# Multimedia Learning Module (MLM) with Hologram Simulation to Improve Students' Mathematical Representation Ability

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## ABSTRACT

This study aims to improve students' mathematical representation skills after using the Multimedia Learning Module (MLM) with hologram simulation. The study was conducted using a pre-experimental design with a pre-test post-test group. Research is being carried out in the midst of the COVID-19 pandemic, so learning is done virtually. The subjects in this study were students of class X IPA 1 SMA Negeri 1 Muntilan. Data collection techniques through pre-test and post-test. The data analysis technique used is descriptive analysis and calculating the N-gain to determine the increase in students' mathematical representation abilities. The results of the N-gain analysis showed that the increase in the mathematical representation ability of class X IPA 1 students resulted in a value of 0.6 in the moderate category.

*Keywords: Multimedia learning module (MLM), Hologram, Virtual learning, Mathematical representation.*

## 1. INTRODUCTION

The world is being shocked by an epidemic of diseases caused by the corona virus or what is known as the corona virus diseases-19 (covid-19). Symptoms that can be caused by Covid-19 are in the form of mild illness to death. According to data from the World Health Organization (WHO) 36.75 million people were exposed to this deadly virus, and there have been 1.06 million victims who have died [1]. The transmission of covid-19 is so fast that it is difficult to detect an exposed person. This virus does not fly, but attaches itself to objects. Until now, a vaccine has not been found to ward off covid-19. The social distancing policy was enforced by the Indonesian government because it was considered effective in reducing the spread of the virus [2]. Almost all wheels of life affected by Covid-19 are included in the field of education.

In mid-March 2020, all schools in Yogyakarta and its surroundings began to do online learning. The government took this policy to break the chain of covid-19 transmission [3]. Students carry out online learning at their respective homes or what is called study from home (SFH) [4]. Learning is an interaction activity between teachers and students to achieve learning objectives. Interactions between teachers and students are done virtually during online learning. Some of the applications used in online learning include Schoology, Google Classroom, Microsoft teams, and many more. Online learning applies to all levels of education from preschool to college. Physics learning must also be done online through the online learning application.

Online learning applies to all subjects including physics. Physics includes subjects that study natural phenomena which are presented using mathematical equations. This condition makes students tend to

memorize equations and consider physics problems only as mathematical problems. Students become less understanding of the concepts of physics symbolized by equations [5]. In learning physics, students need representation skills. Representations can be used to explain how students think. Representations that arise from students are expressions of ideas to solve the problems faced.

Representation has several formats, including verbal, image, graphic, and mathematical representations. The multiple presentation that is most often used by students is mathematical representation. Physics learning often uses mathematical representations to understand physics concepts [6]. Mathematical representation is able to help students represent physics concepts mathematically in an effort to find clarity of these concepts [7]. Mastery of students' mathematical representations is needed in solving problems, especially in physics [8]. Mathematical representations are useful for anticipating misconceptions in understanding the concepts of physics.

The lessons that were carried out during the Covid-19 pandemic were conducted online. Physics as a subject that is also carried out online. Online learning requires each student to have a computer or cell phone and a stable internet connection. In addition, this is a new challenge for physics teachers to design online learning. The policy that was taken suddenly made it difficult for some teachers to design lessons. Especially in physics learning which requires a mathematical representation of physics formulas. Therefore, we need learning media that support students in doing independent learning.

Independent learning can be carried out using modules. Students can learn more freely according to their wishes with modules. The module is more attractive to students so that it can increase students' understanding. The module can be designed by the teacher according to their creativity. Modules can present learning components. Making modules must pay attention to technological developments.

The development of technology in the era of the industrial revolution 4.0 was very fast. Technological advances affect various aspects of life, including aspects of education. At this time, it is necessary to prepare education in accordance with the needs of the times in the era of the industrial revolution 4.0 [9]. Age-appropriate learning can be done using modern technology. Learning using technology can motivate teachers to make learning innovations [10]. The conventional learning is now starting to be less attractive to students. Students today are millennial

generation children or often referred to as generation Z. Millennial generations have characteristics close to technology. Teachers should prepare learning that is integrated with technology [11]. Students are more interested in learning through multimedia.

Multimedia is a combination of several techniques and formats in the form of devices, forms of representation, and information receivers [12]. Multimedia can present text, 2D and 3D images, and videos for simulation. Teachers can present learning according to the needs of the revolutionary era 4.0 with multimedia. The visual components presented with multimedia can make learning more enjoyable [13]. Students can use smartphones for learning with multimedia, so that learning becomes more desirable.

