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Use of semiotic representation in implementation of vector decomposition in the case of inclined plane

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Abstract

The purpose of this study is to determine the differences in learning outcomes using learning models The Model of Model-Based Instruction (MOMBI) based on group exercises and individual exercises with the use of learning models to implement vector decomposition in the case of sloping plane with the design of Two Group Pretest-Posttest Design, which held in the Department of Physics, Manado State University. The population in this study were all semester III and IV students, amounting to 20 people. The data collection technique is descriptive statistics. The research results obtained there are differences in physics student learning outcomes with the use of semiotic representation in the MOMBI learning model based on group exercises and individual exercises. The result of t count = 3,506> ttable = 2,100 at 5% significance level. This means that there are differences in student physics learning outcomes by using The Model of Model-Based Instruction (MOMBI) approach to learning vector decomposition in the inclined plane with the use of semiotic representations. By using semiotic representation in the implementation of vector decomposition in the case of inclined plane and the use of MOMBI can improve learning outcomes of prospective teacher physics students.

Keywords: MOMBI, vector decomposition in the case inclined plane, learning outcomes, semiotic representation

1. Introduction

Physics is a branch of natural science that learns about nature and everything in it and the changes that occur in it. Where physics often uses real modeling. Physical phenomena uses analogy approaches in the form of images, graphs and equations [1]. Pedagogically in the use of physics concepts networks are difficult subjects and are not easy to understand if they only prioritize students' own understanding, so the importance of diagrammatic representation in physics learning [2]. The difficulty of students in learning physics is basically caused by the lack of skills and understanding of the concept of vectors to determine the point of capture of vectors and the direction of vectors. Difficulties that are often faced are in interpreting various concepts, images and principles of physics. According to Wong D *et al* (2011), it requires a unique visual representation that is related to a specific topic [3]. Thus, the success of physics learning is largely determined by the level of understanding of the quantity of vectors. However, many of the results of the study found that some students still have a low understanding of the concept of vectors. This is of course according to the authors the need to support the use of media as an analogy to support teaching and learning tools so that students can show the level of understanding of physics that is easily understood. This is in line with the results of the study of Poluakan & Runtuwene (2018), it can be concluded that the identification of the difficulty in understanding vector material in the component of the gravity projection on the inclined plane was not carried out by touching the percentage of 91% [4]. Based on the data of the initial findings of the study conducted in semester 3 and semester 5 students of the Physics Education Department who have studied basic physics and mechanics about Pretest questions with Vector Topics in the Leaning Case. Referring to the question: a block that is sliding with mass m, above the inclined plane. Describe the forces acting on the block, none of the students answered correctly or could be said 100% of students answered wrong. The difficulty of students in working on these problems is due to the lack of a basic understanding of semiotic representation. This understanding can be represented by using a vector decomposition learning approach in the case of inclined plane using a vector semiotic representation. Vector is a mathematical component which is an essential language for physics [5]. Therefore, in learning physics it is very important to use a representation. Where presenting vector diagram drawings can help students to be able to solve problems procedurally and systematically. Representation is something that can be symbolized or a symbol on an object or process while semiotics is the study of signs. Representations in physics in the form of words, pictures, diagrams, graphs, symbols, and so on. The ability to represent semiotics is one of the important and fundamental components for developing students' thinking abilities [6]. Where this semiotic representation makes it easier for students to reconstruct their own knowledge. In improving students' understanding of physics it is necessary to have a learning model. The use of learning models has an important role in the progress of learning. With the learning model can improve student learning outcomes in semiotic representation. One learning model that can be used to improve student learning outcomes for vector material in the case of inclined plane is (MOMBI). MOMBI learning is a teaching model that consists of lecturer explanations about new concepts and skills, which involves the collaboration of lecturers with students individually, or in small groups that focus on achieving learning targets by providing skills training that is closely related to the target. The use of the MOMBI learning model is modeling learning where the lecturer acts as a model by guiding students to master knowledge, especially those related to skills and concepts.

2. Conceptual Framework

All objects with mass m, if it is in an area of gravitational field caused by other objects with mass M (like earth). So that these objects will experience the force of mutual attraction formulated in Newton's Universal Law of Gravity. Where m mass objects are located around the earth with an M mass so as to produce a gravitational field g. With a large gravitational field proportional to mass m, only the Earth's very obvious gravitational field exerts a gravitational influence on the center of the earth against objects around the earth. In other words, a beam with mass m will be pulled by the earth, and not the earth that is drawn by that object. The direction of motion of the beam drawn by the earth is always towards the center of the earth as the center of mass. Whereas the limited direction of the gravitational field vector causes the surface of the earth to appear flat. Thus the beam is placed on a flat surface with a state of rest, always influenced by the earth's gravitational field. A beam of mass m will emerge a force called the object's gravity. The gravity of an object as a vector quantity can be written (_W ^ →) = m_g ^ → which has a direction towards the center of the earth. The magnitude of the weight w = mg, multiplication of the mass of the object with a large acceleration of Earth's gravity (average 9.8 m / s2).

