Effect of learning media tank ripple wave with the implementation of guided inquiry model on concept mastery of high school students

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Abstract. This study aims to determine the effect of the wave ripple learning media with the implementation of the guided inquiry model on the mastery of concepts for high school students. The material in the learning media for the wave ripples under study is reflection, diffraction refraction and interference. This type of research is an experimental research design with pre-test and post-test group design. The population in this study were all students of class XI high school in Mataram. Sampling using total sampling technique with class XIA as the experimental class and class XIB as the control class. The research hypothesis was tested using t-test with pretest and posttest and the improvement of learning outcomes was tested using the N-gain equation. Based on the results of hypothesis testing to master the concept, the value of t count (1.986) > t table (1.732) is obtained at the 5% significance level, so it can be concluded that there is an effect of the wave ripple learning media with the implementation of guided inquiry models on the mastery of concepts for high school students. Furthermore, the increase in concept mastery can be seen from the highest N-gain score in the experimental class found in the interference sub-material of 89.45%, while the highest N-gain score for the control class is in the refraction sub-material at 76.41%.

1. Introduction

The learning process in the 2013 curriculum that applies in Indonesia emphasizes a meaningful learning process for students. Educators are required to pay attention to two important elements in the teaching and learning process, namely the learning model and learning media so that learning is more learner-centered. Studying physics emphasizes a meaningful learning process that is able to develop the ability to understand the natural surroundings scientifically [1]. Not only limited to memorizing activities but must understand [2]. Meaningful learning can occur in the laboratory, so that students have the opportunity to manipulate equipment and materials in the surrounding environment to build knowledge based on phenomena and the relationship between science concepts [3].

Laboratory is one of the means to bring students to understand the real subject matter which provides a meaningful learning experience directly [4]. The teaching and learning process contains elements that are important to note, namely the learning model and learning media. The two elements are related to each other, the use of certain learning models has an influence on the type of learning

media used [5]. The lack of research in the field of physics about mechanical wave material at the high school level so that students have difficulty understanding the basic concepts of mechanical waves [6, 7].

Media is defined as an intermediary or introduction while learning as a process or method, the learning media can mean anything that can be used to transmit messages and stimulate the learning process in students as learners. The learning media used is the wave ripple tank on the mechanical wave material where students are required to be able to do one experiment, for example the ripple tank, which is a special tool used to investigate the motion of waves on the surface of the water [8]. Experimentally, the ripple tank is one of the media used to conduct experiments regarding the basic properties of waves, such as: reflection, refraction, diffraction, and wave interference [9]. Learning media that have been designed are associated with the inquiry approach, where the inquiry approach is a process of asking and finding out answers to scientific questions asked, then inquiry learning media must be adjusted to what is needed in the process which includes observation activities using tools and materials for conducting experiments to obtain data and make predictions and communicate the results [10, 11].

Guided inquiry model is a learning model that guides students to find and develop knowledge close to life through a hypothetical process so as to increase students' understanding of concepts [12]. The results of previous studies showed that the guided inquiry model found that classes using inquiry learning models were better than those using conventional learning models [13]. Applying a laboratory-based guided inquiry model involves students to actively seek and find solutions to the questions given [14]. The inquiry model has the largest average compared to the conventional model on the science process skills of students. The delivery of mechanical wave material using the wave ripple tank learning media with the implementation of the guided inquiry model is manifested in the form of wave ripple tank learning media as a tool that functions to facilitate students' understanding of the wave material. The purpose of this study was to see the effect of the wave ripple tank learning media with the implementation of the guided inquiry model on the students' mastery of concepts in physics subjects in class XI with the material of mechanical wave characteristics. The wave ripple tank learning media is used as a tool in the learning process which is expected to improve students' mastery of concepts.

2. Method

This type of research is an experimental design with a pretest-posttest group design. The population in this study were all students of class XI high school in Mataram. Sampling using total sampling technique with class XIA as the experimental class and class XIB as the control class. The experimental class was given the treatment of guided inquiry learning models, while the control class was given treatment with conventional learning models. The collection of data on the mastery of the concept of mechanical wave material consists of four sub-materials, namely: reflection, refraction, diffraction, and wave interference. The research instrument used was in the form of an essay test that had been analyzed for validity, reliability, distinction, and level of difficulty [15]. The results were analyzed using the homogeneity test, normality test, and hypothesis testing, namely the t-test with pre-test and post-test. In addition, an N-gain test was also conducted to determine the increase in the mastery of the concept per sub-material. Mastery of concepts measured in this study is limited to the cognitive domain. To find out the amount of N-gain, it can be calculated using equation [16]:

$$\text{N} - \text{gain} = \frac{S_{post} - S_{pre}}{S_{max} - S_{pre}} \quad (1)$$

Where, S_{post} is post-test score, S_{pre} is pre-test score, and S_{max} is highest score.

Based on the results of the score, the N-gain is further categorized into 3 criteria, namely as in Table 1.

Table 1. Criteria for N-gain

N-Gain Value	Category
$g \geq 0.7$	High
$0.7 > g \geq 0.3$	Middle
$g < 0.3$	Low

3. Result and Discussion

The results obtained from this study are the pre-test results, post-test results, homogeneity test results, normality test results, and hypothesis test results. The pre-test results in the experimental class and control class are included in the category that tends to be low. This can be seen from the average score of the test, namely 50.27 for the experimental class and 42.33 for the control class. When compared with the post-test data, the mean score of students in both classes has increased significantly. Students in the experimental class obtained a higher average score, namely 85.72; while students in the control class obtained an average score of 77.34. The results of the pre-test and post-test of the experimental class and control class can be seen in Table 2.

