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ANALYSIS OF STUDENT'S MISCONCEPTIONS ON DYNAMIC FLUID CONCEPTS USING THE FOUR-TIER DIAGNOSTIC TEST METHOD

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ABSTRACT

The learning process is carried out fully in the network during the Covid-19 outbreak so that the use of learning media becomes one of the determinants of students' success in learning. Lack of application of learning media while online causes misconceptions in students. Based on previous research, 28% of students experienced misconceptions in dynamic fluid material with sub-matter continuity. The study was conducted to identify student misconceptions on dynamic fluid material using the four-tier diagnostic test method. The four-tier diagnostic test instrument used in this study was 5 questions tested to 17 grade XI students at one of the high schools in Tanah Datar. The stages of research were carried out as follows: 1) making diagnostic test instruments form four-tier diagnostic tests, 2) data collection, 4) data processing and analysis, 5) conclusion making. Based on data analysis and results of identification of student conception category on dynamic fluid material, 31% of students were in the concept-savvy category, 9% of students were in partial concepts category, 25% of students were in the conceptless category, and 39% of students were in the concept of misconceptions.

Keywords: Misconceptions, Four-Tier Diagnostic Test, Dynamic Fluid

INTRODUCTION

Improving the quality of education in line with the advancement of science and technology (Fanny Rahmatina Rahim, 2020). The advancement of science and technology makes it very easy for users to develop education. In digital and information technology, education can be well packaged following the development of the industrial revolution era 4.0 (Divayana, 2016 and Sugiharni, 2018).

The challenge that often arises lately is the application of technology in learning has not been maximized. In contrast, another challenge is an outbreak of disease, namely the spread of the Covid-19 outbreak. Based

on information from Kompas, Covid-19 has been present since the beginning of March 2020, which still stops education directly in schools (Lalani, 2020). In this condition, learning is conducted online following the circular of the Ministry of Education and Culture of the Republic of Indonesia Directorate of Higher Education Number 1. The learning process is carried out fully in the network so that the use of learning media becomes one of the determinants of students' success in learning.

Media and learning resources can take the form of books, props, maps, images, posters, radio, television, slides, LCD projectors, movies, computers, the internet, libraries, social environments, and humans themselves (Wulandari, 2016). Based on the policy of the Ministry of Education, some applications that can be accessed in the framework of online learning include home learning, our desk, Icando, Indonesiax, google for education, smart classrooms, Microsoft office 365, quipper school, teacher's room, school, zenius, and Cisco Webex. The application is used to support the teaching and learning process that can be accessed using a smartphone.

The application of physics learning media during the learning process greatly affects students' learning outcomes. In fact, most students say that physics is one of the difficult subjects ((Baran, 2016) (Walberg, 1972) and less interesting ((Tsai, 2016). Thus, teachers must apply media that can reduce students' perception of it. One of the media that teachers can use is a virtual lab (https://phet.colorado.edu/). Virtual labs can improve students' skills in conducting experiments independently as stated in the 2013 curriculum that prioritizes student-centered learning.

Lack of the application of deep learning media online causes misconceptions in students. The misconception is a mistake that students understand is contrary to concepts, principles, and theories created by scientists ((Kuczmann, 2017) (Eryilmaz, 2002). The error arises due to several sources, such as mistakes in conducting experiments and understanding students before studying physics. Misconceptions result in the concept of physics decreasing if not improved (Alfian, 2015 &Saehana, 2020). Based on research (Fitri Nurul Sholihat, 2017) there are 28% of students experiencing misconceptions in dynamic fluid material with the sub-matter principle of continuity.

The study was conducted to identify student misconceptions on dynamic fluid material using the four-tier diagnostic test method. One solution to know the misconceptions of students is by diagnostic tests. Diagnostic tests are precise and quick tests to determine the weaknesses and strengths of students in a particular lesson (Zaleha, 2017). That way, teachers can give a re-explanation of the dynamic fluid concept that has not been mastered by students.

