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The Effectiveness of the Reciprocal Teaching Learning Model Based on Multiple Intelligences (MI) on Student Learning Outcomes in Class VIII Vibration, Waves and Sound Material

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ABSTRACT

Purpose of the study: This study aims to determine the effectiveness of the reciprocal teaching learning model based on multiple intelligences on the learning outcomes of students on vibration, waves and sound in class VIII Junior high school.

Methodology: This research is experimental research conducted in junior high schools. The sample in this research was class VIII junior high school students. The sampling technique was carried out using a saturated sampling technique. Data collection uses the test method (multiple choice test) to obtain data about learning outcomes. Test the research hypothesis using the t-test.

Main Findings: Based on t test calculations with a significance level of 5%, tcount = 3.01 while ttable = 1.994. Because $t_{count} > t_{table}$ means that the average physics learning outcomes of students who are taught using the multiple intelligence-based reciprocal teaching learning model are effective on student learning outcomes. So, it can be concluded that learning using the reciprocal teaching learning model based on multiple intelligences on vibration, wave and sound material is effective on the learning outcomes of class VIII students in junior high schools.

Novelty/Originality of this study: This research makes an important contribution in understanding how various learning strategies can be adapted to the individual needs and intelligence of students to improve their learning outcomes in complex material such as Waves, Vibrations and Sound.

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1. INTRODUCTION

Education is a process to influence students to adapt to the environment. Education will cause changes in students, which allows students to be useful in social life [1]. Every human being is born into the world in different circumstances from one another, one of which is genetic differences [2]–[4]. These genetic differences can also be influenced by the environment that surrounds human life experiences, whether family, community, playmates, school or other environments [5]–[7]. The result of a combination of genetic differences and differences in life experiences can transform a human being into an individual with unique basic characteristics (potential, interests and talents) [8]–[10]. This means, no human being has exactly the same characteristics even though identical twins, they still have different characters.

Differences in student character depend on elements that influence each other, one of which is the talent that students have from birth will grow and develop thanks to environmental influences [11], [12]. Conversely, the environment will be more meaningful if it is focused on existing talents, although it cannot be denied that there is a possibility that differences in character are solely caused by talent or by the environment alone [13]. So, these character differences can only be developed and nurtured effectively through an integrated education and learning strategy, which is managed in a harmonious and balanced manner by paying attention to the development of students as a whole. Learning physics is not only studying concepts, mastering a collection of knowledge in the form of natural facts, or principles but is also a process of discovery [14]–[16]. Physics subjects or topics as part of science education allow students to explore nature and natural events using the laws of physics and scientific methods [15], [17].

The learning strategy implemented in schools so far is still mass in nature, namely by providing equal treatment and educational services to all students. In fact, each class of students has different abilities (intelligence, talent, learning speed, and so on), and has different learning styles as well [18]. Creating learning activities that are able to develop maximum student learning outcomes is the task and obligation of the teacher, therefore the teacher tries to plan learning activities that can facilitate student understanding [19]. Thus, student learning outcomes become better and maximal.

The effort that can be made by the teacher to overcome these individual differences is to use an appropriate approach for each student. Efforts have been made especially by education experts to overcome these problems. One of them is Munif Chatib, an Indonesian educational consultant who is trying to improve education in Indonesia through the use of the theory of multiple intelligences. At first multiple intelligences was a theory of multiple intelligences raised by Dr. Howard Gardner, a psychologist from Harvard University in 1983 [20]. Then by Munif Chatib, the theory was modified and applied to the world of education to become a learning strategy used in the learning process [21].

The multiple intelligences strategy includes a variety of learning methods and learning techniques that are implemented based on the intelligences possessed by students. Among them are: 1) linguistic intelligence (related to language), 2) logical-mathematical (related to reason-logic and mathematics), 3) spatial (related to space and images), 4) kinesthetic (related to bodies and body movements) , 5) musical (related to music, rhythm and sound), 6) interpersonal (related to interpersonal-social relations), 7) intrapersonal (related to things that are very personal), 8) extensive, 9) naturalist intelligence (related to liking nature) and 10) spiritual intelligence [22].

Theory of multiple intelligences (MI) is a theory which reveals that no student is stupid, all students are intelligent [23]. Most people see that students who are smart in thinking and speaking are called smart students, while students who may be less prominent in the two intelligences are considered stupid students [24]. On the other hand, in multiple intelligences, every student is highly valued, regardless of the intelligence that is most prominent in them, so that the learning process based on multiple intelligences truly values students with their own uniqueness [25]. Based on the above problems, researchers feel the need to develop a learning model that is supported by Howard Gardner's theory of multiple intelligences in education and teaching.

