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Identification of Student Misconception about Dynamic Fluid

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Abstract

The purpose of this study was to determine how students possessed conceptions on the topic of dynamic fluid. The type of research conducted is a survey with a sample of 30 people held in one of the public schools in Bandung. The instrument used is a three-tier test with six numbers where each question consists of three questions. Data analysis showed that 65.32% of students had misconceptions, 13.06% of students did not understand, 6.76% were lucky/less confident and 14.86% had scientific knowledge about dynamic fluid concepts. Meanwhile, in terms of gender, female students experienced more misconceptions than male students.

Keywords: Misconception, three tier test, gender

Introduction

Misconceptions that occur in students are one of the problems that often occur in learning. Misconceptions that occur in students can be caused because students already have an understanding of the phenomena they see in everyday life. This is certainly a problem in learning physics, so some researchers try to see portraits of students' conceptions. Various types of understanding formed by students are referred to by several terms, such as "alternative conceptions", "misconceptions", "naive beliefs", "conceptual difficulties", "mental models" and many other terms (Gurel, Eryilmaz & McDermott, 2015; Sutarno, Putri, Risdianto, Satriawan and Malik, 2021; Satriawan, Rosmiati, Widia, Sarnita, Suswati, Subhan and Fatimah, 2020). Lack of understanding through concepts can be improved by instruction and further learning, while misconceptions are believed to be able to inhibit the acceptance and development of students' knowledge and abilities (Hasan, Bagayoko, & Kelley, 1999) [4]. Misconceptions must be overcome because they can have a negative effect in further learning (Djanette & Fouad, 2014; Lucariello, Tine & Ganley, 2014; Sholihat, Samsudin & Nugraha, 2017). Based on previous research, it is certainly very important to identify students' misconceptions so that they can be remedied in an appropriate way.

The conceptions possessed by students are sometimes different from the conceptions of physicists. The concept of physicists in general has a more complex explanation and involves many relationships with other concepts. If the student's conception is different from the physicist's, the student is said to have a misconception. Misconceptions can be in the form of initial concepts, errors, incorrect relationships between concepts, intuitive ideas or naive views. The misconception is a situation where students misinterpret a concept (Novak & Gowin, 1984). Misconceptions as a person's ability to define a wrong concept, application of incorrect concepts and inappropriate ways of classifying and even connecting wrong concepts (Foley, Meaghan, John & Roy, 2015). Misconceptions also have characteristics, namely: (1) misconceptions in students are difficult to remove, and if they are not remedied, they will affect students' conceptions of the next material; (2) misconceptions can be eliminated by applying learning that makes students experience cognitive conflicts; (3) misconceptions can affect students' mindsets in working on questions, on easy questions students tend to be able to solve them but if students are difficult, misconceptions will reappear.

One of the concepts in physics that are often encountered in everyday life is fluid. Previous research results said that there were still many students who had misconceptions about static fluids (Saputra, Setiawan, Dadi & Muslim, 2019). Static fluid is related to dynamic fluid so there may be misconceptions about dynamic fluid material.

Seeing the importance of the conceptions possessed by students, it is necessary to identify the conceptions they have. Misunderstandings can be identified in several methods such as using a diagnostic test the instrument used to identify students' misconceptions is a Three-tier instrument (Zukhruf, Khaldun & Ilyas, 2016; Rosmiati, Liliasari, Boyong and Taufik, 2020; Saehana, Werdhiana, Safitri, Saputra and Safira, 2021; Saputra, Setiawan, Rusdiana, Muslim and Izzuddin, 2021). The three-tier test is considered to have an advantage in distinguishing students with lower understanding and students who face misunderstood errors or misunderstandings.

This study intends to identify students' misconceptions about fluid dynamics and see how gender influences misconceptions in class XI science which includes the concepts of discharge, continuity and Bernoulli's principle.

Materials and Methods

The method used in this research is a survey conducted in one of the senior high schools in Bandung. The population is all students of class XI, totaling 300 students which are divided into eight classes and each class consists of 37 to 38 students. The sample in this study were students of class XI MIA 1, totalling 30 students who were selected using a purposive sampling technique, namely determining the sample with certain considerations. To determine the sample, that is based on the teacher's recommendation on the grounds that the class teacher who knows better the conditions of the class is good to serve as a research class.

