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The 3-Dimensional Hologram on Biophysics Learning

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ABSTRACT

This study aims to determine the effectiveness of using 3D Holograms in supporting the learning process in Biophysics courses. The topic of the material taken is about the concept of waves and bone structure. The sample was 60 students who are divided into the experimental and control group. The instruments of research were test and questionnaire. The analysis data used t-test independent sample. The research found an increase in student learning outcomes on the concepts of physical diffraction, interference, and bone structure. 3D Holograms are able to describe perspectives like real pictures because they are able to give a 3600 view of an object. The average learning outcome of the experimental group is 75.47 and 66,00 for the control group. It can be concluded that the experimental class using Hologram 3D technology has a better value than the control class. The 3D in science could interest the students, construct, and find their knowledge aspect. The learning could be the critical thinking, creative, collaborative, and more applicative.

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Introduction

The digital revolution and the era of technology disruption of a major impact in the field of education. In development, many technologies offer solutions to create innovative lesson. The interaction between the real world and the virtual world can be interconnected. Significantly the use of technology can improve learning outcomes; students are more motivated, more interesting, and facilitates communication (Ozdamli & Turan, 2017). The 21st-century learning concepts requires educators to understand and have the technical skills about technology. When used effectively, technology can improve the understanding of the material provided. Adoption of technology in learning, learners can improve information and encourage higher-level thinking (Flake, 2017).

One of the subjects is a matter of concern Biophysics. In this study, the material to be studied is the subject of Biophysics. Results of the study on subjects of Biophysics, especially in STKIP PGRI Nganjuk is still not maximized. Viewed from the aspect of knowledge, the average results of the study on this course is 68 of 100. The maximum value range in terms of aspects, attitudes, and skills, learning outcomes has not shown good results. This is because there is no adequate laboratory and applied learning models are still based on teacher centers. Impact, students have difficulty understanding the material provided. Another influential factor is characteristic of Biophysics demanding course lecturers understand the concepts of physics and apply it into the field of biology into its difficulties (Bronson et al., 2009). For example, in understanding the microscopic creatures' material (microorganism), lecturers should be able to understand the material with the aid of a microscope, which also must master the working principle of geometrical optics physics.

Observations made in the learning process in STKIP PGRI Nganjuk also showed that 90% of lecturers to teach students aided two-dimensional media such as PowerPoint, print media such as textbooks and writing materials on board. From the learning process, the questionnaire results showed that: (1) students feel tired of the media used, (2) the lessons delivered through two-dimensional media is not attractive because of the material

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presented does not display the elements of movement that resembles a real picture. This means it is time for educators started implementing the concept of learning that is visually noticeable explicit materials. One of them uses 3D holographic media. They are learning to use a 3D hologram more attractive than using two-dimensional (Abass, 2014). 3-dimensional visualization capable of presenting things that are more real and closer to the original object. So that students will be more motivated to look at objects that are presented, identifying, analyzing, and concluding findings. If attention, concentration, and motivation have increased the ability of students to analyze also increased.

Based on the problems described above, the learning model used is an appropriate inquiry. Inquiry learning model in accordance with the concept of science learning because being able to place the students as a subject of study. Students find their core role in the material being studied. Holographic media role in the concept of inquiry learning is provided as an aid student in understanding the material, help with the investigation, identifying and designing the settlement of the problem. Through the implementation of the inquiry learning model, the learning outcomes of students has increased. This is because students are directly involved in learning. This involvement implies the skill and attitude that gives an opportunity to find solutions to problems when building new knowledge (Mahulae, et al., 2017). In addition, the inquiry learning model is a strategy that is centered on students, is able to stimulate students' critical and creative thinking, encourage students to conduct an investigation into a problem scientifically, promote the ability to work in teams, and develop self-concept self-esteem so that they can understand basic concepts better (Maduretno, et al., 2017). Stages of inquiry learning model leads students to reach the stage thinking high level, which starts from activities (1) discovery learning, (2) interactive demonstration, (3) inquiry lesson, (4) inquiry laboratory, (5) a hypothetical inquiry (Wening, 2011) , The event begins with studying a concept based on experience, predict, identify scientific concepts based on empirical measurements of variables and produce explanations for the observed science more realistic.

