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Developing analytical mechanics course program using Geogebra multiple representation based (Mgeo-MR)

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²Physics Education Study Program, Faculty of Teacher Training and Education, Universitas Muhammadiyah Prof. Dr. Hamka, Jl. Tanah Merdeka, Kp. Rambutan, Ciracas, East Jakarta, Indonesia.

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Abstract. This research aims to develop analytical mechanics course program using Geogebra multiple representation based (Mgeo-MR). The computer program in Physics learning is a necessity in the era of industry revolution 4.0. There are so many computer programs in Mathematics learning used in Physics learning such as GeoGebra. The subjects of this research were 32 students of third semester. The design of research was pre-experimental in the form of one shot case study. The instruments of data collection in this research were the results of learning process through module developed MR based. Data were analyzed through descriptive analysis technique with Mgeo-MR. The results of this research obtain the average score of students' comprehension achieving MR-verbal 57,7% sufficient category, MR-Picture 71,3% good category, MR-Graph 59,2% good category, and MR-Mathematics 57,7% sufficient category. Out of all of Mgeo-MR course program development obtains achievement with good category. Therefore, it can be concluded that analytic mechanic course program development multiple representation based using Geogebra software is successful.

1. Introduction

The utilization of computer in learning can give various and many learning experiences, improve learning motivation, and develop the skill of Information Communication and Technology (ICT) of the students [1-2]. Understanding the concept and mechanics principle in analyzing the problem of gravity mechanis and central force, dynamics of particle system, rotation of rigid objects, and movement of three dimension rigid objects [3]. The rapid development of science in line with technology developoment which is getting more sophisticated has strong influence and gives benefit for our life. The development of knowledge and technology basically will be beneficial in order to ease human in running all their activities in varioius field of their life. One of examples is in educational field included Physics Education.

GeoGebra is a dynamic program which has various facilities that can be utilized as Mathematics learning media. Beside that, GeoGebra also can be used to demonstrate or visualize Mathematics concept and as the instrument to construct Mathematics concept itself. Through GeoGebra program, abstract Mathematics objects can be visualized at once manipulated correctly and efficiently because the information obtained in the media must involve the students, either in their brain or mental in the



form of real activities until the learning occurs [4]. The main menu of GeoGebra are: File, Edit, View, Option, Windows, and Help to describe the objects of Geometry. According to [5], GeoGebra is extremely beneficial as Physics learning media with various objects as demonstration and visualization media. In this case, in traditional Physics learning, the teacher used GeoGebra to demonstrate and visualize certain Physics concept. GeoGebra is used to visualize the construction of certain Physics concept, for instance constructing inner circle or outer circle, triangle, or tangent. GeoGebra is used as media for the students to find certain concept of Physics. The forming of Physics concept directly influences the process of Physics education in 20th and 21st Century, the most important thing in the field of Physics learning concept, the model of forming the concept, and the method of concept learning in Physics class [6].

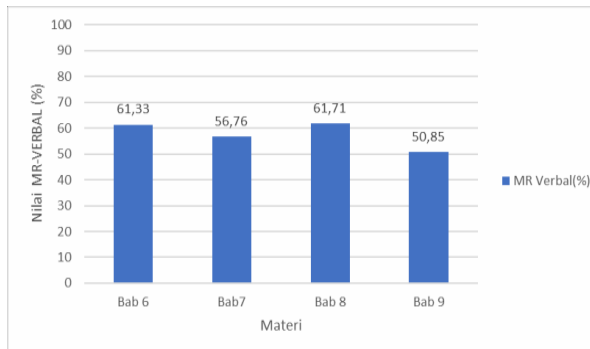
Some research show that good skill of students' representation is the key to gain successful solution in problem solving [7][8]. However, some researchers show that most of the students fail in understanding the importance of the correlation among various kinds of representation. There are three main functions of multiple representation in a learning. First, representation functions as the completion of certain information and a process is presented with other representations. Second, one form of representation to limits the interpretation mistake which probably occurs in the form of other representations usage. Third, representation can assist the students to build deep comprehension when they unite all information from various representation [9]. Lesh proposes three steps procedure for problem solving. The first step is oral translation or vocal with Mathematics pattern, the second step is changing the Mathematics pattern to be Arithmetic symbols. The last step is explaining the results of solution orally [10].

