Identification of student misconception about static fluid

O Saputra*, A Setiawan and D Rusdiana

Program Studi Pendidikan IPA, Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Jl. Dr. Setiabudi No. 229, Bandung 40154, Indonesia

*okasaputra@upi.edu

Abstract. This study aims to identify students' misconceptions about static fluid and to see how gender effects on misconception. The method used in this research is survey to 24 students in one of high school in Palu city. The instrument used is three tier tests of 23 numbers. The result of the analysis shows that there are still many students who have misconception with 70.8% on Pascal’s law subject, 67.6% on Archimedes’ law and 55.7% on the topic of hydrostatic pressure. While for female misconception equal to 42.2% and male equal to 22.5% one of the misconceptions that occurs in static fluid material is that students assume that hydrostatic pressure will be large if it has a large area.

1. Introduction

Physics is one of the most important areas of science controlled by students [1]. Exponentially the general goal of physics learning is to emphasize the mastery of the concept for meaningful learning [2]. The concept is not only obtained by observations such as seeing, hearing or feeling. The ability to make conclusions, categories and patterns in the form of concepts is very important to store the various information received.

When students enter science learning, these students have brought their own concepts. This idea may either be true or acceptable as an alternative conception or prior knowledge if it differs from a scientific perspective. Sometimes different students' ideas from scientists are resistant to change. This may be a big problem for teachers who teach these students [3][4][5].

Initial concepts incompatible with the truth of this science are called misconceptions [6]. Misconceptions as an inaccurate notion of concepts, the use of false concepts, the classification of false examples, the confusion of different concepts and the hierarchical relationships of incorrect concepts. From the above understanding misconception can be interpreted as a conception that is not in accordance with the scientific understanding or understanding received by scientists. Misconceptions defined as student conceptions that do not fit the conception of scientists, are only acceptable in certain cases and do not apply to other cases and can not be generalized. Such conceptions are generally built on common sense or intuitively constructed in an attempt to give meaning to the world of their everyday experience and only a pragmatic explanation of the real world. The initial concept is obtained by learners while in school and formed by students themselves in contact with the environment. Because students construct their own knowledge it is not impossible to make mistakes in constructing. This is because students are not used to construct physics concepts correctly, yet have a scientific framework that can be used as a benchmark [7].

One concept often encountered in everyday life is the law of Archimedes’ about buoyancy, Pascal’s law and hydrostatic pressures, the three materials are part of the static fluid material [8][9]. Previous
research says that the static fluid there are various principles but the students are wrong in interpreting the concepts that exist so misconception occurs.

It is difficult to eliminate misconceptions that occur in students. The cause of the resistance is a misconception because everyone builds knowledge exactly with his experience. Once we have built up knowledge, it is not easy to tell that it is wrong by just telling to change the misconception. So the way to change misconceptions is to construct new concepts that are better suited to explain our experience. A number of misconceptions are very resistant, although it has been attempted to deny them by logical reasoning by showing the difference with actual observations, obtained from demonstrations and experiments designed specifically for that purpose. It is necessary to detect misconceptions that occurred early. Some researchers have used various instruments in detecting misconceptions in students [10][11][12]. One of the tests used to detect misconceptions is the three tier test.

The male and female students' brain abilities have different females in representing a phenomenon they see. So it is interesting to examine more deeply how gender influences students' misconceptions on static fluid materials [13].

This study intends to identify students' misconceptions about static fluid as well as to see how gender effects on misconception in the XI class IPA include the main hydrostatic legal concept, Pascal’s law and Archimedes’ law.

2. Research method
Methods in this study is a survey conducted in one SMAN in Palu City. The population is all students of class XI of 308 students divided into eight classes and each class consists of 38 to 39 students. The sample in this research is the students of grade XI IPA 7 selected by using purposive sampling technique that is determination of sample with certain consideration. To determine the sample is based on the recommendation of teachers on the grounds of classroom teachers who are more aware of good class conditions to serve as research classes.