Table 1. Distribution of three tier test on dynamic fluid topic

Subject matter	Number of questions
Discharge and continuity	1, 2, 3, 4
Bernoulli’s principle	5, 6

Table 2. Rubric three tier test

First tier	Second tier	Third tier	Categorization
Correct	Correct	Certain	Scientific knowledge
Correct	Incorrect	Certain	misconception
Incorrect	Correct	Certain	misconception
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

The method of data collection was carried out using a misconception test instrument in the form of a three-tier test with six numbers. The misconception test instrument is used to measure students' misconceptions on dynamic fluid material. The distribution of the questions used in this study can be seen in Table 2.

Data analysis of test results was carried out to find out how students conceptualize static fluid material by referring to research (Kiray, Aktan, Kaynar, Kilinc & Gorkemli, 2015) with an assessment rubric as illustrated in the table below.

Results and Discussion

Figure 1 shows that the results data in measuring oil viscosity. Please put the results of your research in the form of narration completed with figure or picture when it is needed. Add discussion to your research results accomplished with referring to adequate relevant source.

Analysis of answers from 37 high school students to 6 three-tier questions to see how students' conceptions can be seen in the table below:

Table 3. Percentage of students' conception categories

Subject matter	Categorization			
	Scientific knowledge	**Lucky guess, lack of confidence**	**Lack of knowledge**	**Misconception**
Discharge and continuity	15,54	6,76	11,49	66,22
Bernoulli's principle	13,51	6,76	16,22	63,51

Based on the table above, students' misconceptions on the topic of fluid dynamics are more than half of the sample. Based on the table, it can also be said that the students' ability to understand concepts is still low. Table 3 also shows that students' misconceptions on the topic of discharge and continuity are more than Bernoulli's principle.

If the data is processed by gender, it can be seen that female students experience more misconceptions with a percentage of 40.60% and male students by 24.72%. More clearly related to data analysis by gender can be seen in Table 4.

Table 4. Percentage of students' conceptions seen from gender

Gender	Categorization			
	Scientific knowledge	**Lucky guess, lack of confidence**	**Lack of knowledge**	**Misconception**
Female	9,24	4,20	8,12	40,60
Male	5,62	2,56	4,94	24,72

Misconceptions can happen to anyone and at any level. In Figure 1, it can be seen that more than half of the research sample had misconceptions or 60% to be precise. Both educators and students can also experience misconceptions. Based on the data analysis, students' conceptions were obtained as shown below:

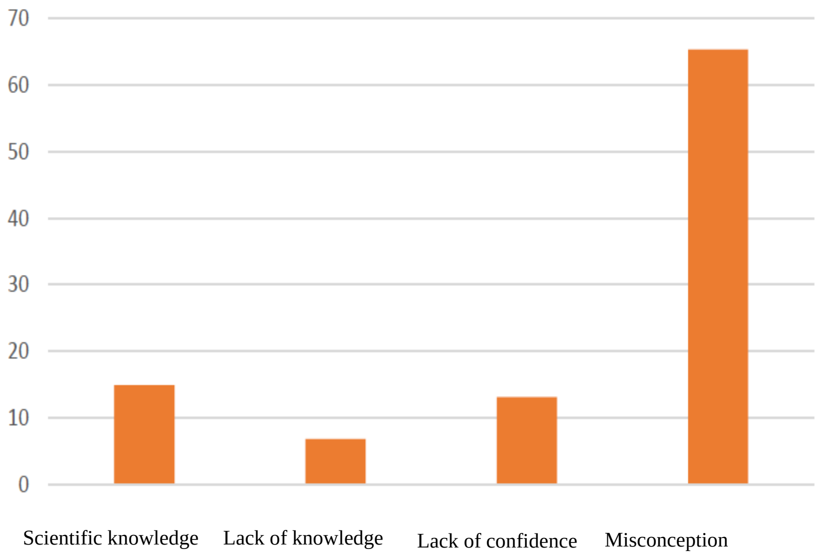

Figure 1. Presentation of students' conceptions

Question number one with an indicator of the question of analyzing the variables that affect fluid flow. Most students are wrong in determining the answers given and choose confident in answering the questions given, causing students to fall into the category of misconceptions. Students find it difficult to understand problems in the form of stories and are accustomed to using problems with calculations. This makes it difficult for students to analyze the variables that affect fluid discharge, causing students to have misconceptions as shown in the picture below.

