teacher, students can conclude that every object that is submerged in water has a buoyant force that leads to the surface of the water. If students make observations and interpretations correctly, students must be able to predict that objects with large or small masses, if inserted in water will have a buoyant force. The teacher encourages students to ask questions or statements to practice their ability to argue. One of the questions that will be investigated in an experimental activity is 'What is the relationship between the volume of objects with buoyant forces?'.

(2) Organization
The student stage is assigned to formulate the experimental hypothesis. Then students are asked to determine the tools and materials needed in an experimental activity that is easily obtained from the surrounding environment. The tools and materials are beverage cans, large containers, water, static, and spring balance. In designing experiments students are given the opportunity to design the steps of the experiment to be carried out, and the activity includes the application of students' argumentation skills. For example, first students design an existing tool, that is marking the parts of the can or hanging the spring balance on the stative as shown in Figure 1.

Figure 1 Hang the can on a spring balance

Figure 1 shows the weight of the can when half-submerged. Then the student measures the weight of the can using a spring balance and gets the weight of the object before it is immersed which is 370 grams or 3.7 N (Fg) and then records the observations in the table. The next step is to experiment or measure the weight of the can when dipping a quarter, half, three quarters, and all parts into the water as shown in Figure 2.
Figure 2. Measuring the apparent weight of a can by changing the volume of a dipped can

Figure 2 shows that by dipping a quarter, half, three quarters, and all the parts into the water as well as changing the immersed volume it will get heavy can data. Based on these data students found the weight before dipping (wg) and weight after dipping (ws). The volume in liquid ounces converted to volume in liters uses a factor of 12 oz = 0.355 L [12].

Table 1 Results of the experimental weight of objects before and after submerging

| No | Volume Submerged (oz) | Volume Submerged (L) | Weight (N) | Buoyant Force (N) |
|----|-----------------------|----------------------|------------|-------------------|
| 1  | 0                     | 0                    | 3.7        | 0                 |
| 2  | 1/4                   | 0.09                 | 2.65       | 0.870             |
| 3  | 1/2                   | 0.18                 | 1.85       | 1.740             |
| 4  | 3/4                   | 0.27                 | 1          | 2.609             |
| 5  | Full                  | 0.36                 | 0          | 3.479             |

From the data in Table 1, students are asked to argue with each other about the results of the experiments obtained and change the form of data from the table into graphs. Examples of graphs based on data in table 1 can be seen as in Figure 3.

Figure 3 Graph of the relationship between buoyancy force and object volume

Figure 3 above shows that the relationship between buoyant force and submerged volume. The relationship between buoyancy and submerged volume is directly proportional. The results of this experiment are then used as materials to construct knowledge at the generalization stage [10].

(3) Investigation

In the investigation phase, from the experimental data students can build their conceptual understanding of buoyant force based on experimental results. The experimental results show that the
relationship between buoyancy force and submerged volume is directly proportional. Then students are asked to analyze the experimental results, both from the table or graph.

(4) Development

In the verification phase, the teacher asks students to state their arguments and helps students to determine the relationship between buoyancy and volume submerged by the concept of hydrostatic pressure.

![Figure 4 Diagram of forces acting on a cylinder immersed in a fluid](image)

Cylinders with height $h$ the upper part and bottom base have area $A$ and are dipped completely in water with density $\rho$. Water puts pressure $P_1 = \rho g h_1$ on the top surface of the cylinder. The force caused by the pressure at the top of this cylinder is $F_1 = P_1 A = \rho g h_1 A$, and points down. In the same way, the liquid giving an upward force at the bottom of the cylinder equals $F_2 = P_2 A = \rho g h_2 A$. The total force caused by the pressure of the liquid, which is the buoyant force ($F_b$) acting up, the equation:

$$F_b = F_2 - F_1$$
$$F_b = \rho g A (h_2 - h_1)$$
$$F_b = \rho g Ah$$
$$F_b = \rho g V$$

Thus, the relationship between buoyancy force and volume immersed in experimental activities can be verified through equations. The relationship between buoyant forces proportional to the volume of objects immersed in the experimental activity can be verified through the equation[13].

(5) Evaluation

The student application phase is assigned to apply concepts that have previously been studied with experimental activities. For example, making boats from plasticine to accommodate large quantities of marbles. Students can design systematically and clearly according to the knowledge that has been obtained from the experiment. Then explain the concepts that exist in the plasticine boat.

Analysis of Correlation Problem-Based Learning with Argumentation skills

Data of observation results and student learning outcomes after applying PBL learning models were analyzed using the SPSS Ver program. 24. Data tested for normality using Kolmogorov-Smirnov. The results of the analysis are presented in Table 2.

|                      | Kolmogorov-Smirnov* | Shapiro-Wilk |
|----------------------|---------------------|--------------|
|                      | Statistic | Df | Sig. | Statistic | df | Sig. |
| Argumentation Skills | .295      | 35 | .000 | .854      | 35 | .000 |
| Learning Outcomes    | .129      | 35 | .153 | .956      | 35 | .172 |

* Lilliefors Significance Correction
The results of the normality test showed that Sig. <0.005, meaning that the data of argumentation skills were not normally distributed so that the data analysis then used non-parametric statistical tests using Spearman’s Rho correlation.

|                  | Argumentation_Skills | Hasil_Belajar |
|------------------|----------------------|--------------|
| Spearman's rho   |                      |              |
| Correlation Coefficient | 1.000               | .639**       |
| Sig. (2-tailed)  |                      | .000         |
| N                | 35                   | 35           |

**Correlation is significant at the 0.01 level (2-tailed).**

Correlation test results show that Sig. (2-tailed) <0.000, meaning that the data of the skills of argumentation and data of student learning outcomes have a positive correlation. Based on the correlation coefficient obtained value of 0.639 this indicates that there is a high correlation between the argumentation skills taught using the Problem Based Learning model in the subject of basic physics in terms of buoyant. The effect of Problem Based Learning on argumentation skills in addition to influencing physics learning, also has a positive effect on increasing the average students' mathematical argumentation skills [14].

4. Conclusion

Based on the literature review conducted, Problem based learning that implements argumentation skills can improve students' conceptual understanding of the relationship between buoyant force and sinking volume. With the concept of hydrostatic pressure, the Archimedes principle is obtained.

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