Data collection method was conducted using misconception test instrument in the form of three tier test of 23 questions. Misconception test instruments are used to measure student misconceptions on static fluid materials. The problem distribution used in this study can be seen in the table 1.

| Subject matter                  | Question number |
|---------------------------------|-----------------|
| The main law of hydrostaticism   | 1, 2, 3, 4, 5, 6, 17, 18, 19, 21, 22 |
| Pascal’s law                    | 10, 15, 20      |
| Archimedes’ law                 | 7, 8, 9, 11, 12, 13, 14, 16, 23 |

The data analysis of the test results was performed to find out how the students' conception of static fluid material by referring [14] with the assessment rubric as illustrated in the table 2.

| First Tier | Second Tier | Third Tier | Categories               |
|------------|-------------|------------|--------------------------|
| Correct    | Correct     | Certain    | Scientific Knowledge     |
| Correct    | Incorrect   | Certain    | Misconception (False Positive) |
| Incorrect  | Correct     | Certain    | Misconception (False Negative) |
| Incorrect  | Incorrect   | Certain    | Misconception            |
| Correct    | Correct     | Uncertain  | Lucky Guess, Lack Of Confidence |
| Correct    | Incorrect   | Uncertain  | Lack Of Knowledge        |
| Incorrect  | Correct     | Uncertain  | Lack Of Knowledge        |
| Incorrect  | Incorrect   | Uncertain  | Lack Of Knowledge        |
3. Result and discussion

3.1. Result

Analysis of answers from 24 high school students on 23 three tier test to see how the conception of students can be seen in the table 3

| Subject matter                | Percentage (%) |
|-------------------------------|----------------|
| The main law of hydrostaticism| 21.6, 8.7, 14.0, 55.7 |
| Pascal’s law                  | 11.1, 2.8, 15.3, 70.8 |
| Archimedes’ law               | 20.8, 3.2, 8.3, 67.6 |
| Total                         | 17.8, 4.9, 12.5, 64.7 |

The table 3 above shows that there are more than half of samples experiencing misconceptions. It also shows that the students’ static fluid conception is still low. The results of data identification can be used to determine the difficulties experienced by students in interpreting the conception, especially on static fluid material. Table 3 also shows that in every subtopics more than half of students experience misconceptions but the most common misconceptions occur on the topic of Pascal’s law, the law of Archimedes’ and who have the lowest misconceptions on hydrostatic pressure materials. If seen from the gender of students mostly female students experiencing the greatest misconception compared with male students, the percentage can be seen in table 4.

| Gender | Percentage (%) |
|--------|----------------|
|        | PL | L | KP | MK |
| Female | 11.6 | 3.2 | 8.2 | 42.2 |
| Male   | 6.2 | 1.7 | 4.3 | 22.5 |
| Total  | 17.8 | 4.9 | 12.5 | 64.7 |

3.2. Discussion

Concerning the concept of determining hydrostatic pressure in two cross sections with 63% misconception percentage, most student students assume that hydrostatic pressure is inversely proportional to the area of the vessel cross section. The problem with the concept of determining hydrostatic pressure on the vessel corresponds to the same depth as the 54% misconception percentage because students assume that the greatest hydrostatic pressure is that it has a smaller tubular cross-sectional area. Problem with the concept of determining hydrostatic pressure experienced objects that have the same depth with the percentage of misconception by 63% where students assume that hydrostatic pressure on the vessel is not related because it has different depths. Concerning the concept of determining the hydrostatic pressure experienced by the object on an L-shaped vessel having the same depth as the misconception percentage of 38% because the student assumes that hydrostatic pressure on the vessel is unequal because it has different depths. The problem with the concept determines the space in the vessel that has the greatest pressure with the percentage of misconception by 42% because students assume that the greatest hydrostatic pressure is that which has the highest surface height. The problem with the concept of determining hydrostatic pressure on the vessel corresponds to the same depth, with a misconception percentage of 63% because students assume the greatest hydrostatic pressure is that it has a small cross-sectional area. Problem with the concept of determining the state of the object in a container that has a larger size with the percentage of misconception by 46% because students assume floating objects when the water in the container contain more capacity. Problem with the concept of
determining the state of objects that have the same type of mass with different volumes when immersed into the water with the percentage misconception of 79% because students believe the greater/weight of the object then the object will drown. Problem with the concept of determining the state of the object in the fluid if the object has the same type of mass with a different volume with the percentage of misconception by 63% because students assume the greater the object then the object will sink and the smaller the object will float. The problem with the concept determines the magnitude of the fluid pressure in the enclosed space if the cross-sectional area is different from the 50% misconception percentage due to the belief that Pressure will increase when the size of one of the suckers is reduced.

