PROC. INTERNAT. CONF. SCI. ENGIN.
Volume 3, April 2020 | Pages: 639-647

ISSN 2597-5250
E-ISSN 2598-232X

The Effect of Blended Learning On Physics Learning Outcomes of Students in SMA N 1 Sewon Class XI Rotation Dynamics

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Abstract. This study aims to determine the effect of blended learning on students' physics learning outcomes on rotational dynamics material. This research is a Quasi Experiment with Group Design Pretest-Posttest Control. The research variables include the independent variables in the form of blended learning and the dependent variable in the form of learning outcomes. The population in this study were all grade XI students of SMA N 1 Sewon in the 2019/2020 school year. Sampling was done using the Simple Random Sampling technique, selected class XII IPA 5 as an experimental class and class XII IPA 6 as a control class. Data collection techniques with the form of tests with the test instruments used are written tests in the form of multiple-choice questions. Data analysis techniques used are nonparametric statistics, Normalized-Gain, and effect size. The results showed that blended learning did not affect students' learning outcomes in rotational dynamics material. Treatment is said to be influential if there is a difference in the increase in student physics learning outcomes between the experimental class and the control class as indicated by the rejection of H_0 in testing the hypothesis using the U-test. Based on the U-test analysis of the posttest data of the experimental class and the control class the significance value obtained is 0.074, which means it is greater than the significance level so that the given H_0 is received or there is no influence from blended learning treatment. The average N-gain of the experimental class was 0.38 and the control class was 0.33. N-gain of both classes is in the medium classification. Effect size test results of 0.22 are in the classification of low effects so that the difference in the increase in physics learning outcomes of students in the experimental class and the control class is not significant.

Keywords: blended learning, cognitive learning outcomes, rotational dynamics

INTRODUCTION

Educators in the current era of information and communication technology are not just teaching (transfer of knowledge) but must be learning managers. Educators are expected to be able to create learning conditions that challenge students' creativity and activeness, motivate students, use multimedia, multimethods, and multisource to achieve the expected learning goals (rusman, 2013: 19). Based on pre-research observations conducted by researchers at sma n 1 sewon learning physics that is still using conventional methods in the form of lectures and have not optimized learning methods that are integrated with information and communication technology so learning is less interactive. And the technological facilities available have not been well utilized in learning. Yet according to the minister of education and culture regulation number 65 of 2013 concerning the standards of the primary and secondary education process that the implementation of learning must utilize information and communication technology to improve efficiency in the effectiveness of learning. Therefore, learning that utilizes information and communication technology is very important in the success of the teaching and learning process.

How fast the students' catching ability in receiving information so that learning is more effective can be optimized by knowing the appropriate learning styles of students. Based on the pre-research observations conducted by researchers at sma n 1 sewon, the physics learning that has been done does not pay attention to the characteristics of students' learning styles. Students tend to be busy with other activities during physics learning such as doing assignments from other subjects. Lack of attention of students in following the learning process can affect the low learning outcomes of students. Therefore, educators can apply learning methods that can improve student learning outcomes. Educators can integrate learning by utilizing communication and information technology and the internet. Using the internet with all its facilities will make it easy to access various information for education that can directly increase students' knowledge for success in learning (rusman, 2013: 344).

Learning solutions that can be used by combining conventional learning with the internet are blended learning. Blended learning can combine positive aspects of two learning environments, namely learning done in the classroom with learning with e-learning (Bonk & Graham, 2006). But nowadays the term blended learning is at the stage of combining two learning environments, which is to integrate a face-to-face learning system using web-based learning. Using blended learning, it is expected that the learning process can run more interactively and increase student learning success.

Based on interviews with physics class XI educators from SMA N 1 Sewon, students' cognitive learning outcomes on rotational dynamics are still low. This is because the rotation dynamics material has a variety of types, as well as enough sub-chapters that require a long time to convey the material as a whole, and students have difficulty in understanding the material. Based on the results of observations made in class XI IPA 4 SMA N 1 Sewon, 65% of students stated that the material of rotational dynamics is difficult. Therefore, the use of blended learning is expected to be able to improve student physics learning outcomes. Based on this background the researcher wants to apply blended learning to the material on rotational dynamics which is expected to be able to improve the physics learning outcomes of students, especially on the material on rotational dynamics.

