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Use of vector semiotic representations in the concept of displacement and velocity

Vernanda G Mandak[1], Rolles N Palilingan[2], Satyono W Mongan[3], Djeli A Tulandi[4], Patricia M Silangen[5], Cosmas Poluakan[6]

[1-6] Student of Department of Physics, Faculty of Mathematics and Natural Sciences, Manado State University, Indonesia

Abstract
This study aims to determine the use of Model of Model Based Instruction (MOMBI) in the use of semiotic vector representations on learning the concept of displacement and velocity of learning outcomes. This research was conducted in semester 1 and semester 3 of Physics Department of Manado State University. One Pretest-Posttest Control Group Design research design. The research sample of 26 people carried out at the same time with 2 treatments namely, treatment individually and in pairs. The instrument used was a test instrument consisting of pre-test and post-test questions in the form of descriptive questions. Based on the analysis of test data, an average value of 86.22 in paired treatment and an average value of 75.59 in individual treatment. This is based on the results of hypothesis testing using t test with a significant level of 5% and degree of freedom (df) 24. The result is t_{count} = 2.39 while t_{table} = 2.06. It appears that $t_{count} > t_{table}$. It can be concluded that the average value for treatment in pairs is higher than the treatment of individuals with the use of learning models based on Model of Model Based Instruction (MOMBI) on the results of learning physics in vector material in the concepts of displacement and velocity.

Keywords: MOMBI, representation of semiotics, displacement and velocity

1. Introduction
Learning model is very important in the learning process and can improve student learning outcomes. Using the MOMBI-based learning model (Model of Model Based Instruction), which is a model-based instruction model that will be applied to the learning process with 5 steps of Model of Model Based Instruction (MOMBI) intervention in the Poluakan research proposal (2018) [1], namely provocation, preconception, presentation, scaffolding and practice.
Representation is the process of forming, abstraction and demonstration of physical knowledge. Thus, representation can be interpreted as a learning process that can be understood from the mental development that exists in a person. Therefore, in correctly presenting vector image diagrams can help students to be able to solve problems procedurally and systematically. Kurnas and Arslan (2013) [2] Representation of images can help students in learning during the teaching process. According to Gilbert (2010) [3] Physics often involves physical modeling in real life that uses external representations from concrete to abstract forms: images, diagrams, words, graphs and equations. Research conducted by Yildiz (2016) [4] has difficulty with mechanical concepts such as velocity. Some concepts are interrelated in a system that is given understanding and requires a higher level of thinking.
Vector material deals with displacement and velocity. Displacement is defined as changes in the position of objects in a certain time interval. Meanwhile, velocity is a quantity that depends on direction, so velocity is a vector quantity that shows how fast the object is moving. Therefore students must understand concepts in vector material such as displacement and velocity. Displacement can only be explained by the concept of vectors, so many researchers associate vector material in the initial discovery of existing problems. Nguyen and Meltzer (2003) [5] investigate the pre-test and post-test of students' knowledge about the nature of vectors and the addition of vectors in learning introductory mechanics. They concluded that more than one quarter of students completed calculus-based mechanics and half of students who completed algebra-based learning were unable to add vectors.
Preliminary data findings of research conducted on students in semester 4 and semester 6 of Physics Department of Manado State University regarding Post-Test questions with Vector Topics Understanding with the question "Draw a vector of a person's displacement running from point A to B. How large is the displacement (Note: One scale = 1 meter). There is no student who answers right or can be said 100% of students answer wrong.

2. Conceptual framework
Vygotsky cognitive theory
Vygotsky is someone who has a very different explanation from his friends about cognitive development (learning). The aspects of Vygotsky that have received the most attention among educators and psychologists are his arguments for the basis of a culture of cognition and for the existence of a "zone of proximal development". Vygotsky (1978) [6] described a very important concept, the Zone of Proximal Development (ZPD). ZPD is defined as problem solving that is guided by adults or working with peers. Vygotsky's idea of a zone of proximal development suggests an approach to teaching, namely scaffolding. Scaffolding is help or support for a child from someone who is more mature or more competent with the intention that the child is able to do tasks or questions that are of a higher level of complexity than at the level of cognitive development.