Concerning the concept of determining the state of objects immersed in liquids of different kinds of mass with the percentage of misconceptions of 92%, most students assume that a more viscous liquid will make a floating object. Problem with the concept of determining the state of objects that have the same type of mass with a smaller size with a misconception percentage of 38% because students assume that The smaller the object the object will float. Problem with the concept of determining the state of the object if the size of the object is made thinner with 79% misconception percentage where students assume that thin flat object will float. Problem with the concept of determining the state of the object if the size of the object is made thinner with 71% misconception percentage because students assume that The bigger/weight of the object will drown. The problem with the concept determines the amount of fluid pressure in pipe 2 when its cross-sectional area is reduced by the percentage of misconception by 92% because students assume that Pressure will increase when the size of one of the suction is reduced. Problem with the concept of determining the state of the object in the fluid effect of changes in the volume of objects with misconception percentage of 79% because students assume the greater the object then the object will sink. The problem with the concept of determining the necessary time interpretation and the cause of the occurrence with misconception percentage of 83% because students assume The pressure of the liquid at the bottom and on the surface is the same. The problem with the concept of determining the state of a liquid having a different type of mass when the tap on the bottom is opened with a misconception percentage of 88% because students believe that liquid with the greatest density will be easier to flow. Concerning the concept of determining the hydrostatic pressure at the bottom and the surface of the vessel with the percentage of misconception is 75% because students assume the pressure of the liquid at the base of the surface is different. Concerning the concept of understanding the working principle of Pascal’s law with a misconception percentage of 71% because it believes that a small cross section will provide a small lift style as well.

Problem with the concept of determining the space in the vessel that has the greatest pressure with the percentage of misconception by 29% because students assume that the greatest hydrostatic pressure is that has the highest surface height. The problem with the concept of understanding the principle of hydrostatic pressure in daily life with the percentage of misconceptions of 17% and is a matter with the category of the smallest misconception of the other problem causes the misconception of thinking that the dike is made flat. Concerning the concept of determining the volume of ice cubes dipped into water with the percentage of misconception by 63% because students The volume of ice dipped in water will increase.

The above data exposures are the problems faced by students resulting in misconceptions, after further analysis (seen in table 4) it turns out that female students experienced the greatest misconception of 42.2% and male students who experienced misconceptions of 22.5%. It is well known that the male right hemisphere has numerical and logical ability over the female right hemisphere. While the left hemisphere of girls have advantages in the field of aesthetics and religious than the left hemisphere boys. It is a basic capital for boys to develop skills in reasoning a concept.

Male students in thinking using concepts, have logical, rational and intellectual thinking patterns, are able to see the existence of interconnected information correctly, able to perform analysis by method, and draw a conclusion to provide answers to problems based on facts, concepts and tori which supports so that it is thought to be more effective if the learning of mathematics is taught by using indirect learning strategies. While female students have regular and specific patterns of thinking, like to solve problems
gradually and provide complete procedures given by others to find new concepts in learning so it is also suspected to be effective if the learning of mathematics is taught by indirect learning strategies.

The discussion in the above paragraph shows that static fluid material is a marriage that allows many students to have their own conception and the conception is not a scientific conception, thus causing one of the causes of misconceptions is the student's daily experience. The second factor that causes misconception can come from teachers who teach physics. Teacher mistakes usually occur in two ways, namely the mastery of the concept and the application of appropriate learning methods. Mastery of the concept of bias is caused by low interest of teachers who only rely on the source of simple reading, or teacher education background is not from physics education. Third factor comes from the book used by students. For it is very important that textbooks are made correctly so can conceptually also true The fourth factor is the method of teaching and media that is not appropriate to the situation, conditions, materials taught and direction is very possible to create a misconception in students. So teachers need to be enthusiastic in choosing and using teaching methods so that physics is perceived with enthusiasm and true also by the students and various other factors.

4. Conclusion
Based on the result of identification study of student misconception on static fluid material, it can be concluded that there are still many students who have misconception with 70.8% average on Pascal’s law legal topic, 67.6% on Archimedes’ law topic and 55.7% on topic of hydrostatic pressure and While for female misconception equal to 42.2% and male equal to 22.5%. Students are still urgently needed to turn misconceptions into actual concepts. It is therefore necessary to have appropriate activities to assist students in remediating misconceptions on static fluid materials.

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