ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)

Homepage : https://journal.uhamka.ac.id/index.php/omega

Omega : Jurnal Fisika dan Pendidikan Fisika
Vol **6**, No **2** (2020)

The Effect of Collaborative Teamwork Learning Model on Work and Energy Matter Based of Multi Representations on Physics Learning Outcomes

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ABSTRACT

This study aims to determine how the effect of the Collaborative Teamwork Learning Model on Work and Energy Matter Based of Multi Representations on Physics Learning Outcomes. The research method used is a quantitative research method with None Quivalent Control Group Design research design. The sampling technique used was purposive sampling. The sample used was 25 students in each class, both the experimental class and the control class. The instrument used was an essay instrument based on multi-representation as many as 5 questions that had passed the validity, reliability, difficulty level, and distinguishing power. The results of this study were tested using the z-test because the data were not normally distributed but homogeneous. Based on the calculation, the value of $-Z_{hitung} < -Z_{tabel}$ or -1.79 < -1.96 is obtained so that it can be concluded that there is a significant effect of the Collaborative Teamwork Learning Model on business material and energy based on Multi Representation on Physics Learning Outcomes. This is also supported by an increase in student learning outcomes using a higher Multi Representation-based Collaborative Teamwork Learning model. This happens because when the learning process takes place students are more active in discussing both group discussions and class discussions and students are also more enthusiastic about learning physics concepts which are represented in several forms of representation by educators.

Keywords: Collabrative Teamwork Learning, Learning Outcomes, Multi Representations, Physics

INTRODUCTION

Improving the quality of education is a must to meet the needs of schools and communities[1]. Improving the quality of education is carried out through various policies that are carried out continuously by the government, starting from curriculum development and improvement, to improving educational support facilities and infrastructure. Apart from the above policies, another step that is no less important in the effort to improve the quality of education is the improvement in the teaching and learning process which includes teaching methods, models, and approaches used during the learning process.

The learning process is very important in the occurrence of changes in children's behavior, so that it becomes the core of the overall education process[2]. The teaching and learning process can be measured through a test of learning outcomes obtained by students. This test is usually carried out in the form of an assessment of learning outcomes whose implementation is aimed at the results obtained by students after participating in the teaching and learning process in class, which is then manifested in the form of changes in behavior[3]. Behavior changes in students that are obtained from learning outcomes can be observed and measured through cognitive, affective, and psychomotor changes. These changes can be interpreted that students experience an increase and development for the better than before.

Based on the results of observations to educators In the 3rd Apprenticeship activity from August to October 2019 which was carried out by researchers at SMA Negeri 5

Tambun Selatan, it was found that the physics learning achievements of class X and XI students at school This is still low due to the lack of understanding of the physics concepts possessed by students. This is supported by the finding of many students who get low learning outcomes or below the minimum completeness criteria set by the school for physics subjects. On the other hand, the low mastery of concepts is also caused by the difficulty of students in understanding physics concepts which are classified as abstract[4].

Physics is one of the branches of natural science that underlies technological development[5]. Physics deals with the discovery and fundamental understanding of the laws that drive matter, energy, space and time. The purpose of learning physics is to help students build knowledge of physics, help students build problem solving skills both quantitatively and qualitatively, and introduce students to scientific culture[6].

Based on this explanation, a learning model is needed that is able to make teaching and learning activities optimal, so that it can improve students understanding and learning outcomes[7]. Various learning activities do not always have to be carried out by students themselves but can also collaborate in a group with peers to solve physics problems that are considered difficult[8]. In general, students can more easily understand a concept and solve problems if they can exchange ideas in a team.

One learning model that can be used as an alternative to improve student learning outcomes is Collaborative Teamwork Learning (CTL). CTL allows students to develop the ability to work collaboratively in teams[7]. That is, the Collaborative Teamwork Learning model is a learning model that allows students with diverse background abilities to work collaboratively with each other in a team so that the learning process is expected to get maximum results. This model requires students to work together in groups that have been determined and responsible for the group in doing tasks. So that students can develop ideas, opinions or thoughts about the material being studied[9]. One of the advantages of this CTL learning model is that students can develop a critical and rational way of thinking by discussing with their peers so that it is expected to make it easier to understand the physics concepts of students.