Model of Model Based Instruction (MOMBI)
Each intervention supports a learning process. The first

teaching intervention is the Model Based Instruction Model (MOMBI). A topic often discussed in the context of model-based instruction is the presentation of external models such as concept maps and visual representations. However, external models are not the only way to realize teaching interventions because there are other possibilities that can support the construction of mental models. The sources used to get the information needed are pictures, concept maps, tables, online sources, experts and library books. The important thing for this teaching intervention is to get information to build mental models that explain new information and make information make sense. The 5 steps of the Model of Model Based Instruction (MOMBI) intervention in the research proposal for Poluakan C. (2018), namely: 1) Provocation: The step of initiation or construction of a mental model where the lecturer will raise real questions and problems or informational challenges that challenge students to think of an instructional intervention as provocative. 2) Preconception: Steps to activate or activate previous views or thoughts, or activate preconceptions or prejudices held by students. 3) Presentation: The step of providing information so that students can answer questions, solve problems, explain conflicting information in other words ensuring the construction of the mental models of students is the same as the expert models or expert conceptual models. 4) Scaffolding: The step of the lecturer who fattens the students to externalize or realize a model that is already understood and they provide feedback. 5) Practice: the final step is to provide an opportunity to reconstruct the model over and over again so that it is stored and schemed in students.

Displacement and Velocity

Displacement

To find an object means finding a position relative to some reference points and origin (or zero) of an axis, such as the x-axis in Figure 1

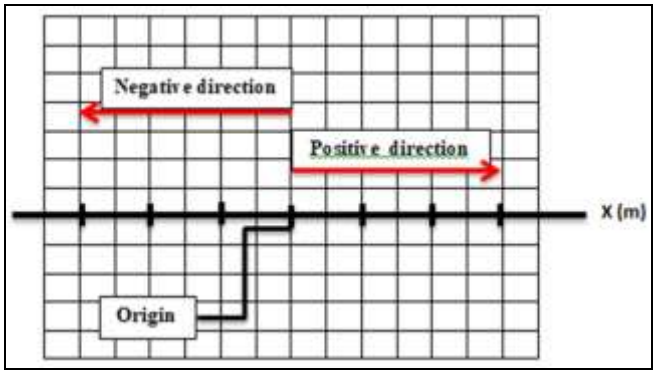

Fig 1: Position is determined on an axis in units of length (Meters). The x-axis is always on the positive side.

The direction of the positive axis to the right and vice versa the direction of the negative axis to the left in figure 2.1. For example, a particle located at x = 5m, which means a particle measuring 5 m in the positive direction. If it is at x = -5 m, the particles will be the same distance from the origin but in the opposite direction. The plus sign for coordinates does not need to be displayed, but the minus sign must always be displayed. Displacement is defined as a change in the position of the object. Thus, displacement is how far away the object is from its starting point. For example, someone who walked 70 m to the east and then turned (to the west) and walked a distance of 30 m (See Figure 2.2). The total distance traveled is 100 m, but the displacement is only 40 m because it is only 40 m from the starting point.