The author will use the reciprocal teaching learning model based on multiple intelligences (MI) to develop Howard Gardner's theory, with the hope that later students will more easily understand physics lessons with their intelligence. So that it can affect their learning outcomes.The reciprocal teaching model based on multiple intelligences (MI) is a model where the learning system is not fully carried out by the teacher, but it is the students who play a greater role in learning [26]. The reciprocal teaching model based on multiple intelligences (MI) provides opportunities for students to get used to analyzing and developing their reasoning from situations or problems given either in the form of reading materials or in the form of questions [27]. The success of the analysis carried out is seen in the conclusions obtained by students and their ability to explain back the knowledge they have obtained.

This strategy is a strategy of reading and taking notes during learning. So that all students have the opportunity to convey what they do not understand. The use of the reciprocal teaching learning model based on multiple intelligences (MI) is expected to foster learning motivation in students so that they can further improve learning outcomes, so that they can match what is desired. Vibration, wave and sound material can be used using the reciprocal teaching learning model based on multiple intelligences (MI), with reciprocal teaching based on multiple intelligences (MI) students can understand and analyze the material given based on the intelligence they have [28].

If the understanding and mastery of students' concepts of vibration, waves and sound material is achieved, then students will no longer have difficulty applying physics problems in everyday life, so that it will improve learning outcomes and achieve learning goals. Based on the results of previous research, it was found that there is an interaction effect between learning models and multiple intelligences on students' mathematics learning achievement [29]. As a novelty from previous research by Nugroho, this research was conducted to determine the effectiveness of the Reciprocal Teaching Learning Model on student learning outcomes [30].

The difference between previous research and the current research is the research sample and also the subjects used as research subjects. As a generalization of previous research, this research was conducted in class

VIII of junior high school on the subject matter of physics, namely Vibration, Waves and Sound Material. This research makes an important contribution in understanding how various learning strategies can be adapted to the individual needs and intelligence of students to improve their learning outcomes in complex material such as Waves, Vibrations and Sound. The urgency of conducting this research is the low level of teacher attention to student potential, so a learning model is needed that can develop students' potential abilities accompanied by success. student academics. So this research aims to determine the effectiveness of the multiple intelligence-based reciprocal teaching learning model on student learning outcomes in vibration, wave and sound material in class VIII junior high school.

2. RESEARCH METHOD

2.1. Research Type

This type of research is quantitative research with experimental methods. Quantitative research is research with data in the form of numbers and analysis using statistics [31]. The experimental method is a research method used to find the effect of a particular treatment [32]. This research used a posttest only control design, namely placing research subjects into two classes which were divided into an experimental class and a control class and the two classes were chosen randomly.

The experimental class was given treatment, namely learning using a multiple intelligence-based reciprocal teaching learning model, and the control class using conventional learning (using lecture and demonstration methods). The independent variable (X) in this research is the learning strategy which consists of learning using a reciprocal teaching learning model based on multiple intelligences (MI). The dependent variable in this research is the results of learning about vibrations, waves and sounds of class VIII students at Assalamah Ungaran Junior High School.

2.2. Population and Sample

The population in this study were all class VIII students at Assalamah Ungaran Junior High School. In this study, researchers used all class VIII as samples, namely one experimental class and one control class. Sampling was carried out using a saturated sampling technique, namely by using the entire population as a sample, namely as an experimental class and a control class. Sampling was conditioned by considering that students received material based on the same curriculum, taught by the same teacher and students who were research subjects sat in the same class. From the entire population, the Al-Hamid class was chosen as the experimental class and the Al-Mukhtar class as the control class, totaling 36 students and 36 students.

2.3. Data Collection Technique

Data collection techniques use documentation and test methods. In research or evaluation, a combination of documentation and test methods is often used to gain a comprehensive understanding of a phenomenon. Documentation provides context and background, while tests provide measurable, empirically testable data. The use of these two methods can strengthen the validity and reliability of the data collected, as well as provide a more complete picture of the research or evaluation topic being carried out.

2.4. Data Analysis technique

Data analysis techniques use normality, homogeneity and hypothesis testing. Normality is important because many statistical methods and hypothesis testing require the assumption that the data is normally distributed [33]. In the context of this research, hypothesis testing is carried out using the independent sample t test. Independent t test is used when we want to compare the means of two independent groups. For example, whether there are significant differences between two treatment groups or whether an intervention has a significant impact compared to the control group.

3. RESULTS AND DISCUSSION

The effectiveness of the reciprocal teaching learning model based on multiple intelligences (MI) on the learning outcomes of class VIII students on vibration, waves and sound at Assalamah Ungaran Middle School can be known by data analysis, presentation of research data then continued with hypothesis testing, discussion of research results and research limitations. Data analysis activities were carried out after data from all respondents and other data sources were collected. In this study, there were several analyses, including: final data testing and hypothesis testing.