Physics learning includes many concepts and principles that are generally very abstract. Because of this, students often find difficulties in learning physics[10]. Representations in learning physics can be used to minimize the difficulties of students in learning physics[11]. Therefore, educators must be able to visualize physics concepts into representations that students can understand well. Because in physics learning, students are not only required to be able to master concepts, but also have to understand mathematics, there are even some subjects that require students to understand a picture or diagram to be able to solve problems well. One of them is in the material of work and energy, where in this material students will be presented with more problems in mathematical form but it does not deny that students will find problems in the form of graphics, pictures or maybe also verbal. So that to be able to solve problems properly, students must be able to understand the material, either mathematically, images, graphs or diagrams, as well as verbal. In other words, in providing physics material, educators must be able to provide a representation of each subject in a different format so that it can be understood well by students both individually and in teams.

Multi-representation based learning can be used as a solution in learning physics. Multi-representation is a learning approach that represents the same concept in different formats, in the form of verbal, diagrams or pictures, graphics, and also mathematics. These various representations can make it

ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)
Omega : Jurnal Fisika dan Pendidikan Fisika
Vol **6**, No **2** (2020)

easier for students to understand the overall concept of physics not only verbally or mathematically. Multi-representation learning helps students who have different intelligence backgrounds, because different representations can provide optimal learning opportunities for each type of intelligence.

There have been many studies that apply the Collaborative Teamwork Learning model and also the Multi Representation approach, both in Physics subjects and other subjects with quite good research results. However, there has been no research that combines these two models and approaches so that the researcher wants to try physics learning strategies with a multi-representation based CTL model in the hope that it can maximize students' understanding of physics concepts both individually and in groups so that it can improve learning outcomes obtained by each learners.

Based on the description above, it can be concluded that this study aims to determine how "The Effect of Collaborative Teamwork Learning Model on Work and Energy Matter Based of Multi Representations on Physics Learning Outcomes".

METHODOLOGY

The type of research used is Quasi Experiment Design. It is said to be Quasi Experiment Design, because this design has a control group, but it cannot fully function to control external variables that affect the implementation of the experiment[12]. This is because in fact it is difficult to find a control group that can be used in the study.

The research design used in this study is None Quivalent Control Group Design. This research design pattern can be described [13].

Table 1. Research Design

Group	Initial Test	Treatment (independent variable)	Final Test
Experiment Class	Y_1	X	Y_2
Control Class	Y_3	-	Y_4

Information:
Y_1: Pretest Value of Experimental Class (Before being given treatment)
Y_3: Pretest Value Control class (Before being given treatment)
Y_2: Posttest Value of Experiment Class (After being given treatment)
Y_4: Pretest Value of Experimental Class (After being given treatment)
X: The treatment given by educators to students using a Multi Representation based Collaborative Teamwork Learning model.

This research was conducted at SMA Negeri 5 Tambun Selatan. The sampling technique used in this study was purposive sampling. Samples are selected based on groups, regions or groups of individuals through certain considerations that are believed to represent the existing unit of analysis[14].

The sample used in this study is based on certain considerations. The considerations made in selecting this sample were taking into account the similarity of the average end of semester assessment results in odd semesters between students in the experimental class, namely class X MIPA 3 with students in the control class, namely class X MIPA 1.

The process carried out in this study consisted of three stages, namely the pretest, treatment, and posttest stages, all of which were carried out online. At the pretest stage, students, both the experimental class and the control class, were given 5 multi-

ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)
Omega : Jurnal Fisika dan Pendidikan Fisika
Vol **6**, No **2** (2020)

representation based essay questions on work and energy materials with an allocation of 1 lesson time through the Zoom Meeting application. The next stage is the treatment stage, at this stage treatment is given in the form of the application of the Multi Representation based Collaborative Teamwork Learning model for the experimental class, and the Discovery Learning learning model for the control class through the Zoom Meeting application, Google Classroom, and WhatsApp Messenger. To measure the learning outcomes of students, the educator conducts a posttest with 5 multi-representation based essay questions on work and energy materials with an allocation of working time, namely 1 lesson hour through the Zoom Meeting application. The results of the pretest and posttest will be used as data on student learning outcomes.