This study aims to determine the effect of blended learning on physics learning outcomes of students of SMA N 1 Sewon class XI on rotational dynamics material.

MATERIALS AND METHODS

Study area

The study was conducted at SMA N 1 Sewon. This research is a quasi-experimental study (Quasi Experiment) with the research method in the form of Pretest-Posttest Control Group Design. In this design, there are two groups chosen randomly so that class XI IPA 5 is obtained as an experimental class and XI IPA 6 as a control class.

Procedures

Before learning the two classes of samples were given a pretest to find out the initial state is there a difference between the experimental group and the control group. The experimental group was given a treatment in the form of physics learning using blended learning with the help of a quipper school, while the control group was given a learning treatment conventionally manner. This method is used to determine the effect of using blended learning on student physics learning outcomes. After being given the treatment then the experimental group and the control group were given a posttest to find out whether there was an increase in physics learning outcomes.

1. Pre-Research Stage
   a. Request a school permit for research.
   b. Determine the experimental class and the control class.
   c. Compile a question grid for empirical validity.
   d. Develop lesson plans and questions.
   e. Validate.
   f. Analyze data on test results of test instruments
   g. Determine the questions that will be used as a pretest-posttest based on data analysis of the trial results.
2. Research Phase
   a. Test the students' initial abilities with pretest questions in the experimental class and the control class.
   b. Carry out learning using blended learning with the help of quipper school in the experimental class and conventional learning using lesson plans from educators in the control class.
   c. Carry out a posttest to find out the increase in physics learning outcomes of students.
3. Post-Research Stage
   a. Analyzing posttest results data.

Data analysis

Data collection techniques in this study used test techniques. The test technique is used to collect data related to physics learning outcomes of students both pretest and posttest.

Data analysis techniques used include:

1. Test for Normality

   Data normality test is performed to determine whether the data used is normally distributed or not. Testing for normality uses the *Kolmogorov-Smirnov* test. In this study, the data normality test was performed using *SPSS 24* software. The Kolmogorov-Smirnov test equation was written as follows:

$$D = max\left|F_s\left(x_i\right) - F_t\left(x_i\right)\right|$$

   information:
   D = maximum deviation
   $F_s\left(x_i\right)$ = cumulative distribution function
   $F_t\left(x_i\right)$ = cumulative distribution function of the theory

2. Homogeneity Test

   Homogeneity testing uses the Levene test formula with the help of SPSS 24 software. The Levene test equation is written as follows:

$$W = \frac{(N-p)\Sigma_{i=1}^{p} N_i\left(\overline{Z_i} - \overline{Z}\right)^2}{(p-1)\Sigma_{i=1}^{p}\Sigma_{j=1}^{n_i}\left(\overline{Z_{ij}} - \overline{Z_i}\right)^2}$$

   Information:
   N = number of observer
   P = many groups
   $Z_{ij} = \left|Y_{ij} - \overline{Y_i}\right|$
   $\overline{Y_i}$ = average from group i
   $\overline{Z_i}$ = average from group Z_i
   $\overline{Z}$ = overall average of Z_{ij}

3. Hypothesis Testing
   In this study, the U-test (Mann-Whitney U) is used to determine whether there is a difference in physics learning outcomes between the control class and the experimental class after being given competency. There are two formulas used for testing, namely (Sugiyono, 2007: 153):

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

and

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

Information:

n_1 = jumlah sampel 1

n_2 = jumlah sampel 1

U_1 = jumlah peringkat 1

U_2 = jumlah peringkat 2

R_1 = jumlah rangking pada sampel n_1

R_2 = jumlah rangking pada sampel n_2

4. Normalized - Gain
   To find out the improvement in physics learning outcomes of the control class and experimental class the N-gain equation (Meltzer, 2002: 1260) is used as follows:

$$N\text{-}gain\,(g) = \frac{\text{posttest score - pretest score}}{\text{maximum possibel score - pretest score}}$$

The normalized N-gain classification according to Richard R. Hake (1998) can be seen in Table 1.