Table 1. List of final test scores for vibration, waves and sound material for the experimental class and the control class

Experiment			Control		
No	Code	Learning outcomes	No	Code	Learning outcomes
1	E-1	80	1	K-1	92
2	E-2	68	2	K-2	80
3	E-3	92	3	K-3	80
4	E-4	72	4	K-4	92
5	E-5	76	5	K-5	80
6	E-6	100	6	K-6	80
7	E-7	88	7	K-7	92
8	E-8	76	8	K-8	76
9	E-9	88	9	K-9	84
10	E-10	96	10	K-10	80
11	E-11	76	11	K-11	80
12	E-12	88	12	K-12	64
13	E-13	80	13	K-13	84
14	E-14	88	14	K-14	80
15	E-15	92	15	K-15	76
16	E-16	88	16	K-16	72
17	E-17	88	17	K-17	88
18	E-18	80	18	K-18	72
19	E-19	88	19	K-19	72
20	E-20	88	20	K-20	80
21	E-21	80	21	K-21	80
22	E-22	88	22	K-22	76
23	E-23	88	23	K-23	76
24	E-24	96	24	K-24	92
25	E-25	84	25	K-25	84
26	E-26	92	26	K-26	88
27	E-27	96	27	K-27	84
28	E-28	80	28	K-28	68
29	E-29	76	29	K-29	72
30	E-30	84	30	K-30	68
31	E-31	92	31	K-31	80
32	E-32	88	32	K-32	80
33	E-33	100	33	K-33	92
34	E-34	68	34	K-34	80
35	E-35	84	35	K-35	80
36	E-36	88	36	K-36	76
Total (Σ) 3076			Total (Σ) 2880		
N 36			N 36		
Average 85,44			Average 80		
Variance (S^2) 65,968			Variance (S^2) 51,2		
St. Deviation (s) 8,122			St. Deviation (s) 7,155		

Information from table 1 above obtained data on the vibration, wave and sound mastery test for the experimental class with the highest score being 100 and the lowest score being 68. The total scores of 36 students were 3076 with the average obtained being 85.44, variance 65.968 and standard deviation 8.122 . while the test results for learning vibration, wave and sound material in the control class had the highest score of 92 and the lowest score of 64. The total scores of 36 students were 2880. While the average obtained was 80, the variance was 51.2 and the standard deviation was 7.155.

The first stage of testing the final data is that the data is tested again for normality by carrying out a normality test. Data from both samples were tested for normality using the Kolmogorov Smirnov test. The hypothesis used is:

H_0 : Data is normally distributed

Ha : Data is not normally distributed

The test criterion is that H_0 is accepted if it is calculated <table with a significant level of 5%. The results of the final stage of normality test analysis were obtained.

Table 2. Normality Test Results (Final Data)

No	Class	D_{count}	D_{table}	Conclusion
1	VIII (Al-Hamid)	0.135	0.226	Normal
2	VIII (Al-Muhtar)	0,166	0.227	Normal

From the table above it is known that D_{count} for both samples is less than D_{table}, so Ho is accepted. This means that the two samples, namely data on class learning outcomes that are given lessons using the reciprocal teaching learning model based on multiple intelligences with conventional learning are normally distributed. After being tested for normality, the homogeneity of the two classes' learning outcomes was tested. It is known that the results of the final stage of homogeneity test calculations are as follows:\

Table 3. Homogeneity test results (final data)

Class	VIII (Al-Hamid)	VIII (Al-Muhtar)
Total value	3076	2880
N	36	36
Average	85,44	80
Variance	65,968	51,2
X^2 count	0,607	
X^2 tables	3,841	

The homogeneity test table above shows that X^2 count < X^2 table with dk (2-1) = 1 and a significant level of 5%, so that the two samples have the same variance or the data of the two samples is homogeneous.

This hypothesis test is used to answer the research hypothesis. Based on data analysis techniques in chapter III, to determine the effectiveness of this study is to look at the two average student learning outcomes. This is done to find out whether learning using the reciprocal teaching learning model based on multiple intelligences is more effective than conventional learning (with the lecture method). The test uses the formula t-test (independent sample t-test) with the following hypotheses:

$H_0 : u_1 = u_2$

$H_1 : u_1 \neq u_2$

Explanation:

u_1 = Average learning outcomes of experimental class students

u_2 = Average learning outcomes of control class students

And with the test criteria: if tcount ≥ ttable with df = n1+n2-2 and a significant level of 5%, then H_0 is rejected. Based on the calculation of the t-test as follows:

Table 4. Independent t-test results

Class	VIII (Al-Hamid)	VIII (Al-Muhtar)
Number of values	3076	2880
N	36	36
Mean	85.44	80
Varians	65.968	51,2
Combined Var	56.97775	
Composite Standard Deviation	7.548	
tcount	3.01	
degrees of freedom	70	
ttable	1.994	

The table above shows that t count = 3.01 and t table = 1.994. Because t = 3.01 > 1.994 then Ho is rejected and Ha is accepted. This shows that there is a difference in the average learning outcomes of students in the experimental class and the average learning outcomes of students in the control class. This means that learning using the reciprocal teaching learning model is more effective in improving student learning outcomes in vibration, wave and sound material.

