Students concept understanding of static fluid based on the types of teaching

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Abstract. This research aims to know the concept understanding of student are taught by guided inquiry based learning and conventional based learning. Subjects in this study are high school students as much as 2 classes and each class consists of 32 students, both classes are homogen. The data was collected by conceptual test in the multiple-choice form with the students argumentation of the answer. The data analysis used is qualitative descriptive method. The results of the study showed that the average of class that was using guided inquiry based learning is 78.44 while the class with use conventional based learning is 65.16. Based on these data, the guided inquiry model is an effective learning model used to improve students concept understanding.

1. Introduction

The aim of some physics education research is to study students’ understanding or conception in physics [1]. Physics is a very conceptual subject. Excavating students’ mental model in certain topics, provide a constructive feedback to stakeholders of physics education particularly to probe the reasons behind misconception [2]. This feedback is used to improve the quality of physics learning [3]. Misconceptions on several physics concepts becomes an important concern to be investigated. Student misconceptions have their origins in a diverse set of personal experiences [4]. The term concept is defined to be a general physics idea such as the basic concept of physics being taught [5]. The research in Physics teaching points that a great amount of students don’t succeed to learn physics basic concepts [6,7]. Students only notice the surface features of problem situations [5]. The research in Physics teaching points that a great amount of students don’t succeed to learn physics basic concepts [6,7]. Students only notice the surface features of problem situations [5]. Students must learn to apply physics principles in diverse situations to explain and predict physical phenomena [8].

Indicators of the cognitive process of understanding include: interpreting, exemplifying, classifying, summarizing, attracting inferring, comparing, and explaining [9]. The lessons learned in most teachers at the senior high school level still refer to the conventional learning model which using teacher center method. Implementation of learning science which mostly occurred with conventional models namely a way of classical teaching. This learning process did not give students to get involved in the learning process. This model has many weaknesses such as the role of the teacher is still more dominant (teachers centered), students tend to be passive and just accept information by memorizing concepts without adequate understanding. It is because the learning process did not guide the students to think critically, creatively, practicing to find concepts or principles to develop their creativity. So that, the achievement of learning is limited only to the aspects of knowledge (cognitive) but it did not develop in the aspect of attitudes (affective) and skills (psychomotor) [10].
The concept will be easily accepted by students if students are directly involved in learning. One of learning model that can effective to improve understanding concept is guided inquiry based learning. The usage of guided inquiry method is very important in the transition from lecturing method to other teaching methods which are less and more clearly structured for alternative solutions. Learning activities in guided inquiry model help students to develop their individual responsibility, cognitive levels, report making, problem-solving and understanding skills [11].

Guided inquiry method which helps in integrating scientific and constructivist rationales together with the facts, principles and rules [12].

The purpose of this research is to know the effectiveness of conventional and guided inquiry learning model in understanding the concept of static fluid.

2. Methods
This study used descriptive qualitative method. Data were obtained using a multiple choice conceptual test that was accompanied by student arguments on classes taught using conventional and class using guided inquiry learning models. The purpose of this test is to measure students concept understanding of static fluid. The items in the test were conceptual and there are no quantitative calculations were needed to answer the question. The subject in this research is tenth grader of senior high school, which consisting of 2 classes and each class consists of 32 students. Both classes are homogeny. The control class is the class that taught by using the conventional based learning and the experimental class is the class using guided inquiry based learning.

3. Result and Discussion
Based on the results of research, students concept understanding analysis is provided on the following histogram in Figure 1.

![Figure 1. The Students Concept Understanding](image-url)

Figure 1 show that students in the experiment class have a higher level of conceptual understanding. The level students concept understanding in the control class is still low, high number of criteria is "less understanding concept". Most of the students answer correctly but their arguments were wrong. Their argument is still low to seeing concretely the problem without further studying the concepts contained in the problems presented.