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The utilization of 3D hologram media is intended as a tool to support the learning process. This holographic technology can replace real objects in a lesson. Such as the lack of laboratory equipment, which can be addressed through the media a copy of the hologram. Learning by utilizing holographic technology can increase the motivation to learn and clarify understanding of the material to be delivered. Application of holograms in education as a medium of learning will make the students tend to be more active. Students seemed to interact directly with a learning object. In contrast to the study of books only display images in two dimensions. With the hologram students can see the object from any point of view (Gohane & Longadge, 2014). Holograms, in theory, are to take the light from the objects around and describe it in three dimensions. Hologram is a Greek term derived from the word Holos which means to see and gram means writing. Three-dimensional hologram is a recording that can be developed in learning to visualize the holographic content of a material (Khorasaninejad, et.al., 2016) and (Sudeep, 2013).

The purpose of this study to determine the effectiveness of the use of 3D Hologram in supporting the learning process in the subject of Biophysics. Thus, the hypothesis (Ha) proposed is the use of 3D Hologram effectively to improve student learning outcomes at the course Biophysics. Hologram 3D media utilization is expected to make students more enthusiastic and keener to learn. The effectiveness of learning in terms of the results of tests and questionnaires.

Methods and Materials

The research uses descriptive method with quantitative approach. The population in this study is the semester students of three (3) in Science Education Program who took the course Biophysics. Topic materials used are waves and order. Samples were taken randomly (cluster random sampling) is comprised of 30 students as the experimental class (group 1) and 30 students as control group (group 2). The study design using posttest control group only by comparing the final test in the control group and the experimental group after treated (treatment) as shown in Figure 1. The validity of the instruments used in the form of construction validity is gained through consideration of the

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expert (expert judgment). Validity testing aims to get the level of validity and the validity of the instrument.

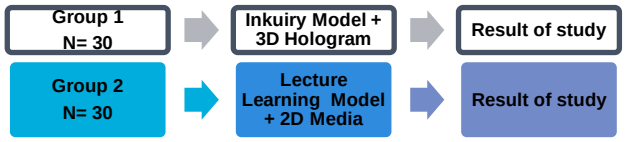

Figure 1. Research Design Methodology

Referring to Figure 1, Group 1 is an experimental class and the process is inquiry learning teaching methods aided 3D holographic media. Group 2 is a control class learning process using model lectures and demonstrations aided two-dimensional media. Two-dimensional media in question is using PowerPoint media, printed books and blackboards. The learning process implemented as shown in Table 1 below.

Table 1. Learning Process in Experiment Class and Class Controls

Learning Process In Classroom Experiment (Group 1)	On the Learning Process Control Class (Group 2)
Level of Inquiry 1: Discovery Learning Understanding the concept of order and wave (interference and diffraction). The stimulus is done by showing a 3D video hologram.	**Level 1. Preparation** Formulate the purpose and subject matter to be discussed.
Level of Inquiry 2: Interactive Demonstration Students study the link between 3D hologram with the material. In this level students formulate the hypothesis that physically, there is a link between the concept of 3D hologram with wave concept.	Explain the material by utilizing PowerPoint media, printed books, and write on the board for the learning process.
Level of Inquiry 3: Inquiry Lesson Students seeking information, collecting data, and facts to answer the hypothesis. The literature is used through Youtube videos, books and scientific articles.	**Level 3. Cover** 1. Guide students to draw conclusions from the subject matter that had just delivered. 2. Giving matter.
Level of Inquiry 4: Inquiry Laboratory Students conduct experiments create 3D holograms to reinforce the concepts found. The laboratory inquiry process can be seen in Figure 3.	
Level of Inquiry 5: Hypothetical Inquiry Drawing conclusions from the material that has been given (to be explained in Figure 4)	