Based on the hypothesis test above with the t test (independent sample t-test), it is known that there is a difference in the average learning outcomes of experimental class students, namely 85.44 and the average learning outcomes of control class students, namely 80, so learning uses the reciprocal teaching learning model. based on multiple intelligences is more effective compared to conventional learning models. The description above can answer the hypothesis that there is a difference in the average learning outcomes for vibration, wave and sound material in class VIII students at Assalamah Ungaran junior high school between those who use the reciprocal teaching learning model based on multiple intelligences and conventional learning. Therefore, the results of learning vibration, wave and sound material using the multiple intelligence-based reciprocal teaching

learning model are better than the results of learning vibration, wave and sound material using conventional learning (lecture learning).

The results of the experimental class gain calculation (VIII Al-Hamid) obtained an average pretest of 60.667 and an average posttest of 85.44 so that a gain of 0.428 was obtained. In the control class (Al-Mukhtar) the pretest average was 63.667 and the posttest average was 80 so that a gain of 0.268 was obtained. The full calculation can be seen in Appendix 22. Based on these data, it is said that the increase in learning outcomes for the subject matter of vibration, waves and sound in the experimental class using reciprocal teaching learning strategies based on multiple intelligences is better than the control class using conventional methods (lecture method).

The success in this study can be proven by the increased learning outcomes of students in the experimental class and control class with an average value of the experimental class = 85.44 and the average value of the control class with an average = 80. In addition, the reciprocal teaching-based learning model multiple intelligences also have a positive impact on students' cognitive learning outcomes. The reciprocal teaching learning model based on multiple intelligences has a positive impact on students' cognitive learning outcomes, because in learning that involves students directly so that they can learn to teach and develop creativity and find ideas to solve a problem in practical implementation. Student involvement was evident when one of the class representatives conveyed the results of discussions and experiments in front of the class according to their intelligence as evidenced by the presence of students who conveyed the results of the discussion by singing. This research has limited time and place. This research was conducted at Assalamah Middle School Ungaran and was limited to that location. This allows different results to be obtained if done in different places. However, the possibility is not much different from the results of this study.

This research is supported by the results of previous research which revealed that the Multiple Intelligences strategy has an influence and can be a significant predictor of the development of students' Multiple Intelligences. Previous research showed an increase in students' science process skills, especially their ability to ask questions. In line with the results of previous research conducted by Winarti, this research also found that the use of a reciprocal teaching learning strategy based on multiple intelligences (MI) on vibration, wave and sound material was different from the learning outcomes of students who used the conventional model (lecture method) [34]. The difference in previous research is that it is not specific on what learning materials. So this research is a generalization of previous research which integrates multiple intelligences into reciprocal teaching learning strategies.

The implication of this research is that the results of this research will change the views of teaching staff in using teaching strategies in the future, from being oriented towards academic abilities to being oriented towards multiple intelligences and focusing on the potential of each student. The hope is that students can develop their potential and improve their academics. Learning models that focus on Multiple Intelligences can help teachers and researchers understand how students respond to learning based on certain intelligences. Findings from this research can contribute to the educational literature, provide additional empirical evidence about the effectiveness of certain learning models, and enrich our understanding of how students process information and learn. This research is limited by the research sample, time and place of research. This research is also limited by measuring only the cognitive aspects of students in the physics of vibrations, waves and sound. The hope is that in further research we can also measure students' cognitive and psychomotor aspects.

4. CONCLUSION

Based on the results of the research and discussion, it can be concluded that the learning outcomes using the multiple intelligence (MI)-based reciprocal teaching learning model on vibration, wave and sound material are different from the learning outcomes of students using the conventional model (lecture method). This can be seen from the average student learning outcomes, namely the experimental group average was 86.44. Meanwhile, the average learning outcome of the control group students was 80, meaning the difference between the two classes was 6.44. Therefore, it is clear that there are differences in learning outcomes between the experimental class and the control class. Thus, the use of a reciprocal teaching learning model based on multiple intelligences (MI) is more effective in improving the learning outcomes of class VIII students in vibration, wave and sound material compared to the conventional model (lecture method). The recommendation for further research is to be able to measure students' cognitive and psychomotor aspects by using a reciprocal teaching learning model strategy based on multiple intelligences.

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