Understanding the early concept is the main thing that must be haved by students, if the beginning students already have the correct concept then students can solve more complex physics problem. Understanding the concept consists of several indicators. Here are the results of the average analysis of students concept understanding on each indicator presented in Table 1.
Table 1. Mean results of student understanding concept each indicator

| Indicator      | Experiment | Control |
|----------------|------------|---------|
| Interpreting   | 7.57       | 6.56    |
| Exemplifying   | 7.97       | 6.72    |
| Classifying    | 7.66       | 6.25    |
| Summarising    | 7.81       | 7.19    |
| Inferring      | 7.96       | 6.56    |
| Comparing      | 7.34       | 6.01    |
| Explaining     | 8.28       | 6.64    |
| Average        | 7.84       | 6.52    |

The average results of the students concept understanding of the experiment class and the control class is difference. The experiment class obtained the average learning outcome of 7.84 while the control class was 6.52. It means that the guided inquiry based learning is an effective used to help students understand physics concepts that have complex characteristics. Students investigate and discover their own concepts directly through learning activities. The guided inquiry based learning makes the students as the center of learning and the students are directly involved in the learning, the concepts that students receive will remember in their journey to follow the next studies. This is very upsetting because this learning model helps students to reduce the occurrence of misconceptions. Understanding the concept in the control class shows the lower average, this is because in the conventional learning students are not required to be active and directly involved in learning. Learning is concentrated only on the teacher. Data of the research results show the students answer the correct answer but the argument is wrong or choose wrong answer and the argument wrong. This indicates that the explanation that the student receives from the teacher cannot be entirely well received by the student.

Students concept understanding of physics in experimental class the largest is in explaining indicator that is equal to 8.28 and the lowest in the comparing indicator 7.34. In the explaining indicators students determine the cause of the consequences of a problem. Be aware of the students answers to this indicator problem students have shown correct answers and correct arguments. This shows that in the experiment class, the concept given during the learning process can be received correctly by the students. The lowest conceptual understanding indicator in the experiment class is in the comparing indicator. In this indicator students determine the relationship between two problems of ideas, objects and so on. In the control class the highest student concept of understanding is in the summarizing indicator that equal is 7.19. In this indicator the students abstract the general theme or the main points in the problem. Students are asked to analyze the problem and relate it to the equations contained in the static fluid. While the lowest students concept understanding indicator on the control class is in the comparing indicator that is equal to 6.01. This is similar to the result of experiment class where the lowest concept understanding indicator is in the comparing indicator. In this indicator students are required to analyze the matter of everyday life and compare it with the concepts and equations contained in the static fluid material. In the control class many students misunderstand multiple choice questions and their arguments are incorrect.

The following presented some of the answers of students found about understanding static fluid in the experiment class and control class presented in Table 2.
Table 2. Student’s answer in experiment and control class

| Experiment Class | Control Class |
|------------------|---------------|
| **Problem 1**    |               |
| Problem 1        |               |
| ![Image](image1.png) | ![Image](image2.png) |
| Answer:           |               |
| a.                | a.            |
| b.                | b.            |
| c.                | c.            |
| d.                | d.            |
| Problem 2        |               |
| ![Image](image3.png) | ![Image](image4.png) |
| Answer:           |               |
| a.                | a.            |
| b.                | b.            |
| c.                | c.            |
| d.                | d.            |

The answers and arguments of the student are correct. Students answer the point that in the picture a, b, c have the same depth and both are in the water, then the amount of hydrostatic pressure at the three points are the same.

Based on the answers and arguments of the students in the experiment class and control class it is seen that in the control class the student’s answer and the arguments that the students give are also incorrect. This suggests that the concept of understanding in the control class is still very low. The actual concept of hydrostatic pressure is the actual concept corresponding to the hydrostatic law equation \( P = \rho gh \), the surface area of the liquid does not affect the amount of hydrostatic pressure.

**Problem 2**

Based on the picture above shows that students answers are correct and the arguments they provide are also true. Point A and B are at the same height and at the same liquid so that the hydrostatic pressure at point A=B, but the points C and D are on different fluids but the height is the same. Student answers point C≠D.

