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EXSTERNAL REPRESENTATION TO OVERCOME MISCONCEPTION IN PHYSICS

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ABSTRACT

The aims of the research are to determine the profile of symbols and visual representations of the students in understanding the concepts of physics and effectiveness of used external representation to overcome misconceptions. Method of this research are descriptive qualitative with purposive random sampling consist of studnets who have taken basic physics course in first semester (2013/2014) 25 students. Instrument of this research using test concept and interview. The results showed that 40% of college students suspect misconceptions on the problem of type I, 36 % type II, 48% type III and 56% type IV. External representation could be used as an alternative solution to prevent misconceptions with high total gain value (0.90).

Keywords: External Representation, Misconception, Physics

INTRODUCTION

Physics is a subject that difficult to understand by the students. In learning physics, students have to use mathematical, symbols and intuition language influence to construct student's conception. Incorrect understanding of mathematical language and intuition can cause misconceptions. Some Researcher and education scholars conducted research to investigate and overcome misconceptions. Kurnaz, M. A. & Calik M. (2008) 5E approach to reduce the use of alternative concepts students, kaya B. E & Gullu D. (2008) followed by identifying misconceptions by using a conceptual test, (Aydin G. & Balim A. G: 2010) uses the concept of change strategy to eliminate the student misconceptions. The term misconceptions expressed differently by researchers. Alternative concept, is one of the term was also used by researchers Physics (Kurnaz, M. A. & Calik M. : 2008). Misconception is consider as a student's conception different from that understood the concept of scientists / experts. Hammer d. (1996) revealed that"misconceptions to refer only to the phenomenology of patterns in students' responses that are inconsistent with expert understending".(Giuseppe M. D. & Fraser D:2012) revealed that "Ideas and Explanations That vary significantly from accepted knowladge are typically called misconceptions or alternate conceptions, and science misconceptions abound". Misconceptions different from preconceptions. Zhou G. Nocente N, & Brouwer W (2008) revealed that the "preconceptions serve as a platform from the which students interpret Reviews their world". Clement J., Brown E. D., & Zietsman A (1989) defines preconception as an "idea heald before instruction". If students preconception different with experts conceptions, the students has the potential misconceptions. Students can't answer the problem is not necessarily experiencing misconceptions, Students also have no knowledge at all about the problems that we provide. Misconceptions can occur due to various factors, including intuition (Clement J., Brown E. D., & Zietsman A: 1989), the subject abstract and difficult to understand "In some cases, students generate erroneous explanations Because some scientific ideas are abstract", misinformation from friends, teachers, and sources of teaching "another cases, students learn wrong ideas created by others, Including teachers and textbook developers" (Giuseppe M. D. & Fraser D:2012).

Representation is the disclosure of the source of information returned by the recipient. In the perspective of education, has developed the terms of representation of students and external representation. Student representation is the disclosure back to the source received by the students, exsternal representation is the representation given by the lecturers to the students to help students reflect back the information obtained. Cox R. J & Jones W. B. (2012). Tsui Y. C. & Treagust F. D. (2003). External repesentation is a presentation of information from the lecturer to the students (**Figure 1**).

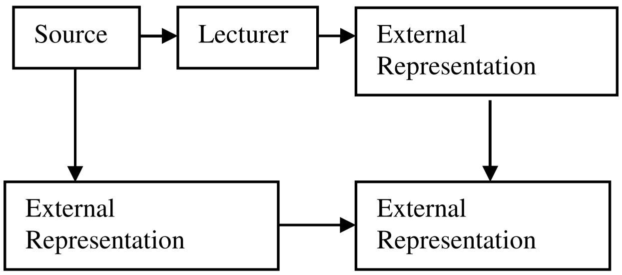


Figure 1. External Representation and Students Reprsentation

In the kinematics and dynamics lessons, students have difficulty in represent visual and symbols information. Representation difference between the two can bring cognitive conflict for students. (Lee et al, 2003) in Lee G. & Yi J. (2013) clarify the definition of cognitive conflict, cognitive conflict is the basis of a wrong perception that gives the difference between a person's cognitive structure and the environment (external information) or between components of a person's cognitive structures (ie conception of man, belief, substructures, etc., which is part of the cognitive structure). If the cognitive conflict experienced by students are not treated properly, it will potentially bring up misconceptions.