The data collection technique used observation, documentation, questionnaire, and test. Data were analyzed using Independent Sample T-Test. The effectiveness of the learning process, in addition to review of the test data, is also based on a questionnaire given to the students after learning. This questionnaire refers to the five indicators: (1) effective in presenting original visualizations that resemble objects;

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(2) Enhance the real-time experience of participants; (3) Enhance effective interaction between students and teacher; (4) effective in theoretical and practical subject content delivery; and (5) encourage active participation in the learning process.

Finding

Table 2. Means and SD of the Control and Experimental Groups of Scores Post Test.

Group Statistics					
	Class	N	Mean	Std. Deviation	Std. Error Mean
Learning outcome	Group 1	30	75.4667	8.11866	1.48226
	Group 2	30	66.6000	8.36083	1.52647

Based on Table 2, with each sample number 30 showed an average of learning outcomes in Group 1 was 75.47 and group 2 was 66.66. Group of 1 standard deviation value is also lower than group 2, and still below the mean value of the total. This means that the mean value can be used as representative of the overall data—the standard error of the mean of 1.4822 group 1 and group 2 at 1.526.

Table 3. Value of T-Test Obtained Through Simple Independent T-Test used for the Equality of the Mean.

Independent Samples Test									
	Levene's Test for Equality of Variances		t-test 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 variances assumed	.008	.931	4.167	58	.000	8.86	2.127	4.607	13.125
Equal variances not assumed			4.167	57.95	.000	8.86	2.127	4.60749	13.1258

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Based on Table 3, with a significance level of 0.05 was obtained T_{count} value of 4,167 to 2,002 T_{table}. While based Sig. (2-tailed) for the experimental class and control class of 0.000, which is less than 0.05. Then the basis for a decision in accordance Test Independent Sample T-Test can be concluded H_a accepted. This means that the use of 3D hologram is effective for improving student learning outcomes at the course Biophysics. If the views of the average value of the two groups, the first group had better learning outcomes of Group 2.

Discussion:

The effectiveness of learning with 3D Hologram media compared with 2D media

If evaluated based on the results of learning, the learning outcomes using the 3D is better than 2D. In this case, the educator also performs observation and questionnaires to better know more effectiveness. As shown in Figure 2.

Based on Figure 2, it can be explained that (1) 86% of respondents believe that 3D improve the real-time experience of the of participants compared to media 2D only by 67%, (2) 92% of respondents believe that 3D Enhance effective interaction between students and teacher compared with media 2D by 70%, (3) 84% of respondents believe that the 3D effective in theoritical and practical subject content delivery compared with media 2D by 72%, (4) 89% of respondents believe that 3D encourage active participation in the learning process than the media 2D by 68%, and (5) 95% of respondents believe that 3D visualizations effective in presenting original objects that resemble compared with 2D media at 65%. Based on Figure 2, we can conclude that learning to use the media better 3D than 2D. Via 3D hologram, the respondents can see something resembling the original image, see the depth, parallax, and perspective view of 3600. So students as if invited to learn the real object (Abass, et al., 2014). Another advantage, the teacher can present a variety of objects that do not exist in the laboratory with ease.