Based on the answer of the students in the experiment class and control class it is seen that in the control class the students’ answers are wrong and the arguments that the students give are also wrong. The actual hydrostatic pressure concept is in accordance with the hydrostatic pressure equation. Hydrostatic pressure is influenced by the fluid type of mass, gravitational force and the height of the liquid. If a point is at the same height but on different substances the magnitude of the hydrostatic pressure will also be different. On the problem of hydrostatic pressure at point A = B because of the density and the same height, but it is different with point C and D are at the same height and density of different types then the amount of hydrostatic pressure will also be different.
Problem 3

Based on the picture above shows that students answers are correct and the arguments they provide are also true. When identical vessels sail at the same depths in the river and in the ocean then the bottom that sinks deeper is the ship that sails on the river. The argument that the students give is the density of the river water is smaller than the sea water.

The student’s answer indicates that the students still can not understand the concept because the answers and arguments that they provide are still wrong. Students assume that if the vessel is identical and sailed at the same depth then the part of the ship that sinks down the water surface is also the same.

Based on the students’ answers, the students understanding of the correct concept is in the experiment class but the control class is still low. The above problems concerning the law of Archimedes. The equation of Archimedes is $F_A = \rho g v$. $F_A$ is influenced by the fluid type mass, the gravitational force and the volume of the dyed object. The volume of the dyed object is smaller than the volume of the object so that the object is floating. If the mass is large then upward force is also large. In the above case $\rho$ seawater ($1030 \text{ kg/m}^3$) is greater than $\rho$ fresh water ($1000 \text{ kg/m}^3$), so the correct answer should be that the bottom of ship A will sink deeper than ship B because $F_A$ on board A fewer.

Based on the table the concept can be correct in the experiment class and the student control class is still incorrect. The following presents the correct of the concept in the problems given to the students in this study presented in Table 3.

| Incorrect Concept of Students | Correct Concept |
|------------------------------|-----------------|
| Hydrostatic pressure is influenced by the surface area of the liquid container | The equation of hydrostatic pressure: $P = \rho gh$ Thus, hydrostatic pressure is influenced by the density of the liquid ($\rho$), gravity (g) and height (h).|
| The height of the liquid in the hydrostatic pressure is measured from the bottom of the liquid (bottom) | The altitude in the liquid is measured from the surface of the liquid (top) |
| Hydrostatic pressures of the same height and different mass of the same value remain the same. | The hydrostatic pressure will be the same if the same height (h) and the density ($\rho$) are equal, if the object is at the same height (h) but the density ($\rho$) is different |
| The law of Archimedes is only influenced by the depth of the dyed object regardless of the density of the liquid type | Equality of law Archimedes: $F_A = \rho g v$ $F_A = \rho g (A. h)$ Thus, the law of archimedes is influenced by the density of the liquid($\rho$), gravity (g), the volume of the object (v), the area of the liquid (A) and the volume height of the dyed object (h) |
| Upward force in the case of a floating object is heard by the depth of the object. | For completely submerged objects, ($F_A$) upward force does not depend on its depth |
4. Conclusion

Based on the results and discussion of this research, the class that taught by using guided inquiry based learning obtained higher learning outcomes than the control class. The average of experiment class of is 7.84 and in the control class is 6.52. The understanding of students who are taught with inquiry learning model is guided higher than control class. This can be seen in the average of each indicator of students conceptual understanding. This shows the guided inquiry based learning effectively used in learning compared to conventional learning model. The average indicators that were taught using the guided based inquiry learning most improved on the explanatory indicator is 8.28 and the control class is summarizing of 7.19. The lowest level conceptual indicator of the class with inquiry based learning is same with conventional based learning class is in the comparison indicator. The result is 7.34 in guided inquiry class and 6.01 in the conventional class. Based on these data, the guided inquiry model is an effective learning model used to improve students concept understanding.

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