In this research, will be profiled four examples of symbols and mathematical representation in the process of learning the basic physics (kinematics and dynamics), which can cause cognitive conflict within the student. With good treatment of cognitive conflicts, problems arise can reduce and improve understanding of the students conception. The information from this research are expected to be used as a reference for lecturers / teachers to modify the learning process, by promoting the provision of cognitive conflict through the strengthening of external representation.

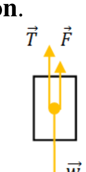
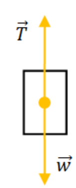
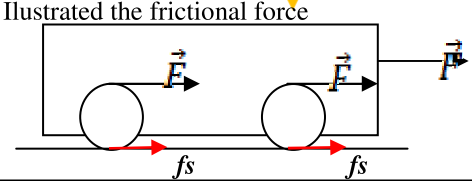
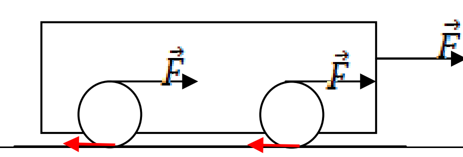
METHODS

This research was conducted in IKIP PGRI MADIUN Samples in this research are students of first semester who take a course of basic physics (25 Students). Method of This research are descriptive qualitative. Method of data collection in this research is test understanding concept and interview.

RESULTS AND DISCUSSION

First Issues. Student representation provided information that there are students who have misconceptions. Here is presented a representation of students on the subject of kinematics and dynamics (Table 1).

Tabel 1. Students Representation

Type	Sample Concept	Sample Students Representations
	Kinematics	
1.	Mathematical representation $\Delta\vec{V} = \frac{\Delta\vec{s}}{\Delta t}$	Equal form of Mathematical representation $\Delta\vec{V} = \frac{\nabla\vec{s}}{\nabla t} = \Delta V = \frac{\Delta s}{\Delta t} = V = \frac{s}{t}$
	Dynamics	
2.	$\sum\vec{F} = m.\vec{a}$ $\sum\vec{F} = m.\ \frac{d\vec{v}}{dt}$ ....(1) $\vec{F} = m.\ \frac{v^2}{r}$ ....(2)	Net force equal with velocity and square of velocity
3.	**Visual Representation**. Moving upward and slowing to a stop. 	
4.	Ilustrated the frictional force 	

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alternative Solutions. On the first issue, the student can't distinguish similarities speed and velocity, and mathematical symbols presented. Displacement is a change in position, which changes in physics finite symbolized in (Δ). In addition to reading representation of a symbol, a visual representation in the form of graphs and essential questions can be used to enhance the student's understanding. Graph relationship between two variables will help students understand the issue (**Figure 1**).

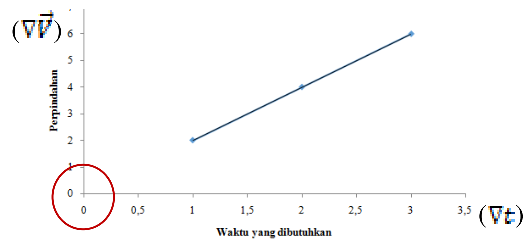

Figure 1. Virtual Exsternal Representation of Velocity (Dispalcement vs time)

With the external representation of the graph (**Figure 1**), the representation of students who answered $V = \frac{s}{t}$ will experience cognitive conflict, when s = 0 and t = 0 or t = 0. Graphically they can show a specific coordinate, but when substituted value produces Infinity. Students will reflect back the answer. The concept of instantaneous velocity needs to be instilled in students. That the concept of using the instantaneous speed limit where t is close to zero, it does not mean $\nabla t = 0$. From this definition it is clear that physically or mathematically ∇t value should not be zero.