The data that will be obtained through the stages above is the value of the learning outcomes of students which are then analyzed to determine the effect of the learning model applied. The learning outcome data were analyzed through hypothesis testing, where previously the data had gone through the prerequisite analysis phase, namely the normality test and the homogeneity test.

The normality test was carried out to determine whether the data obtained by researchers came from populations with normal distribution or not[15]. The normality test used is the Chi Square test with the following conditions:
If $^{x2}\ count < {}^{x2}\ table$, then the sample comes from data that is normally distributed.
If $^{x2}\ count > {}^{x2}\ table$ then the sample comes from data that is normally distributed.

The homogeneity test is used to determine that the two sample groups come from populations that have the same variance[16]. The homogeneity test used was the F test with the following criteria:
Accept H_0: if $F_{count} \leq F_{\text{table}}$, then both variances are homogeneous.
Reject H_0 : if $F_{count} > F_{\text{table}}$, then the two variances are not homogeneous.

Hypothesis testing is carried out using the Mann Whitney test to see the effect of the Collaborative Teamwork Learning model on work and Energy material based on Multi Representation on the learning outcomes of students in both the experimental class and the control class.

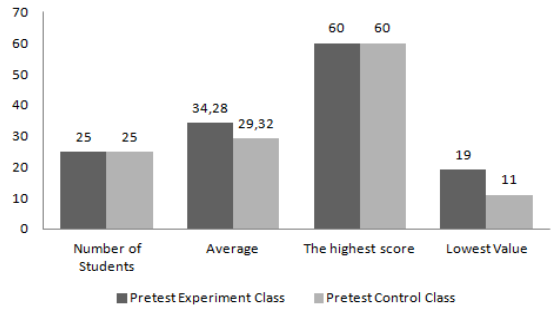
RESULT AND DISCUSSION

The purpose of this study was to determine how the effect of Collaborative Teamwork Learning model on work and energy matter based of multi representations on physics learning outcomes. The data obtained in this study are the learning outcomes of students. Before students were given treatment in both the experimental class and the control class, they were given a pretest to determine the students' initial abilities. The results of the students' pretest are shown in Table 2.

Table 2. Student Pretest Results

Description	Pretest	
	Experiment Class	Control Class
Number of Students	25	25
Average	34.28	29.32
The highest score	60	60
Lowest Value	19	11

The table above can be graphed as in Figure 1 below



ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)
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Figure 1. Student Pretest Results

Based on the table and graph of the results of the pretest conducted by the two classes above, it can be seen that there is a difference that is not too big. This difference can be seen from the average pretest results obtained by each class, namely the experimental class of 34.28 and the control class of 29.32. The difference between the two classes' average is 4.96. This average difference is not too big because the distribution of the learning outcomes of students from the two classes is almost the same and has not been treated. The results of the pretest of both classes were calculated for normality using the chi square test and homogeneity using the F test. After calculating, the value was obtained x^2_{hitung} the experimental class and control class respectively 11.88 and 3.21 with a significant level α = 5% obtained x^2_{tabel} is 7.81. The data is said to be normally distributed if $x^2_{hitung} < x^2_{tabel}$, due to the pretest results of the experimental class $x^2_{hitung} > x^2_{tabel}$, it can be said that the data is not normally distributed. Meanwhile, the F test on the pretest data obtained a value F_{hitung} of 1.2 and F_{tabel} at the 5% significant level of 1.98. Due to $F_{\text{hitung}} < F_{\text{tabel}}$ or $1{,}2 < 1{,}98$, it can be concluded that the two variances are homogeneous for the pretest scores. Then for the students' posttest results are shown in Table 3.