METHOD

The research was conducted using one shoot research method (Sugiyono, 2014). Four-tier diagnostic test instruments used in this study as many as 5 points of questions tested to 17 grade XI students in one of the high schools in Tanah Datar. The stages of research were conducted as follows: 1) making diagnostic test instruments from four-tier diagnostic tests, 2) data collection, 4) data processing and analysis, 5) conclusion making.

The advantages of using a four-level diagnostic test are (1) distinguishing the level of answer confidence and the level of confidence of the reason the student chooses so that they can dig deeper into the strength of understanding the student's concept, (2) diagnosing the misconceptions experienced by the student more deeply, (3) determining the parts of the material that are putting more emphasis on, (4) planning better learning to help reduce student misconceptions (N Amin, 2016).

Table 1. Student conception category based on answers to four-tier diagnostic tests

Categories	Option	Level convidence	Reason	Level of Convidence
Misconception (M)	F	S	F	S
Don't Understand the concept (DU)	F	NS	F	NS
	F	NS	F	S
	F	NS	F	NS
Understanding the concept (U)	T	S	T	S
	T	S	T	NS
	T	NS	T	S
	T	NS	T	NS
	T	S	F	S
	T	S	F	NS
Partial understandings (PU)	T	NS	F	S
	T	NS	F	NS
	F	S	T	S
	F	S	T	NS
	F	NS	T	S
	F	NS	T	NS
Cannot Be Encoded (CE)	If one, two, not or all of them are not filled in.			

(N Amin, 2016)

RESULT AND DISCUSSION

Based on the data processing conducted, students experienced misconceptions in dynamic fluid material and found weaknesses in concepts that caused misconceptions in students. Misconceptions are identified by analyzing the confidence level of students' answers in answering the four-tier diagnostic test instrument in the second and fourth tiers. Furthermore, the cause of misconceptions is seen from the student's choice in answering the reason in the third tier. Here is an example snippet of the four-tier diagnostic test used to determine the misconceptions that occur in students and identify the cause of the misconception. In the third tier, there is a column E which is a blank field that students can answer if the student has the correct answer that they believe.
Look at the figure 1!

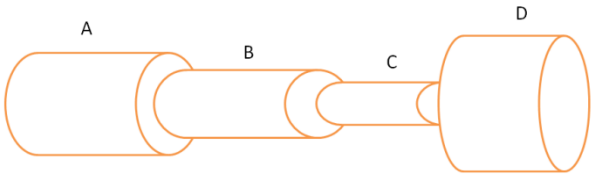

Figure 1. Footage of the four-tier diagnostic test instrument

Based on the picture above. Thus the correct statement regarding fluid cheese v in each fluid is

A	$v_B < v_A < v_D$
B	$v_A < v_B < v_C$
C	$v_A = v_B < v_C$
D	$v_D > v_A > v_B > v_C$
E	$v_D > v_C > v_A > v_B$

Confidence in answer options

1. Be sure

2. Not sure

Reasons for the choice of answers

A. The relationship between the cross-sectional area of the pipe and the speed of the fluid is directly proportional. The wider the cross-section of the pipe, the greater the speed of fluid flowing in the pipe.
B. The relationship between the cross-sectional area of the pipe and the speed of the fluid is inversely proportional. Thus, the wider the cross-section of the pipe, the smaller the speed of fluid flowing in the pipe.
C. The cross-sectional area of the fluid does not affect the speed of the fluid itself.
D. The continuity equation states the discharge of fluid entering the pipe is the same as the fluid discharge flowing out of the pipe.
E. .....
.....
.....
.....
.....

Confidence in reason
1. Be sure
2. Not sure

From the data processing on all answers given, students obtained a percentage of student conception catechism on dynamic fluid material shown in table 2.