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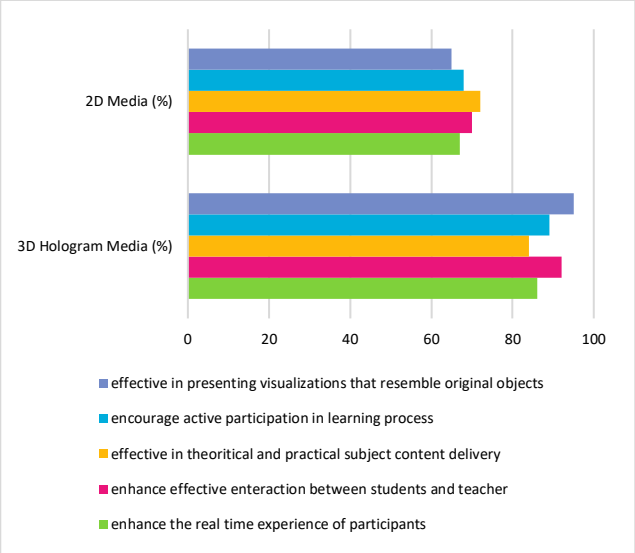

Figure 2. Effectiveness of Learning Using 3D charts and 2D

The incorporation of technology in learning is not inevitable. Numerous studies show that the use of 3D holographic technology in learning can affect the ability of spatial visualization. The use of 3D hologram has several advantages such as (1) conducting activities in a risk-free environment, (2) facilitating collaboration and communication, and (3) allowing visualization of abstract or difficult, concepts or ideas (Eschenbrenner et al., 2008), However, it does not mean the use of 3D hologram has no weaknesses. 3D rendering quality may be one of the most important factors in determining the effectiveness and clarity of visualization. If rendering quality is bad, then the 3D view is also not optimal (Lee, 2013).

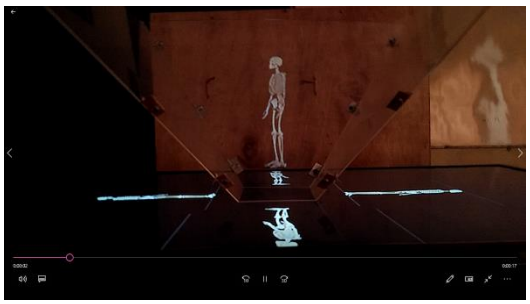

Figure 3. 3D Holograms to Content Frame

Based on Figure 3, it can be explained that the process of making a 3D hologram by students to utilize mica material with a trapezoidal shape is used to learn the material, especially the Framework Biophysics and Wave. Video hologram itself is made using Camtasia Studio 8 software that display uses LED TV as a light source. In the laboratory inquiry process, the process of cooperation, team communication, and discussion can be established. This triggers for activists and motivated students to understand the material (Katsioloudis & Jones, 2018). Of course, the skill aspect of the respondents also increased.

The conclusion that the hologram is formed from a combination of coherent light beam in the form of microscopic. It is within their interference terms that would have happened if the two light waves combine in one point has the same phase difference (coherent). Another condition that is both light must have the same

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frequency, same amplitude, and interference occurs in a linear polarized light. Referring to the concept of interference, the hologram is the sum of the superposition of two waves of light that is constructive (Figure 4). If the phase difference of the two waves of the same, then the new wave is formed from the sum of the two waves.

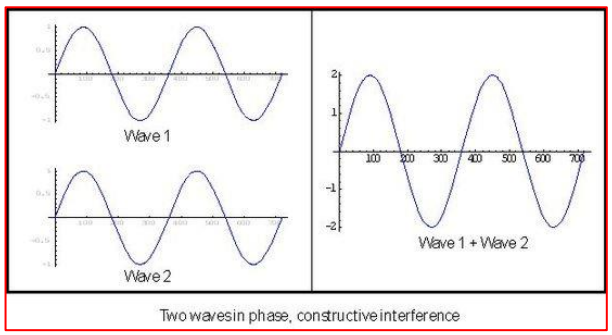

Figure 4. Constructive Interference.

The working principle of diffraction and interference as a combination of coherent light rays and microscopic. The process consists of a holographic recording and reconstruction. In the recording process, the laser beam as monochromatic light emits light, some light there was forwarded to the object and is reflected in the mirror due to the beam splitter. The transmitted beam directly on the object, whereas the monochromatic light beam splitter is then reflected on the mirror. Then the mirror is reflected to the light as the reference beam and the surface area of the image. The light meets the light reflected by the object to the surface of the image area into a mix of monochromatic light. Projector screens and surfaces form an angle of 450 images. This is what is referred to as the recording process. The combination of the light is then captured by the projector screen as in Figure 5.