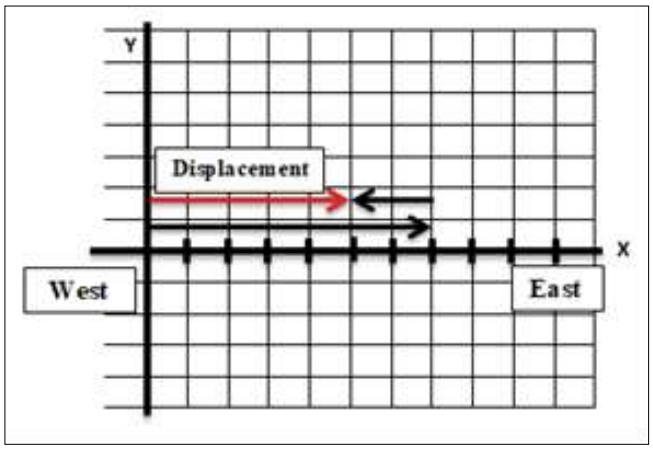

Fig 2: Displacement

The change in position x_1 to position x_2 is called the displacement Δ_x (symbol Δ or Delta uppercase Greek, representing changes in quantity and that means the final value of quantity minus the initial value).

$$\Delta_x = x_2 - x_1$$

Switch to the positive direction (to the right) and negative move in the opposite direction (to the left) in Figure 2.3. for clarity, for example x1 = 10 m and x2 = 30 m, then

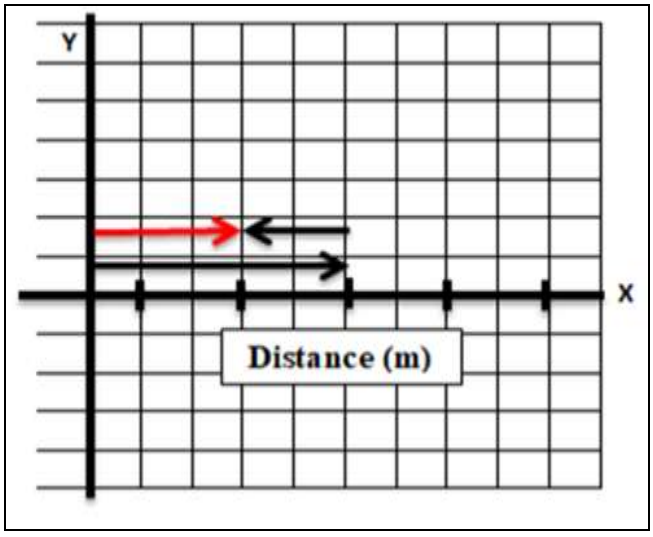

Fig 3: Arrows show displacement x2-x¬¬1. Distances are expressed in meters.

$\Delta_x = x_2 - x_1$= 30 m – 10 m = 20 m.

Now looking at a different situation, an object moves to the left as shown in figure 2.4. Here an object, say a child, starts from x_1 = 30 m and goes left until the point x_2 = 10 m. In this case

$\Delta_x = x_2 - x_1$= 10 m-30 m= -20 m

And the thick arrow represents the displacement vector pointing to the left.

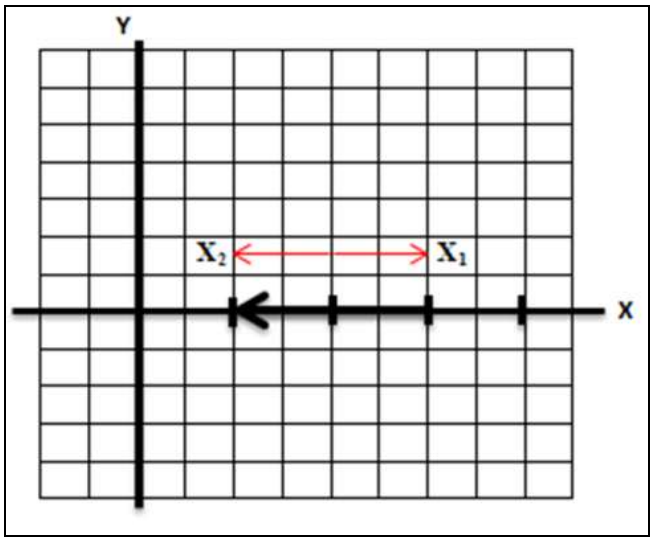

Fig 4: For displacement $\Delta_x = x_2 - x_1$, the displacement vector points to the left.