Multimedia Learning Module (MLM) is a module that uses multimedia. MLM is a multimedia module that combines text, animation, video, and representation [14] [15]. MLM is flexible and easy to use because it can be accessed anywhere and anytime [16]. MLM can be used as an alternative in learning compared to less effective use of textbooks [17] [18]. The application of multimedia techniques is currently more effective than other techniques to improve the abilities of students [19]. Books in general can only display 2D text and images, while MLM can display 3D simulations. 3D simulation in MLM can be displayed using the help of a hologram.

Hologram is a photographic method that combines light into 3D forms [20]. A hologram is formed from a microscopic combination of coherent rays. Holograms are a storehouse of information which can then form 3D images and videos. Holograms have a bright future and can be applied in various sciences [21]. The use of technology in the form of 3D holograms is effectively used in learning [22]. Smartphone-based MLM equipped with 3D hologram simulation for physics learning is expected to be a new innovation. Hologram simulations can be displayed easily using a smartphone and hologram mica. Interesting learning makes learning activities more meaningful, so as to improve the abilities of students.

## 2. RESEARCH METHOD

This study uses MLM with holographic simulations to improve students' mathematical representation skills. The research method in this study was pre-experimental with one group pre-test and post-test. The research design image can be seen in Figure 1 with $O_1$ is Pre-test, $O_2$ is Post-test, and X is MLM implementation with hologram simulation. The researcher chose to use the experimental method

because the number of students was limited considering that there was an outbreak of Covid-19.
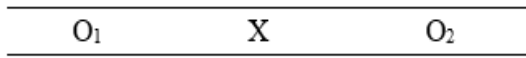
$$O_1 \qquad X \qquad O_2$$

**Figure 1** Research design

This research was conducted at SMA Negeri 1 Muntilan in the 2019/2020 academic year. The research was conducted from April to May 2020. The research subjects in this study were students of class X IPA 1. The number of students as research subjects was 35 students, selected by purposive sampling. In this study, the dependent variable measured was the students' mathematical representation ability. While the independent variable in this study is learning using MLM with holographic simulations. The physics material used is simple harmonic vibrations. Data collection was carried out using multiple choice questions to measure students' mathematical representation abilities.

This study uses learning tools and research instruments that have been validated by expert validators. Learning tools and research instruments are feasible based on validation analysis from expert validators.. An example of an MLM display with hologram simulation is shown in Figure 2 and Figure 3.
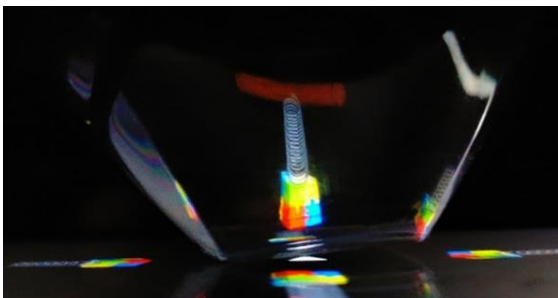


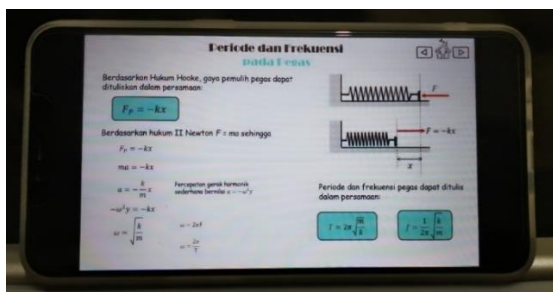**Figure 2** Simulated hologram display of harmonic vibrations on a spring



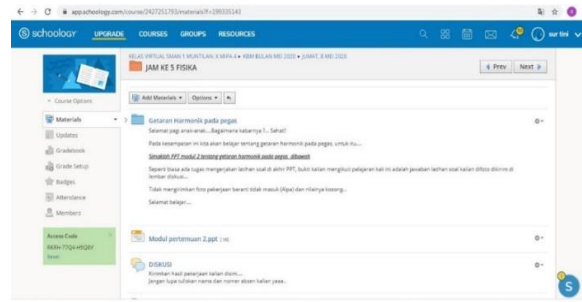**Figure 3** Display of Multimedia Learning Modules



**Figure 4** Display of virtual class via schoology application

This research begins by measuring the initial abilities of students through a pre-test. After obtaining the pre-test value, the study continued to provide MLM with hologram simulations to students on simple harmonic vibration material. Learning is carried out online through the Schoology application. The Schoology display can be seen in Figure 4. After learning, the study ended with a post-test. The pre-test and post-test data collection techniques used multiple choice questions. The pre-test and post-test questions given each amounted to five questions of mathematical representation.