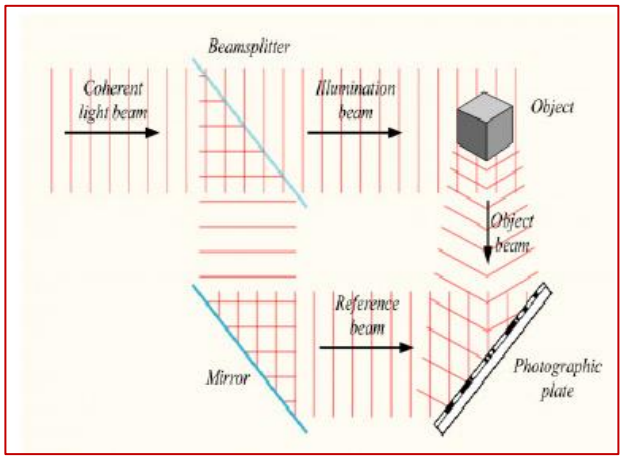

Figure 5. Recorded hologram from a coherent beam of light

After the recording is the process of reconstruction. The combination of monochromatic light on the surface of the image area then demonstrated to the observer as a result of reconstruction. Wavelength from the light source to the process must be qualified reconstruction Bragg diffraction the following equation:

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$2 d \sin \theta = n \lambda$

With λ is the wavelength, d is the lattice spacing, θ is the angle of the incident light, and n = 1, 2, 3, 4, and following is the order of diffraction. In this study, using the light from the light source LED TV. According Arifah, et al., (2007), a reflection holographic reconstruction that uses several different wavelengths of LEDs in white, blue, and yellow, then reconstructed using white LEDs produce clearer images than the use of other colors.

Through inquiry learning model aided 3D hologram, the submitted materials become more attractive and can significantly improve learning outcomes. The results were significant can be seen in Figure 2. The issue of the lack of media as well as laboratory equipment, can be overcome by using a 3D hologram media. According to its function, the media is able to present 3-dimensional mock objects that resemble the original object without changing its function (Daryanto, 2010). Overview on the material aspects of biophysics, physically students are able to analyze the theory of the concept of the wave. While on the biological aspects, students can learn the material remains of human skeleton without any significant problems. 3D hologram is able to reinforce the learning process and be an effective tool in delivering teaching materials (Sudeep, 2013). The process of investigation done by respondents in using technology becomes an important point of teachers in instilling the concept independently (Williams et al., 2017). By creating a 3D hologram project independently, showing the proceedings already under way. Respondents responding to problems and answer them through practical activities. The results, summarized. This invention independently concepts that make more meaningful knowledge and an experience not easily forgotten. Inquiry learning model proved effective because it can make students more active in participating in classroom learning, practicing critical thinking skills, and increase the independence of learning. The excellence inquiry model is capable of making the students easily understand the content of the material because it is a real experience activities of investigation, analysis, and apply the data to resolve the problem (Sefriyan & Coesamin, 2013).

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Conclusion:

Based on research conducted, it can be concluded that the use of 3D hologram effectively to improve student learning outcomes at the course Biophysics. Effectiveness seen in the experimental class using inquiry learning model-aided 3D holograms have better value than learning with lectures and discussion models using 2D media. The end product of this research are 3D Hologram with the theme of the Framework. Media created is used to discuss the concept of wave and Skeleton Man. Significantly, the use of 3D Hologram media through inquiry learning model can replace the instructional media that does not exist, students have the experience to create new things, improve the atmosphere of discussion and communication between faculty and students, and enhance the activity of the students to learn.

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