The Students Conception About Kinematics
Displacement and Distance Concept

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Abstract: This research aims to reveal the student's conception of the displacement and distance in physics learning. Student conceptions explained. The students' conceptions derived from test results and interviews. This research is descriptive qualitative research, by profiling and grouping student answers. The population of this research is physics education student in PGRI Madiun University academic year 2017/2018. The sampling technique used purposive sampling (12 Students). Negative case analysis techniques were used in this research to reveal the cause of misconception and incorrect conception. It found that 75% of students assumed that the displacement is equal to the distance. Incorrect conceptions arise because (1) little understanding of scalar and vector concepts, (2) Students only focus on solving math problems (3) Students do not know the magnitude of displacement. Understanding vector and scalar concepts need to emphasize. Presenting simultaneous problem of displacement and distance can reveal the student's conception more deeply.

1 INTRODUCTION

The research on the conception of kinematics and dynamics is the topic which studied by physics education researchers. The results of the research by (Aguirre and Rankin, 1989) revealed that 52% of students retained the conception of their intuition about the trajectory of objects in the inclined air-table. The limitation of visual perception can make it difficult for students to understand the concept of kinematics and dynamics (Lemmer, 2013). Further (Lemmer, 2013) reveals that students have difficulty in providing constant speed and acceleration, thus impacting misunderstanding of Newton's law. Visual Presentation is one form of concept representation. Cari et al (2016) revealed that concepts could present in visual, text, mathematical symbols and graphs.

The concept of kinematics and dynamics can be presented in graphical form in its presentation. Research on student difficulties in understanding the concept of the graph and its prevention has also been investigated by (Ploetzner et al., 2009). Students need to learn to relate the information presented in a dynamic and interactive visualization to other sources of information in the form of text.

The student's conception of the physics concept has been revealed in previous research, the student's conception of Newton's law (Handhika et al. 2016; Handhika, et al. 2017; Cari et al. 2016; Handhika et al. 2017; Handhika et al. 2015), speed and velocity (Handhika et al., 2015; Handhika et al., 2015), temperature and heat (Carlton, 2000), and other physic concepts. Student's conception of the physics concept becomes important to be revealed because it becomes the basis for the lecturer to give the treatment of learning process become effective (Handhika et al. 2016). The results (Handhika et al. 2016; Handhika et al. 2017; Cari et al. 2016; Handhika et al. 2017; Handhika et al. 2015), speed and velocity (Handhika et al., 2015; Handhika et al., 2015) provide information that the conceptions held by some students are inconsistent with physicists conceptions. The term more commonly known as the misconception.

In physics, such conditions can arise in students and lecturers. Intuition, understanding of mathematics language, text language, physics language, and communication language become some of the factors causing misconception (Handhika et al. 2016; Handhika et al. 2017). Not all conceptions of students have the misconception. Student conceptions can be categorized as follows

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(1) understanding the concept, (2) partial understanding the concept, (3) misconceptions, (4) not understanding concepts (Handhika et al., 2018). In this study will be profiled student's response for the concept of displacement and distance. The selection of this concept is based on the results of research that the student's mistake in solving the concept of displacement problems and distance. The initial assumption, the concept of displacement and distance ideally easy to understand by students, but when the problem is presented simultaneously, students found many problems.

Research on the concept of displacement and distance has been done by (Yildiz, 2016), but has not studied deeply about the causes of misconceptions and only emphasizes the equality of both concepts. The Research by (Antwi el al., 2011) used the graphical representation to reveal student's conceptions about displacement and distance. This research does not focus on student conceptions but focuses on the effects of the learning methods used.

The student already has both of the concepts from their community. Information stored in student memory, then represented verbally, visually, text, and others form of conception. Information held by students, some stored in the long-term memory. Consequently, it will be difficult to change the information that has entered into long-term memory.

This condition causes students misconceptions if the information held by the students does not match the with physicist's conceptions. The students experiencing misconceptions will be difficult to change their conception because they assumed their perception was a fact. To change the student's conception required information that can create cognitive conflicts. To creating cognitive conflicts, it can do by asking students questions. In this research, specifically reveal the student's conception of displacement and distance simultaneously. It is the contrast to previous research that only focuses on the influence of implementation of methods and reveals of student conceptions partially. Questions are structured and designed to reveal both concepts simultaneously that enable students to evaluate their conception. The student conceptions of both concepts described, and the causes of conception appear in this paper.

2 METHODS

This research is descriptive qualitative research, by profiling and grouping student answers. The population of this research is physics education student of academic year 2017/2018. The sampling technique used purposive sampling (12 Students). Negative case analysis techniques were used in this research to reveal the cause of misconception and incorrect conception. Negative cases are limited to the response of students who have different conceptions with physics scientist's conception. This research using two test questions that have been developed from (Handhika et al., 2018).

Unstructured interview techniques used. Before the tests given, students were asked to read the literature from various sources. The misconception is a specific case, so not all students experience misconceptions. The steps of the research are as follows: (1) provide conception test, (2) profiles students 'answers, (3) reduces students' answers to misconceptions, (4) analyses student answers, (5) conclusions. Triangulation of the student responses, interview result, and literature review are used to analyse the cause of negative case.

3 RESULT AND DISCUSSION

The conception of the student described through student response to test given by lecturer. Questions and examples of student responses (Table 1.1) describe student conceptions of the concept of displacement and distance presented in writing. The student responses of conception test as follows:

1. The ball moves from point A, to B, to C, and Back to A, following the path in figure 1.

Figure 1. The ball Path A-B-C-A.