Even though the beam is stationary and there are no outside disturbances that push / shift or lift and move objects. But on the beam with mass m working force arising from the influence of the earth's gravitational field. This force is the weight of the block w. due to the onset of gravity w acting on the beam, the gravity of the object will emphasize the plane of the flat surface where the beam is placed. The weight of the beam can be said as an action force that presses the contact area of the beam with a flat surface. As a result, the force on the touch plane arises as a reaction called the normal force N. With the magnitude of the reaction force N being equal to the weight force w, or N (reaction) = w (action), the capture point of the normal force vector N is in the boundary plane (the touch field) beam with a flat surface. Because there is only one reaction force that is the normal force N, the resultant force due to the action of gravity wi can be written as P = N. To explain this, it requires a four-step review of the process, namely the first stage: when the tensile force has been applied to the beam but the beam has not moved (it is still at rest). Second step: when the pulling force is still applied to the beam and the beam is still stationary or will immediately start moving. Third stage: the force applied while the beam is in a state of motion. The fourth stage: where when the beam will start to tumble. The normal force N arises due to the vector of gravity w, but the magnitude is the same as the vector of gravity w which is projected on the perpendicular axis axis that is the vector wcos θ. The beam situation is not moving / still stationary and will almost move. In this situation there are two possibilities that will occur in the beam (if the beam is then moving) [7]. the first possibility is that the block will slip off, or the second possibility that the block will roll over. Beams that are above the inclined plane will only slip sliding or the beam will be rolled depending on several variables or factors. Variable in question is the large or small variable value of the coefficient of friction of the touch plane between the surface of the beam coefficient of friction of the rough sloping surface. And another variable is the ratio of dimensions of area (length / width) of the touch area between two surfaces compared to the height of the beam that is above the inclined plane.

The first possibility

If the beam slips on a rough inclined surface, then the force vectors acting on the beam above the inclined plane are temporarily slipping. Factually, in addition to the beam's gravity which causes the beam to slip, of course friction forces will automatically arise in the opposite direction to the direction the beam is sliding down along the surface of the plane.

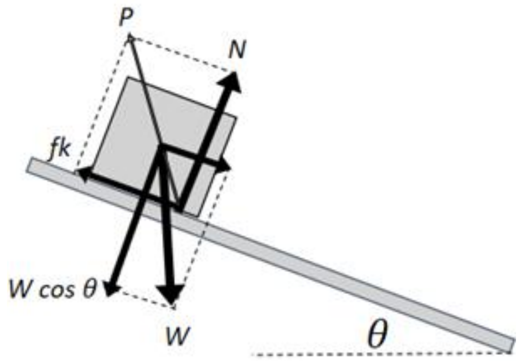

Fig 1: The beam temporarily glides over the inclined surface

The frictional force that arises between the inclined plane surface and the beam which temporarily slides down along the inclined plane is called the kinetic frictional force whose direction is upward. The magnitude of the kinetic friction is always smaller than the static friction (fk <fs).

The second possibility;

Beams tend to be more likely to roll and will not slip if the touch area variable is smaller than the height of the beam. This is due to the gravity beam position w which is the inclined plane surface. Thus, if rolled over, the normal force N will not arise.

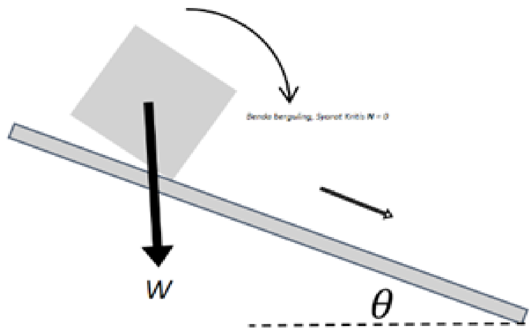

Fig 2: Beams when rolling

3. Methodology

This research was carried out in the Manado State University Physics Department in 2019/2020 school year. This study uses a learning model (MOMBI) which consists of 5 intervention steps: provocation, preconception, presentation, scaffoldfing and practice [8]. 1) Provocation: the initiation step or starting construction of a mental model where the lecturer raises real questions and problems or conflicting information that makes learners like students think, or condition an instructional intervention to be provocative. 2) Preconceptions: steps to activate or activate previous views or thoughts, or activate preconceptions or prejudices that the learner has. 3) Presentation: the step of providing information so that learners can answer questions, solve problems, explain conflicting information in other words ensuring the construction of the mental models of learners is the same as the expert models / expert conceptual models. 4) Scaffolding: the step of providing information so that learners can answer questions, solve problems, explain conflicting information in other words ensuring the construction of the mental models of learners is the same as the expert models / expert conceptual models. 5) Practice: the final step is to provide an opportunity to reconstruct models repeatedly so that they are stored or settled and schemed on them. The five steps are tested on Physics Department students consisting of semester 3 and semester 5.