Table 2. Percentage of student conception category on dynamic fluid material

Problems	Categories			
	M	**DU**	**U**	**PU**
1	12%	18%	53%	18%
2	65%	18%	9%	12%
3	29%	18%	53%	0%
4	47%	35%	18%	0%
5	41%	35%	24%	0%
Total	39%	25%	31%	9%

Note : M (Misconception), DU (Don't Understanding the concept), U (Understanding the concept) and PU (Partial Understanding the concept)

Based on table 2, you can see the percentage of student conception that occurs in a dynamic fluid material, namely concept understanding, partial understanding, misconceptions, and not understanding concepts and can not be coded.

From the data above, it can be seen that, in question no.1, as many as 58% or nine students are in the category of concept understanding, 18% of students or three students are in the category of partial concept understanding, 18% of students or three students are also in the category of not understanding concepts, and 12% of students or two students are in the category of misconceptions.

Furthermore, in question no. 2, as many as 9% or one student experienced concept understanding, 12% of students or two people experienced partial concept understanding, 18% or three students experienced not understanding the concept, and 65% or 11 students experienced misconceptions.

Next, analyze question no.3. A total of 53% or nine students experienced concept understanding, 0% or 0 students experienced partial concept understanding, 18% or three students experienced not understanding the concept, and 29% or five students experienced misconceptions.

Next, analyze question no.4. As many as 18% or three students experienced concept understanding, 0% or 0 students

experienced partial concept understanding, 35% or six students experienced not understanding the concept, and 47% or eight students experienced misconceptions.

Next, analyze question no.5. A total of 24% or four students experienced concept understanding, 0% or 0 students experienced partial concept understanding, 35% or six students experienced not understanding the concept, and 41% or seven students experienced misconceptions.

Based on the description above, overall, 31% of students are in the concept-understanding category, 9% of students are in the partial concepts category, 25% of students are in the concept-savvy category, and 39% have misconceptions.

Students experience misconceptions because they think that a large cross-section of pipe will result in a large fluid flow speed and vice versa. Such assumptions are due to the instigating of the concept and logic of students who are not precise in analyzing the movement of fluids in pipes that have different cross-sectional areas. The correct concept can be found and analyzed from the continuity equation as follows.

$$A_1 v_1 = A_2 v_2 \quad (1)$$

The equation above is an equation known as a continuity equation. Based on the equation above, at a small cross-sectional area, the fluid flow speed will be greater than that of pipes that have a large cross-sectional area will have a small fluid flow speed.

Misconceptions are misconceptions that students understand from pre-defined concepts. Some of the misconceptions from various relevant studies, namely: a) misconceptions can occur due to cultural, religious, and language differences, b) in students' minds there are already misconceptions before learning begins and it is difficult to change them, c) when explaining natural phenomena various misconceptions can occur, d) after learning takes place misconceptions can also occur (Setiawati, 2014). The occurrence of misconceptions in students is caused by the student's error in perceiving the concept given by the teacher, the error between the impression and memory that is already in the student's mind during the memory, not checking the truth of the information obtained or very confident with the results of one of the observations and conceptual thinking (Suryanto, 2002).

Misconceptions that occur in students should be immediately reduced. Students do not have difficulty connecting concepts in the next physics subject, and the understanding that the wrong students have does not get carried away to the next level. Therefore, teachers should be able to reduce misconceptions in students by implementing the right learning strategies. Process Oriented Guided Inquiry Learning strategy can make students more active and responsible with problems posed by teachers (Erna, 2021). The activeness of students during learning will improve learning outcomes and eliminate concept errors in learning. Improved learning outcomes mean students reduce the misconceptions they have experienced (Anjali, 2020).

CONCLUSION

Based on data analysis and results of identification of student conception category on dynamic fluid material, 31% of students were in the concept-savvy category, 9% of students were in partial concepts category, 25% of students were in the conceptless category, and 39% of students were in the concept of misconceptions.

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