The position of point A (0,0), position of point B (2,0) m and position of point C (2,2) m. Based on this information, the displacement and distance of the ball is ...
The students responses:

Type 1.
The students used Pythagoras formula to solve the problems. They also assumed the displacement and distance have the same meaning. The answer is $\sqrt{8}$ (5 Students).

Type 2.
The students assume that because the ball path is a triangle, the displacement and distance can solve by

calculating the slope of the sides. The answer is $\sqrt{8}$. (4 Students).

Type 3
The students argue that because the ball moves to where it started, so the displacement equal zero, dan the distance is 4 m.
(3 Students)

2. Muchsin moves from the origin (0,0) to the north for 1 unit, then moves eastward as far as 1 unit. The displacement and distance from the starting position is…

The students responses:

Type 1
The displacement is $\sqrt{2}$ unit, and the distance is 2 unit. (3 Students)

Type 2
The displacement and distance are $\sqrt{2}$ unit. (2 Students)

Type 3
The displacement and distance are 2 unit. (5 Students)

Type 4
No responses. (2 Students)

Based on the conception test, number 1, 75 % of the students assume that displacement have equal meaning with distance. From the response type 1 and 2 tests number 1, revealed that the students also assumed the displacement could calculate by using the Pythagoras formula. In response number 3 students determine the displacements with the correct answer, but incorrect in determine the distance.

Based on the conception test number 2, 58.33% students assumed that displacement have equal meaning with distance, but with difference type of responses (type 2 and 3). Three Students give response the displacement is $\sqrt{2}$ unit, and the distance is 2 unit, and two students with no responses. From responses type 2, students have conception that distance, displacement and magnitude displacement have same meaning.

To reveal more deeply the student's conception, the interview used in this research. Quote of the interview as follows:
Lecturer: L, Students: S

L : why is the displacement can resolve with the Pythagoras formula?
S : from the source that I read sir.
L : can show the book (source)?
S : this sir (showing reference source).
L : Please give short argue about the difference between distance and displacement?
S : the distance is scalar, and the displacement is the vector, the distance is calculated? by summing unit, and the displacement by Pythagoras.
L : if the ball is moving from A to B to A, calculate the displacement?
S : calculated by summed sir.
L : how the displacement?
S : 4 m.
L : how the distance is?
S : same with the displacement
L : what is the distance and what is the displacement?
S : in mathematics form, distance and the displacement is same sir.
L : can you give a little explanation?
S : the same unit sir "meters," and both the same formula.
L : can you explain the difference between displacement and distance?
S : the difference is displacement is vector and distance is scalar and only have magnitude.
L : if the result of the displacement is 4 m equal to the distance, can you explain the direction of displacement?
S : direction must be in the test or problem, sir.
L : The ball moves from point A to B to C, How can you calculate the distance?
S : The distance can calculate by summing 2m plus, 2m plus 2m become 6 m
L : how about the displacement?
S : the displacement can calculate using Pythagoras the result is $\sqrt{8}$.
L : if the ball moves A to B to C to D?
S : with the same ways sir, by Pythagoras
L : what's the difference with A to B to C?
S : Ooo. yes, correction sir, should be 2m + 2m +2 m + $\sqrt{8}$ m.
L : what about the distance?
S : same as the displacement sir.
L : means distance and displacement are same?
S : no sir, displacement is vector has direction and magnitude, and distance only have magnitude
L : why the result are same?
S : there is same in some part, and difference in another part, but maybe sir
L : before the test, are you studied?
S : yes, sir
L : What did you study?
S : the questions in the book, sir.
L : the concepts and explanations that exist in the book are studied too?
S : read and just writing the physics

Formulas, sir.
L : can you write the symbol of displacement and distance?
S : (writing symbol)
L : why the symbols of both are same?
S : is it same sir, I think.
L : how about the symbols of vector quantity for displacement?
S : O yes sir (write add vector symbol on displacement)
L : ok thanks for your confirmation.

Based on test and interview, students have assumed that displacement has equal meaning with distance. This conception arises because the students understood the concept from the book and other source (teacher and learning community) partially. They understand that the displacement is vector and distance is scalar, but they have the same meaning if implemented in case problem. Vector symbols on displacement often ignored by them, so the assumption of the displacement and distance have same meaning same is getting stronger.

Based on responses test number 2 type 4, There were 16.66% of students did not respond. Based on the results of discussions with students they are confused in response because they feel that their conception is inappropriate. They realize that the concept of displacement and distance must be different, but they cannot explain the reason. The lack knowledge of vector concepts is the main cause of this incorrect conception.

The concept of physics must be comprehensively understood. The concept of vector which is the basic knowledge of kinematics must also be mastered. Previous research presents graphic and image presentations capable of uncovering student conceptions in reading graphs and drawings (Yildiz, 2016; Antwi et al., 2011), but not being able to simultaneously create cognitive conflict in question. The emergence of cognitive conflict is characterized by the presence of 16.66% of doubtful students (not responding) in test number 2.

4 CONCLUSIONS

The concept of physics must be comprehensively comprehended by students to overcome misconception. Uncovering conception is not limited to exposing concepts in various representations, but the "meaning" of the concept must express as well. The results of this study reinforce that there are still students who equate the concept of the displacement and distance, although they know the definition of both concepts. From the results and discussion can be concluded that incorrect conception arises because (1) a little understanding about the concept of scalar and vector, (2) The student only focusses in solving mathematics problem (3) The students have not knowledge about the magnitude of displacement. Understanding the concept of vector and scalar needs to be emphasized, both from the writing of symbols (mathematics) and their use in physic.

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