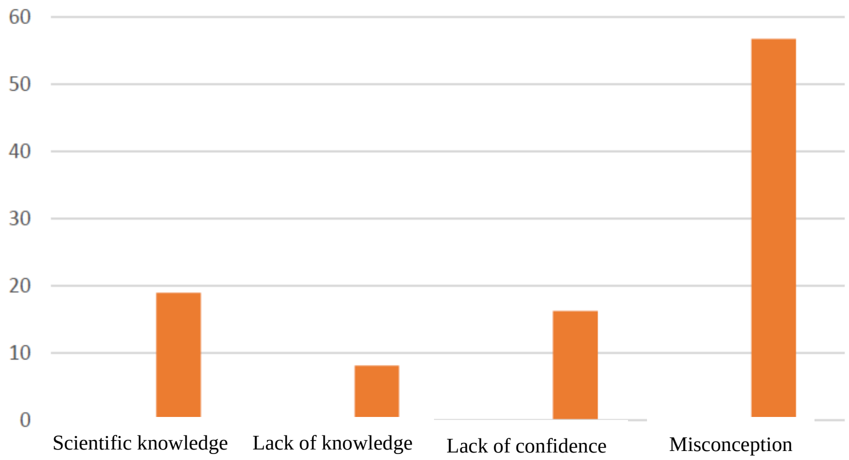

Figure 2. The percentage of students' conceptions of question number one

Question number two with a question indicator compares the flow rate of water at different cross-sectional areas. More than half of the class had misconceptions. This misconception is caused because students assume that in a pipe that has a large size, the pressure on the pipe will be large and vice versa, in a smaller pipe, the pressure will also be small.

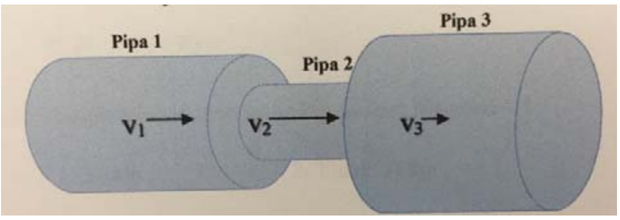

Figure 3. Three pipes with different cross-sectional areas

The answer is the wrong answer or can be called a misconception. The correct concept is that in pipes that have a larger size, the flow will flow more smoothly so that the pressure on the large pipes will be smaller. On the other hand, in a smaller pipe, the flow will be slower so that the pressure in the small pipe is large. Based on this, it can be concluded that in large pipes the pressure is small and in small pipes the pressure is large. The number of misconceptions in question number 2 can be seen in Figure 4.

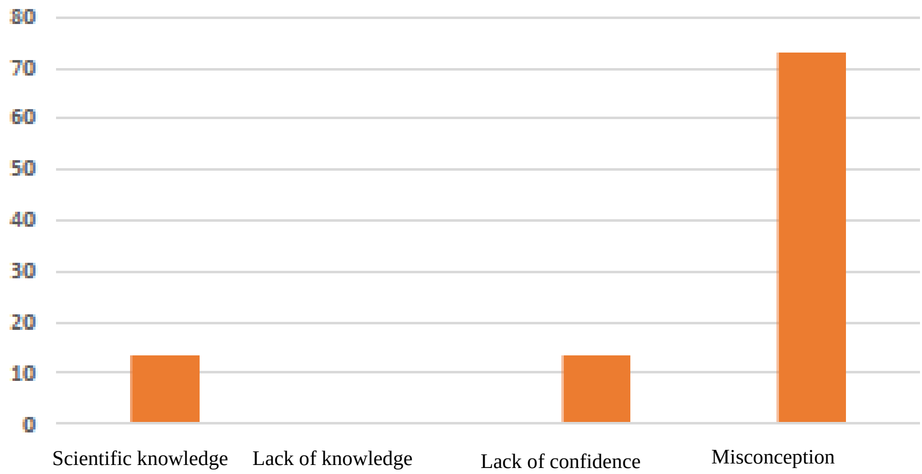

Figure 4. The percentage of students' conceptions of question number two

Question number three with a question indicator analyzes the flow rate of water at different cross-sectional areas. Some students are in the category of misconceptions because they think that in a large pipe the pressure will be large and in a small pipe the pressure will be small. If you pay attention to the causes of students experiencing misconceptions in question number three, the causes of misconceptions in question number two are the same.