This example illustrates that when discussing one-dimensional motion, the vector pointing to the right has a positive value, while the one pointing to the left has a negative value.

Velocity

Velocity is used to express both the magnitude (numeric value) of how fast an object is moving and the direction of its motion. Thus velocity is a vector. Average velocity is defined in relation to displacement.

$$\text{Average Velocity} = \frac{\text{Displacement}}{\text{time}}$$

Suppose a child goes 70 m to the east and 30 m to the west. The total distance traveled is 70 m + 30 m = 100 m, but the displacement is 40 m which requires 70 s. So, the average velocity is:

$$\frac{\text{Displacement}}{\text{Time}} = \frac{40\ \text{m}}{70\ \text{s}} = 0{,}57\ \text{m/s}$$

At a point in time, say t_1, the object is on the x-axis at x_1 on the coordinate system, and some time later, at time t_2, it is at point x_2. The time required is t_2-t_1 and during this time interval the displacement of the object is $\Delta_x = x_2 - x_1$. Thus, the average speed, which is defined as the displacement divided by the time required, can be written down

$$\bar{v} = \frac{x_2 - x_1}{t_2 - t_1} = \frac{\Delta x}{\Delta t}$$

Where $\bar{v}$ is the average velocity. Note that x_2 is smaller than x_1, moving objects to the left means $\Delta_x = x_2 - x_1$ smaller than zero. The sign of displacement, and also means speed indicates direction. The average velocity is positive for objects moving right along the x-axis and negative if the object is moving left. The direction of velocity is always the same as the direction of displacement.

3. Method

The type of research used is experimental research. In this study there is a treatment given that is the Model of Model Based Instruction (MOMBI). This research was conducted in the odd semester of the 2018/2019 school year at the Department of Physics Education, Manado State University. The subjects of this study were students in semester 1 and semester 3 in the 2018/2019 school year. In this research, the design of One Pretest-Posttest Control Group Design is used. Where this study uses preliminary tests to determine students' initial abilities, then given treatment. Then do the final test. There are 2 variables: treatment variable and response variable. The instrument used was a test. The tests provided consisted of pre-test and post-test questions in the form of question details.

4. Results and Discussion

Based on the results of data analysis using parametric statistics calculated using the SPSS application it can be stated that the Physics Learning Outcomes after application learning Model Model of Model Based Instruction (MOMBI) for Semester 1 and Semester 3 students in the Physics Department, Manado State University found the average value of the treatment of paired exercises is higher than the treatment of individual exercises on vector material in the concepts of displacement and velocity. Based on table 1 looks the average value in pairs of 86.2209 and the average value in individuals 75.5938. Thus, the average value for treatment in pairs> individual treatment. If, the data is homogeneous or the variance is the same then the data is seen in equal variances assumed and if the data is not homogeneous then the data is seen in equal variances not assumed.

Table 1: Independent Samples Test

Independent Samples Test										
		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
HASIL BELAJAR	Equal variances assumed	1.465	.238	2.395	24	.025	10.62711	4.43722	1.46914	19.78508
	Equal variances not assumed			2.336	19.751	.030	10.62711	4.54932	1.12972	20.12450

In table 1, t_{count} is 2,395 and t_{table} is 5% significant and degree of freedom (df) 24 is 2,06390, because $t_{count} > t_{table}$ (2,395> 2,06390), then H_1 is accepted and H_0 is rejected, so it can be concluded that the average value for the treatment of Pairs is higher than the treatment of individuals with the use of learning models based on Model of Model Based Instruction (MOMBI) on physics learning outcomes on vector material in the concepts of displacement and velocity.