Table 3. Student Posttest Results

Description	*Posttest*	
	Experiment Class	Control Class
Number of Students	25	25
Average	78.48	58.76
The highest score	100	85
Lowest Value	45	32

The table above can be graphed as in Figure 3 below

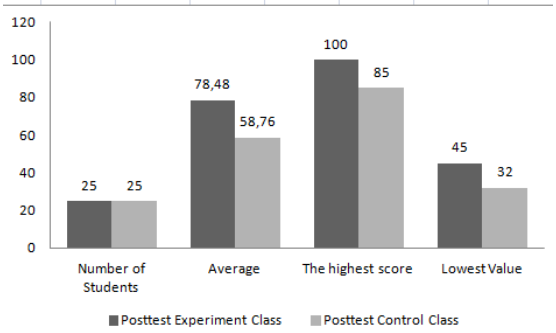

Figure 2. Student Posttest Results

Based on the tables and graphs of the results of the posttest conducted by the two classes above, it can be seen that there is a significant difference. This difference can be seen from the average posttest results obtained by each class, namely the experimental class of 78.48 and the control class of 58.76. The difference between the means for the two classes is 19.72. The difference in average is due to the different treatment given by educators between the experimental class and the control class. The results of the posttest for both classes were calculated for normality using the chi squared test and homogeneity using the F test. After calculating the values were obtained x^2_{hitung} the experimental class and the control class respectively 31.54 and 8.32 with a significant level α = 5% obtained x^2_{tabel} was 7.81. The data is said to be normally distributed if $x^2_{hitung} < x^2_{tabel}$, because the posttest results of the two classes produce it $x^2_{hitung} > x^2_{tabel}$, it can be said that the two data are not normally distributed. Whereas for the F test on the posttest data the value F_{hitung} was 1.42 and at the 5% significant level F_{tabel} was 1.98. Due to $F_{\text{hitung}} < F_{\text{tabel}}$ or $1{,}42 < 1{,}98$, it can be concluded that the two variances are homogeneous for the posttest scores.

After the analysis prerequisite test was carried out with the data results not normally distributed but homogeneous, then the hypothesis testing was carried out using the

ISSN: 2502-2318 (Online)
ISSN: 2443-2911 (Print)
Omega : Jurnal Fisika dan Pendidikan Fisika
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Mann Whitney test with the results Z_{hitung} amounting to $-1{,}79$. At a significant level of 5%, it is obtained Z_{tabel} of $-1{,}96$, because $-Z_{hitung} < -Z_{tabel}$ or $-1.79 < -1.96$ so it can be concluded that H_1 is accepted, which means that there is a significant effect of the Collaborative Teamwork Learning Model on work and energy material based on Multi Representation on Physics Learning Outcomes.

CONCLUSION

Based on the results of the research data analysis, it was found that the average learning outcomes of students using the Multi Representation-based Collaborative Teamwork Learning model were higher with an average of 78.48 compared to the Discovery Learning model with an average 58.76. This shows a significant differenceon the learning outcomes of students who experience learning using a Multi Representation-based Collaborative Teamwork Learning model and learning using the Discovery Learning model. The results of the calculation of the hypothesis test carried out using the Mann Whitney statistical test with the value $-Z_{hitung} < -Z_{tabel}$ or $-1.79 < -1.96$ so that it can be concluded that H_1 is accepted and it can be concluded that there a significant effect of the Collaborative Teamwork Learning Model on work and energy material based on Multi Representation on Physics Learning Outcomes. This is also supported by an increase in student learning outcomes using a higher Multi Representation based Collaborative Teamwork Learning model. This happens because when the learning process takes place students are more active in discussing both group discussions and class discussions and students are also more enthusiastic about learning physics concepts which are represented in several forms of representation by the educators.

ACKNOWLEDGEMENT

The completion of this research cannot be separated from the help of many parties, therefore I would like to thank the Physics Education Study Program, University of Muhammadiyah Prof. DR. HAMKA for providing support for my research and I would also like to thank SMA Negeri 5 Tambun Selatan for providing permits and facilities to support this research.

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