The data that has been obtained are then analyzed to determine the increase in the mathematical representation ability of students. The data analysis technique used is descriptive analysis calculating the value of $N_{gain}$ [23]. The $N_{gain}$ equation used is in equation (1)

$$N-gain = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \times 100\% \qquad (1)$$

The results of $N_{gain}$ analysis is categorized as in Table 1 [23].

**Table 1.** N-gain analysis category

| The $N_{gain}$ value | Category level |
|---|---|
| $x \geq 0{,}7$ | High |
| $0{,}7 > x > 0{,}3$ | Medium |
| $x \leq 0{,}3$ | Low |

## 3. RESULT AND DISCUSSION

Development of MLM learning media with hologram simulations using simple harmonic vibration material in physics subjects. This research took place online through a virtual Schoology class because it was still in a pandemic state of Covid-19. The first stage of learning begins by measuring the initial ability of students' mathematical representations. Students work on pre-test questions through virtual Schoology

classes. In the second and third stages, students studied MLM part 1 and MLM part 2, which they downloaded from the virtual Schoology class. The lesson ends by discussing the questions contained in MLM. The fourth stage measures the final ability of students' mathematical representations with post-test questions through virtual Schoology classes. The pre-test and post-test data analysis used descriptive analysis by calculating the $N_{gain}$ value. Table 2 provide analysis of pre-test and post-test result of mathematical representation.

**Table 2.** Results of the pretest and posttest of mathematical representation ability

|  | Pretest | Posttest |
|---|---|---|
| Lowest | 20 | 40 |
| Highest | 80 | 100 |
| Average | 38 | 76 |
| Average of $N_{gain}$ | 0,6 | |
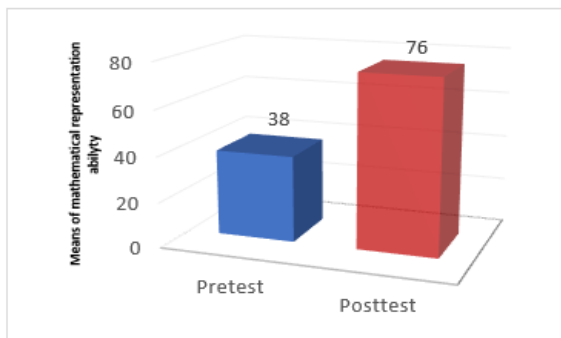


**Figure 5** The average value of the mathematical representation

The average pre-test value acquisition for mathematical representations can be seen in Figure 2. The results of the calculation of the $N_{gain}$ 's score obtained a value of 0.6, This value indicates an increase in the mathematical representation ability of students in the medium category. MLM can help students learn independently. In addition, hologram simulation in MLM can help increase students' representational abilities by learning through virtual classes. In addition, by using MLM students can learn anytime and anywhere [19], so that MLM is flexible to use.

The improvement of students' mathematical representation ability is still in the medium category, based on the results of data analysis. One of the things that affects is a virtual learning model without any prior preparation due to covid-19. Learning through virtual classes is carried out with the help of Schoology. Schoology is able to assist in providing

online questions, means of discussion, and sharing learning media, in this study the form of MLM media with hologram simulations. The use of Schoology in virtual learning makes it easy for researchers and students. The value of the work of students can be downloaded from Schoology along with the answers to each item. Even so, learning through virtual classes is still ineffective, because it cannot monitor students directly. Besides Schology, you can also use other learning applications such as Google Classroom, Microsoft Teams, and many more.

MLM with holographic simulations can be used for learning physics based on the results of improving students' mathematical representations. Several studies on the development of Android-based MLM improve mathematical representations [24], MLM based on local wisdom increases diagrammatic representations [25], and the importance of MLM as a learning medium for the 21st century [26]. Effectiveness of 3D hologram animation learning [22]

## 4. CONCLUSIONS

Multimedia Learning Module (MLM) with hologram simulation can improve students' mathematical representation skills quite well. MLM can help students in independent learning. In further research, improvements in hologram simulations and MLM are needed to make them more detailed and easier to understand. In addition, online learning should be carried out by video conferencing so that students can monitor students through video shows.

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