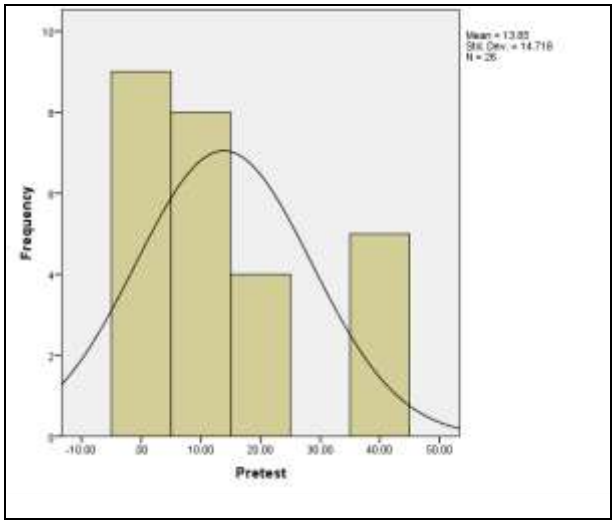

Fig 5: Pretest Results Histogram Data

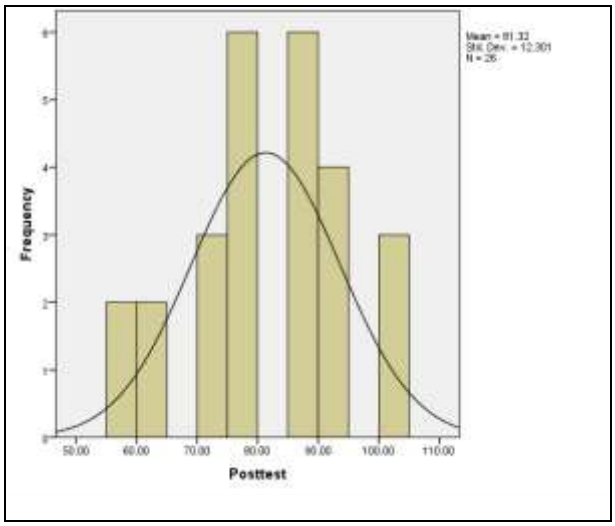

Fig 6: Posttest Results Histogram Data

5. Conclusion

This study uses the MOMBI learning model in the implementation of semiotic representations with individual treatment and paired treatment. Based on the results of the study and its discussion, it can be concluded that the average value of the treatment of paired exercises is higher than the treatment of individual exercises on vector material in the concepts of displacement and speed. These results were obtained from the average value in pairs of 86.2209 and the average value in individuals 75.5938 and reinforced by t_{count} of 2.339 and t_{table} at a significant level of 5% and degree of freedom (df) 24 of 2.06390, because $t_{count} > t_{table}$ (2,395> 2,06390).

6. References

1. Poluakan C. Model Asesmen Formatif Kelas Berbasis Semiotic Resources Dalam Pembelajaran Fisika. Proposal Penelitian DRPM Kemristekdikti, 2019.
2. Kurnaz Arslan M. Effectiveness of Multiple Representations for Learning Energy Concepts: Case of Turkey. Procedia - Social and Behavioral Sciences. 2013; 116:627-632.
3. Gilbert J. The role of visual representations in the learning and teaching. Asia-Pacific Forum on Science Learning and Teaching. 2010; 11:1.
4. Yildiz A. A discussion on velocity–speed and their instruction. Journal of Physics: Conference Series, 2016, 707 012040.
5. Nguyen N, Meltzer D. Initial understanding of vector concepts among students in introductory physics courses. American Associantionof Physics Teacher. 2003; 71(6):630-638.
6. Vygotsky L. Mind in Society : The Development of Higher Phychological Process, 1978.
7. Giancoli D. Fisika Edisi Kelima Jilid 1. Jakarta: Erlangga, 2001.
8. Walker J. Fundamental of Physics 10th Edition, 2007.
9. Poluakan C. Semiotika Vektor Dalam Mekanika. Jurusan Fisika Fakultas Matematika dan Ilmu Pengetahuan Alam, 2019.
10. Hanke U. The Model of Model-Based Instruction, 2008, 175-186.