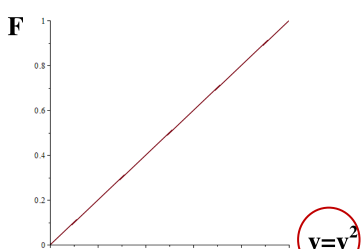

Figure 2a. Incorrect External Representation

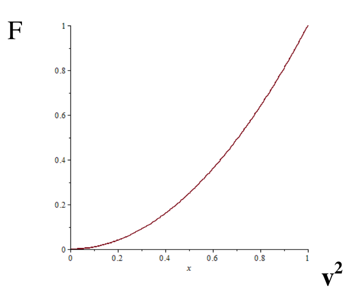

Figure 2b. Correct External Representation

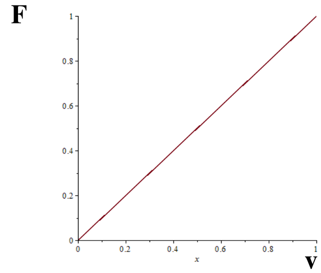

Figure 2c. Correct External Representation

On the second issue, of course, students are also confused. The right external representation can help students draw conclusions. On this issue, without due attention to the graphical representation of variables and concepts can produce a wrong conception. In equation (1) if we assume $\vec{F} \approx d\vec{v}, \vec{F} \approx \Delta\vec{v}$, ∇t of course is not appropriate. As we know, the value dt may not be equal to zero, because the symbol of the changes in invinite time. If students can not read this symbol will display two graphical representation (**Figure 2a**). Emphasis needs to be given an understanding of mathematical language in teaching physics.

Impulses also reinforces that (**Figure 2a**) is not proper, where $I = \vec{F}.\Delta t$, despite the magnitude of $\Delta\vec{v}$ the impulse, but the valueΔt must exist. On the third issue, an example of the external representation of the lecturer is needed, the depiction of the vector is longer for values greater force is necessary, but also need identification how many forces acting. Giving the right external representations can help students understand the concept.

On the fourth issue, accuracy factors influence in ilustrated the frictional force. Students ilustrated frictional forces swipe left, assuming conception frictional force opposite to the direction of force, because the direction of the force to the right, so the direction of the frictional forces to the left. For students who understand the concept, that the wheels are spinning in the down position, the wheels and the floor when the interaction occurred, it would seem that the direction of the friction force to the right, because the direction of the force to the left, even if the object is moving to the right. It should also be emphasized that the direction of the force is not is not always in line with a velocity. Lecturers can also use a simple media, to make a circle and describe the force on a spinning wheel (**Figure 3**).

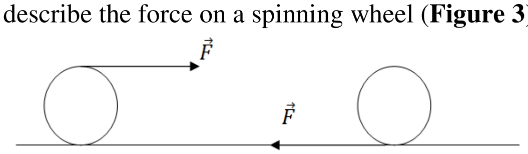

Figure 3. The force on a spinning wheel

By using the external representation more detail, can help students understand concepts and solve problems of physics. In resolving the problem, drawing a free-body diagram and determining the direction of the force entered the stage of problem identification. Physics problems can be resolved with proper identification when done right well . (**Table 2**) Represent students conception after and before usinng external representation. Total gain value from table 2 is (0.90).

Table 2. Percentage suspect Misconceptions

Type Problem	Before using external Representation (PreTest)		After using external Representation (posttest)	
	Correct Conception	**Incorrect Conception (Suspect Misconception)**	**Correct Conception**	**Incorrect Conception (Suspect Conception)**
1	60%	40%	88%	12%
2	64%	36%	92%	8%
3	52%	48%	92%	8%
4	44%	56%	92%	8%

CONCLUSION

Students representation should be explored, both symbols and visual representation. These findings provide information that is not all student representation are correct. External representation from the lecturer in accordance with representations that developed during the learning can be used as an solution to overcome misconceptions students. Lecturers should be able to choose an appropriate representation. Concept must be managed by teachers and lecturers, it's affect to student comprehension. If lecturer don't understand the concept, most likely a visual representation (2a) would appear. Learning physics can't be separated from a mathematical language, mathematical language should be understood as any mathematical symbols have a specific physical meaning.

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