2. Method

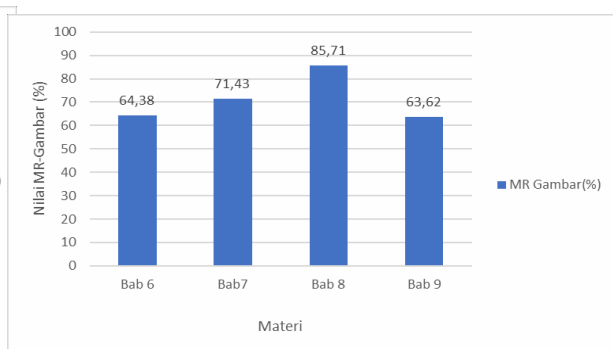
This research used descriptive quantitative and qualitative method to know the achievement percentage of analytics mechanic course program development using geogebra (Geo) multiple representation based (MR) at a Private University in Jakarta, in October until December 2018. The instruments used consisted of module instrument of analytics mechanic concept arranged MR based by using geogebra software. The subjects this research were third semester students academic year 2017/2018. The number of students were 21 people consisted of 1 male student and 20 female students. The research results are in the form of learning process through fulfilling the module developed MR based using geogebra.

3. Results and Discussion

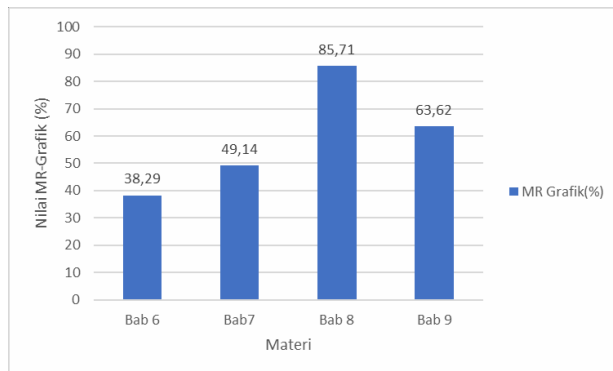
The most important process in Physics learning is understanding the basic concepts of Physics itself [11]. The collected data in this research were in the form of percentage of score of understanding the concept of analytics mechanic obtained from the score of per variable existed in Mgeo-MR (Verbal, picture, graph, and Mathematics). The analysis result of research data obtains the skill of program development of geogebra software MR based at the improvement of conceptual understanding result for each variable can be shown in table and graph below.



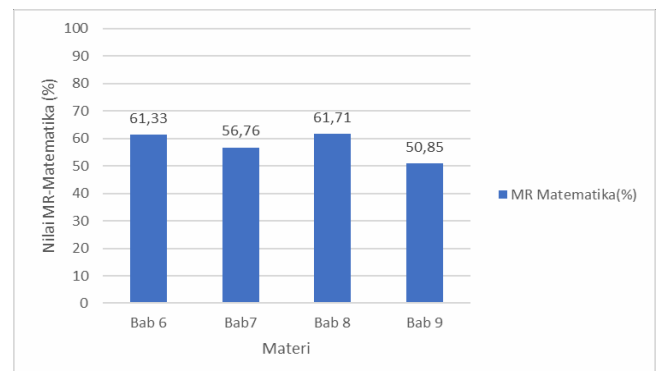
Graph 1 MR-Verbal



Graph 2 MR-Picture



Graph 3 MR-Graph



Graph 4 MR-Mathematics

The results of data analysis and discussion about developing analytics mechanic course program using Geogebra multiple representation (Mgeo-MR) based on third semester students obtain the average score of students' comprehension achieving MR-Verbal for chapter 6; 57,7 %, chapter 7; 56,76%, chapter 8; 61,71% and chapter 9; 50,85% included into sufficient category, MR-Picture for chapter 6; 64,38%; chapter 7; 71,43%; chapter 8; 85,71% and chapter 9; 63,62% included into good category and MR-Mathematics for chapter 6; 38,29%; chapter 7; 49,14%; chapter 8; 85,71%; chapter 9; 63,62% included into sufficient category. Out of all results of course program development M-geo-MR obtain achievement included into good enough category.

4. Conclusion

Thus it can be concluded that the development of analytics mechanic course program multiple representation based using geogebra software can be used as one of alternatives for developing course program Mgeo-MR. Other researchers can give more variation on the development of mechanics learning representation multiple based.