4. Results and Discussion

There are many research findings relating to the representation of vector semiotics, one of which was also discovered by Barniol P *et al*. (2010) [10] that the most common difficulties in determining vector direction, drawing vector lines, not understanding head to tail vectors and difficulty in determining vector position [9]. Based on data analysis of research results at Manado State University in Physics Department students in the odd semester of the 2019/2020 school year shows that there are differences in student physics learning outcomes based on group exercises and individual exercises. Where the average score of learning outcomes in group exercises applied to the MOMBI learning model is 85 and the average learning outcomes in individual exercises that are applied to the MOMBI learning model is 70. Before testing hypotheses, data normality tests and data homogeneity tests must first be performed. Calculation of data normality test, testing using the Kolmogorov-Smirnov test with the help of SPSS Software 20. From the analysis of data testing produces a significance value of 0.594 so that it can be concluded accept H1 for group exercises and analysis of testing data for individual exercises produces a significance value of 0.710 so that it can be concluded accept H1. Thus it can be seen the scores of student learning outcomes taught using the MOMBI learning model in group exercises and individual exercises with normal distribution.

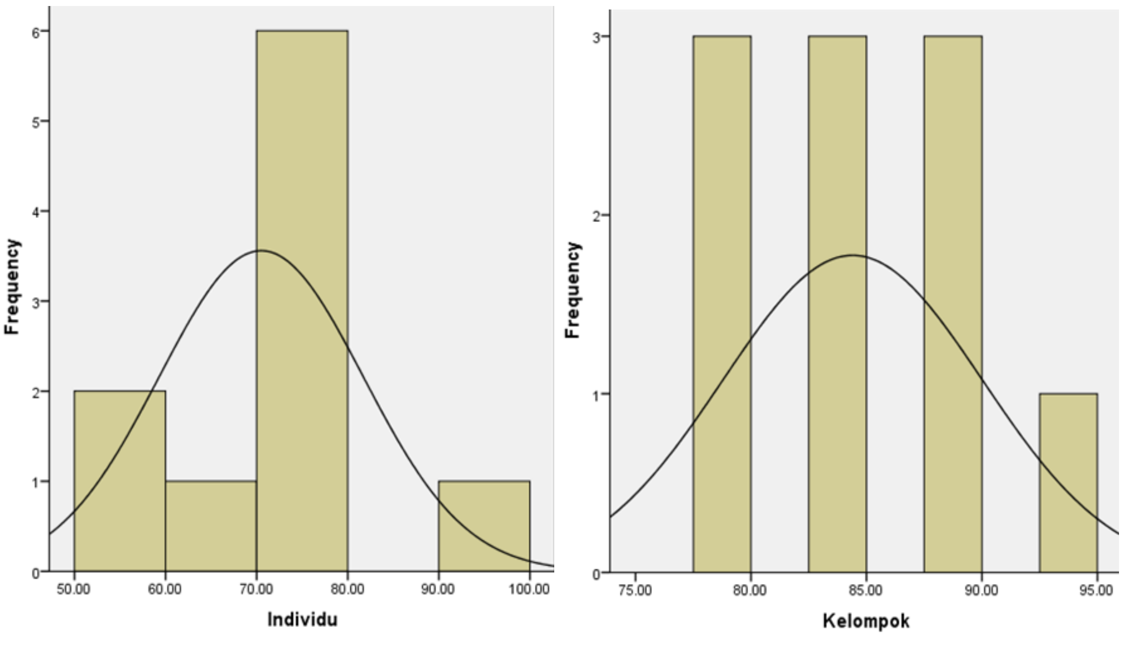

Fig 3: Individual and group histograms

Then the data homogeneity test is carried out the results of data analysis produce a significance value of 0.259 so it can be concluded accept H1. So, the variance of both exercises is homogeneous.

Using normal distribution statistics (t-test), it is done in group exercises and individual exercises have significant differences as in Table 1.

Table 1: Independent Samples Test

	Independent samples test								
	Leyene's Test for Equality of Variances		**t-tast for Equality of Means**						
	F	Sig	t	df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal Vanances assumed HASIL	1.361	259	3.506	16	003	13 90000	3 96499	5.56987	22 23013

Equal Vanances not assumed			3.506	13 259	004	13 90003	3 96499	5 35113	22 44887

The results of the levene test, the sample is homogeneous, then used df = 18 (first row). Based on the table above, the value of p 0.003 <0.05 and tcount = 3.506> ttable = 2.100. This means that H1 is accepted, meaning that there are differences in student physics learning outcomes by using The Model of Model-Based Instruction (MOMBI) approach to learning vector decomposition in the incline using a vector semiotic representation. Where obtaining significant results between group exercises and individual exercises.

5. Conclusions

The use strategy (MOMBI) of the vector decomposition learning approach in the inclined plane by using semiotic representation can improve student learning outcomes. Based on research Nguyen *et al* (2011) concluded that the use of semiotic representations in learning can help students become better problem solvers [10]. This is evident from the results of the pretest and posttest there is an increase, there is even a difference in the physics learning outcomes of students using the learning model (MOMBI) to the learning approach of vector decomposition in the incline using semiotic representations. Seen from the differences in group exercises and individual exercises with the value of tcount and ttable which indicates that tcount=3,506>ttable = 2,100.

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