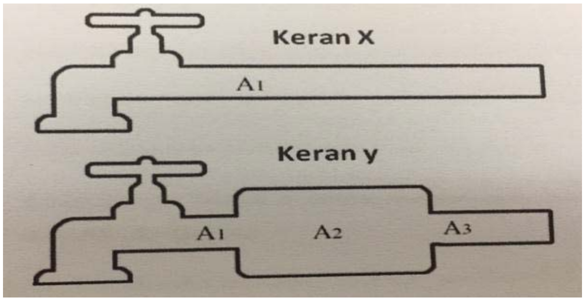

Figure 5. Pipe faucet installation

If you look at the picture, the size of the pipe $A_1 = A_3$ so that the flow rate in both pipes will be the same and the pressure will be the same. However, pipe A_2 is larger than pipe A_1 and A_3 so that the fluid flow velocity will be different and the pressure will also be different. The real theory is that if the cross section is large, the fluid flow rate will be small so that the pressure will be large, while a pipe that has a small cross-sectional area will have a large fluid flow so that it has a small pressure. Conceptions owned by students are different from the actual concepts, causing students to fall into the category of misconceptions. The percentage of conceptions owned by students can be seen in Figure 6.

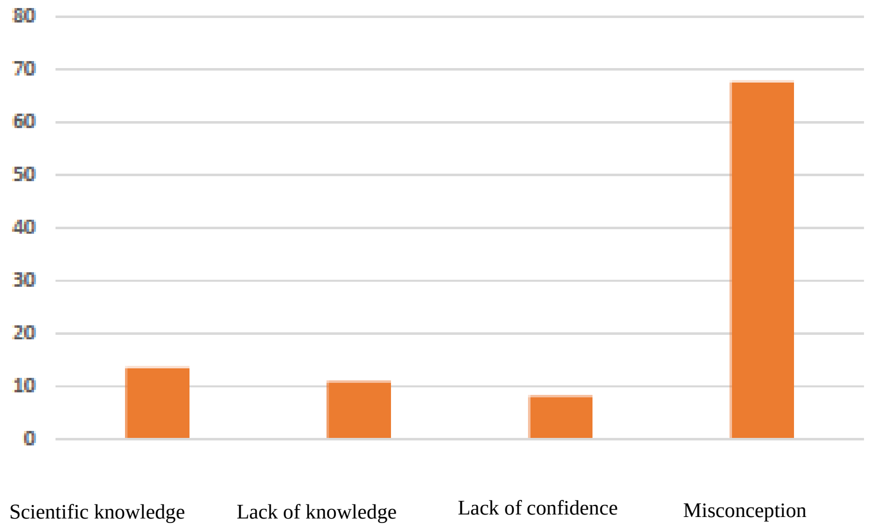

Figure 6. The percentage of students' conceptions of question number three

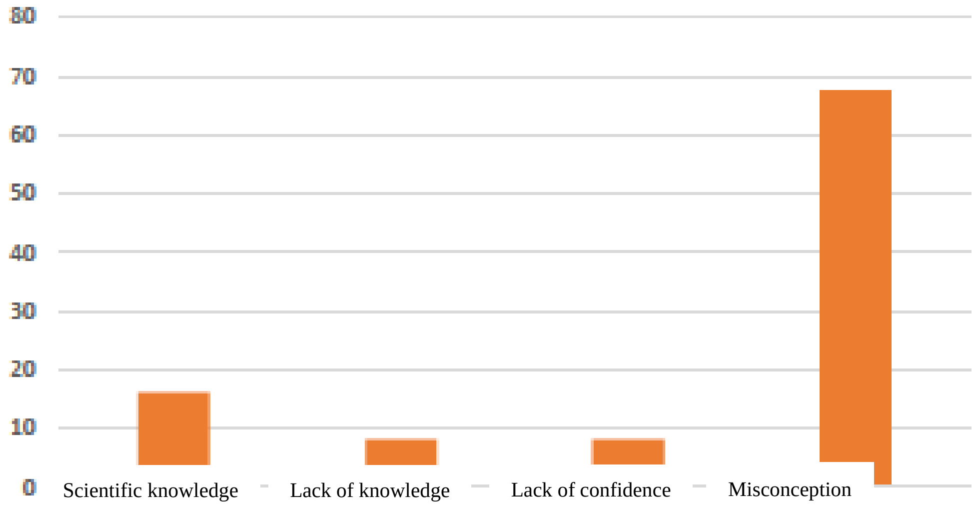

Figure 7. The percentage of students' conceptions of question number four

Problem number four with indicators determines one of the water flow rates on different surface areas. In question number four, there are still many students in the category of misconceptions.

The causes of students experiencing misconceptions in question number four are the same as the causes that occur in question number one where students have difficulty solving problems in conceptual form and are accustomed to calculations. Students assume that the product of the fluid flow rate and its cross-sectional area is always different in a horizontal pipe. This is contrary to the continuity equation which states that the product of the fluid flow rate and its cross-sectional area always remains in a horizontal pipe. This causes students to experience misconceptions. The size of the conception possessed by students can be seen in Figure 7.