5. References

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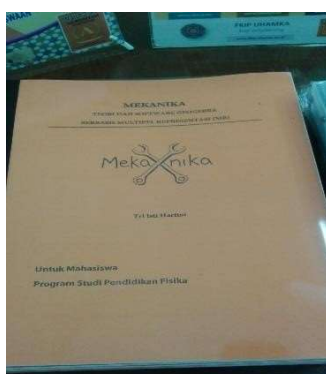
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Acknowledgements

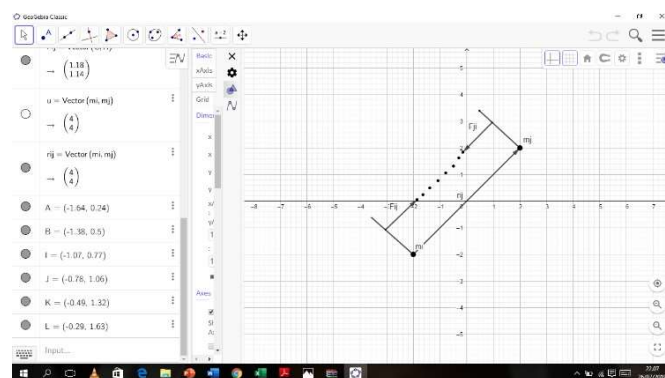
The writer would like to thank all students who had participated in data collection. The writer also would like to thank UHAMKA because of giving opportunity to conduct this research. In this chance, the writer would like to deliver the highest appreciation and thanks to BUDI-DN and LPDP as the sponsor and all parties to have big impact on the success and completion of this research. The writer realizes that this article is far from perfect, therefore any criticism and positive suggestions are highly expected. Hopefully this research is useful for the readers.

Appendixes:

Photos of Experimental Class:



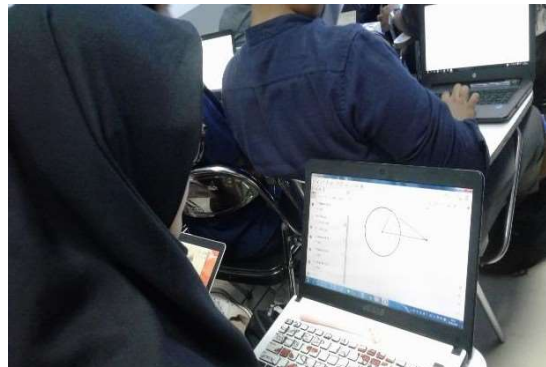
a. MR-based Module



b. Geogebra Software



c. The situation of experimental class when given treatment



d. The student using Geogebra software

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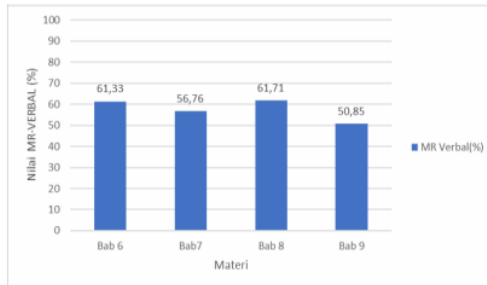
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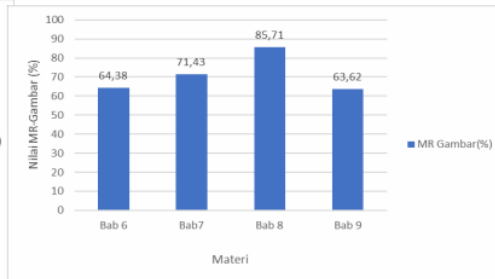
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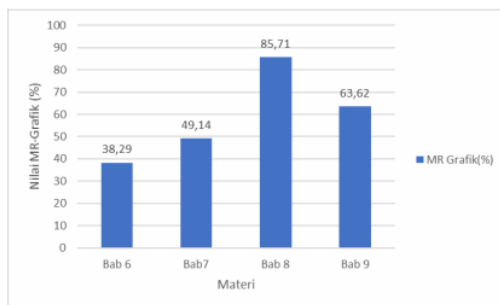
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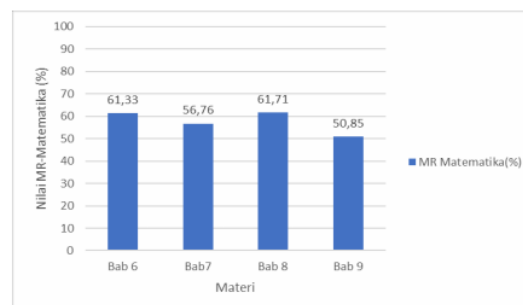
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