Table 2. Data on pre-test and post-test results for experiment class and control class

Test	Classes	Total Student	Maximum Score	Minimum Score	Average	Varians
Pre-Test	Experiment	23	61	30	50.27	Homogeneous
	Control		60	28	42.33	
Post-Test	Experiment	23	89	79	85.72	
	Control		80	66	77.34	

One of the requirements to be able to provide treatment to the experimental class and control class is to use a homogeneous sample. To find out whether the experimental class and the control class had relatively homogeneous initial abilities, the sample homogeneity test was carried out using the F-test with a significance level of 5%. Based on the initial homogeneity test, the variance value for the experimental class was 67.56 and for the control class was 83.33. By comparing the largest and the smallest variance, the F_{count} value is 1.23; while the value of F_{table} is 1.98. To determine the difference in the increase experienced by the two classes quantitatively and the effect of the given model, it is necessary to test the hypothesis and test the N-gain. The requirements for conducting a hypothesis test and N-gain test, the data obtained comes from a homogeneous sample with normally distributed data as shown in Table 3.

Table 3. Homogeneity and normality test results for experimental class and control class

Homogeneity Test			
Classes	*Post-test*		
	F_{count}	F_{table}	Homogeneous
Experiment Control	1.52	1.89	
Normality Test			
Classes	*Post-test*		
	χ^2_{count}	χ^2_{table}	Normally distributed
Experiment	5.569	7.423	
Control	4.670		

The value of F_{count} and χ^2_{count} in the experimental class and control class is smaller than F table and χ^2_{table}. So it the data obtained is homogeneous and normally distributed. Thus, the hypothesis test used is the t-test with pre-test and post-test. By using the t-test with pre-test and post-test, the value of

t_{count} = 1.986 while the value of t_{table} = 1.732. This shows that t_{count} is greater than t_{table}, which means Ho is rejected, so it can be concluded that the wave ripple tank media with the guided inquiry learning model have an effect on the conceptual mastery of mechanical wave sub material.

As a follow-up to data analysis, an N-gain test was conducted to determine the increase in the value per sub-material in the two classes. The normalized gain test also aims to determine the significance level of the increase in concept mastery after being given treatment. This test is the difference between the initial test score and the final test which is made in the form of a percentage. The highest N-gain score in the experimental class was in the Wave Interference sub-material by 89.45, while the highest N-gain score for the control class was in the refraction sub-material at 76.41.

For the sub-material of reflection, refraction, diffraction and wave interference in the N-gain experimental class, it is in the high category. Meanwhile, for the control class, for the low category of reflection, the medium category of diffraction and refraction and interference was in the high category. Increased mastery of concepts per sub-material can be seen in Figure 1.

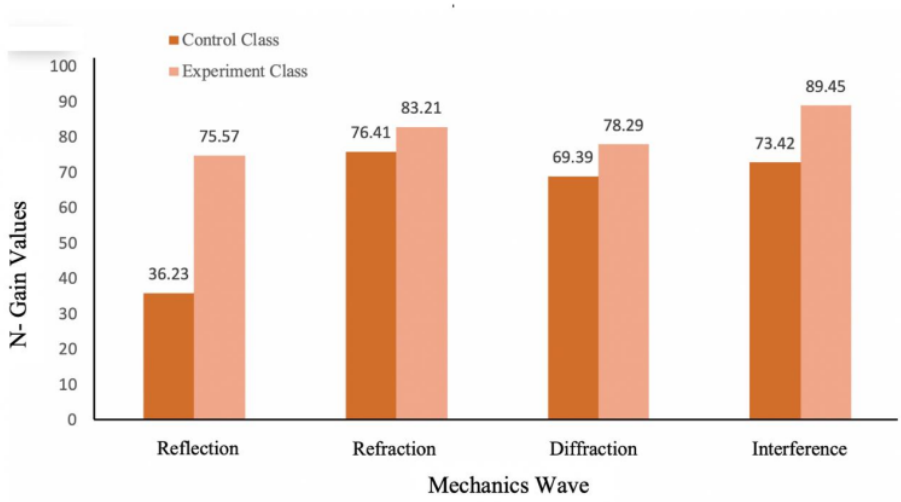

Figure 1. N-gain per sub wave mechanical material in class experiment and control class

As seen in Figure 1, the N-gain value in the experimental class for each sub-material is always greater than the control class, so it can be concluded that the increase in understanding of the concept of mechanical waves in the experimental class is better than the control class. This increase can occur because the experimental class is given treatment by applying the guided inquiry learning model. In line with research that has been carried out, physics intranet web learning has been effective in increasing the mastery of concepts but has not been effective in increasing the problem-solving abilities of vocational high school students [17]. The effect of guided inquiry learning models can improve students' critical thinking skills [18]. The use of the interactive multimedia-based STAD cooperative learning model in thermodynamic learning affects students' mastery of concepts [19]. In addition, the development of guided inquiry learning tools based on real media and the development of quantum phenomenon learning tools with the TPS model can improve students' understanding of concepts and science process skills [20, 21, 22].

4. Conclusion

The post-test mean score of the experimental class students was higher than the control class. The increase in mastery of the mechanical wave concept per sub-material after being given treatment in the experimental class was higher than the control class. Students in the experimental class are more

active in learning activities than the control class. The wave ripple tank learning media with the implementation of the guided inquiry model has an effect on the conceptual mastery of high school students.

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