Problem number five with a question indicator compares the maximum range of fluid that comes out of an open and closed vessel given a hole. In question number five, many students are still in the category of misconceptions because they think that the transmission distance of two vessels will be the same. If you notice that one vessel has a hole at the top of the water, the fluid range will definitely be different.

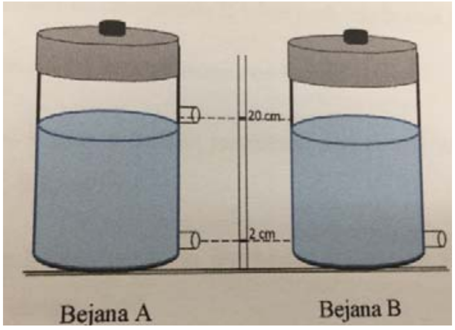

Figure 8. Two vessels filled with water

If you look at Figure 8, the top of the water has a hole so that it will cause a pressure difference so that it gives a different push to the water. Students tend to ignore this. Whereas air pressure will increase the pressure felt by the water so that it will cause the reach of vessel A to be further than vessel B. This causes students to experience wrong conceptions as shown in Figure 9.

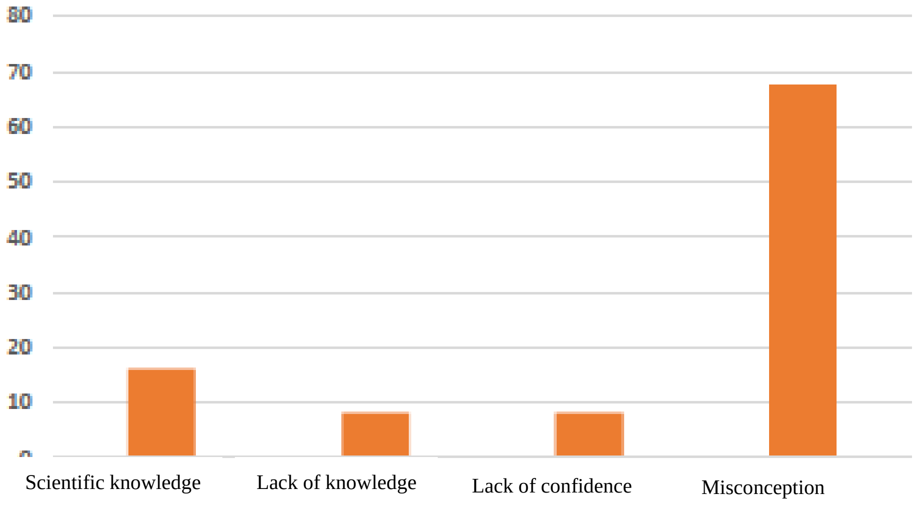

Figure 9. The percentage of students' conceptions of question number five

Problem number six with indicators inferring the lift of an airplane wing based on Bernoulli's principle. There are still many conceptions owned by students in the category of misconceptions. Students assume that the velocity of fluid flow at the bottom of the plane will be large so the pressure will be small. If you look at Figure 10, it can be seen that if there are no obstructions at the bottom of the airplane's wings, the velocity at the bottom of the airplane will be small and the pressure will be high.

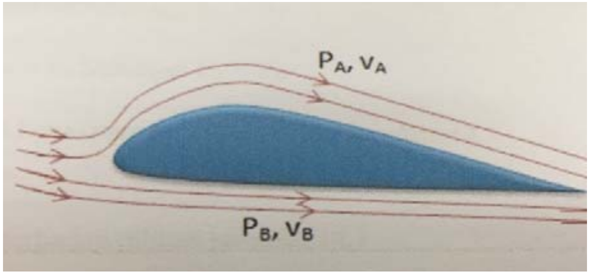

Figure 10. Fluid flow on an airplane wing

The air flowing will be blocked by the aircraft wing so that the air will flow up the aircraft wing and under the aircraft wing. The top of the aircraft wing has a shape that is not flat and will block the flow of air so that the air flow rate will be large and have a small pressure. The underside of the airplane wing has a flat shape so that the air velocity is lower than the top but has greater pressure. Because there are differences in the conceptions possessed by students and the actual conceptions so that most students are in the category of misconceptions as shown in Figure 11.

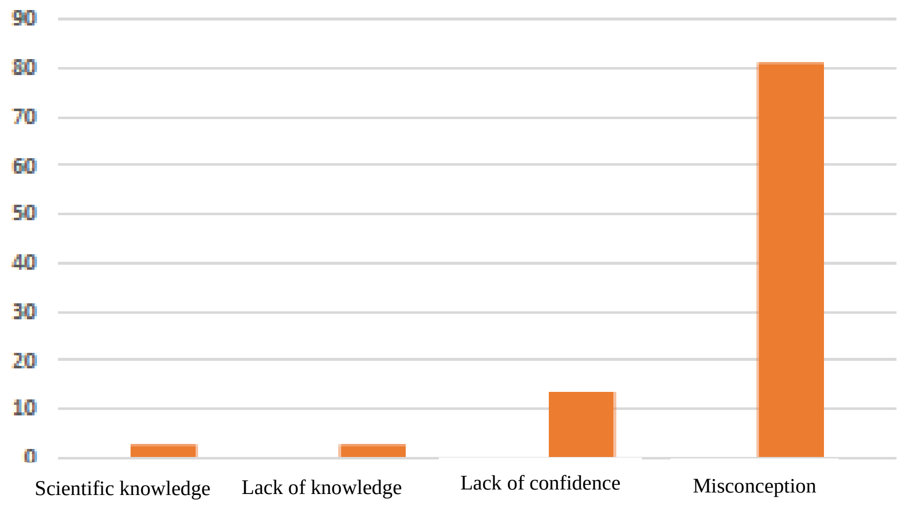

Figure 11. The percentage of students' conceptions of question number six

Table 4 shows the results of the analysis of students' misconceptions by gender. Female students experienced the greatest misconceptions, namely 40.6% and 24.72% for male students. The cause female students experience more misconceptions than male students is because male brain abilities are better at numerical and logical abilities, while female students tend to have aesthetic and religious abilities. Based on the ability of the brain causes male students to be better able to reason about the phenomena they see so they experience fewer misconceptions. The research conducted to answer this question in the results of his research said that women have extraordinary abilities when compared to men, where women have good verbal dexterity, the ability to use good feelings and thoughts and greater abilities conscientious than men (Saputra, Setiawan, Rusdiana & Muslim, 2020; Lilia, Tan & Tamby, 2015).

Conclusion

Based on the results of the analysis to see the percentage of the number of students who experience misconceptions on the topic of static fluid, the average results are 65.32% of students experience misconceptions, 13.06% of students do not understand, 6.76% of students are lucky/lack confidence and 14.86% have scientific knowledge of dynamic fluid concepts. Meanwhile, in terms of gender, female students experienced more misconceptions than male students.

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