Table 1. *N-gain* classification.

Average N-gain Normalized	Classification
0,70 < *N-gain* ≤ 1,00	High
0,30 < *N-gain* ≤ 0,70	Medium
N-gain ≤ 0,30	Low

5. Effect Size
   Knowing how big the difference in improvement in physics learning outcomes of experimental and control class students can be seen through the effect size. The effect size calculation uses the Cohen's d formula as follows:

$$d = \frac{M_1 - M_2}{\sqrt{\frac{SD_1^2 + SD_2^2}{2}}}$$

Information:

d = effect size value

M_1 = average score of the experimental group

M_2 = average score of the control group

SD_1^2 = variant of the experimental group

SD_2^2 = variant of the experimental group

The effect size classification according to Cohen (Brecker, 2000) can be seen in Table 2.

Table 2. *Effect Size classification.*

Large d	Classification	Information
0,2 ≤ d < 0,5	Low	Difference Increase is not significant
0,5 ≤ d < 0,8	Medium	Differences The increase is quite significant
≤ 0,8	High	Difference The increase is very significant

RESULTS AND DISCUSSION

Result

Research Data

The analysis prerequisite test is carried out to determine the statistical test steps to be performed. If the research data generated are normally distributed then parametric statistics are used, while the data are not normally distributed then the statistics used are nonparametric statistics (Sugiyono, 2007: 75). Processing data in this study using SPSS 24 assistance programs to facilitate statistical calculations. In the pretest and posttest data physics learning outcomes of the experimental class and control class students were tested for normality.

a. Normality Test

Test pretest and posttest normality of the experimental class and the control class using the Kolmogorov-smirnov test. The results of the Kolmogorov-smirnov normality test data for the pretest of the control class and the experimental class are presented in Tables 3. and 4.

Table 3. Pretest Normality Test Results with the *Kolmogorov Smirnov* Test.

Class	Calculation			Result Remarks
	Statistic	df	*Sig*	
Experiment	0,108	22	0,200	Normal
Control	0,230	22	0,004	Abormal

Table 4. Hasil Uji Normalitas *Posttest* dengan Uji *Kolmogorov-Smirnov.*

Class	Calculation			Result Remarks
	Statistic	df	Sig	
Experiment	0,194	22	0,031	Abnormal
Control	0,155	22	0,186	Normal

Based on Table 3. The average value of the experimental class of 0.200 is greater than the pretest score of the experimental class normally distributed. A significant class control value of 0.004 is smaller than the control class pretest score is not normally distributed. Based on Table 4 The significant value of the experimental class is 0.031 smaller than, then the posttest score of the experimental class is not normally distributed. Significant class control value of 0.186 is greater than, then the posttest score of the control class is normally distributed.

b. Homogeneity Test

Homogeneity test of pretest and posttest of the experimental class and the control class using the Levene test. Homogeneity test results of the control class and experimental class pretest data are presented in Table 5. and 6.

Table 5. Pretest Homogeneity Test Results with Levene Test.

Class	Calculation Results (Test of Homogeneity of Variances)				
	Statistics	df1	df2	Sig	Information
Experiment Control	0,396	1	43	0,533	Homogeneous

Table 6. Posttest Homogeneity Test Results with Levene Test.

Class	Calculation Results (Test of Homogeneity of Variances)				
	Statistic	df1	df2	Sig	Information
Experiment Control	0,830	1	43	0,367	Homogeneous

Based on Table 5. it is known that the significant value of the experimental class and the control class by 0.533 is greater than $\alpha = 0{,}05$ then it can be concluded that the cognitive abilities of the experimental class and control class students before learning are homogeneous or tend to be the same. Based on Table 6. it is known that the significant value of the experimental class and the control class by 0.367 is greater than $\alpha = 0{,}05$, then it can be concluded that the cognitive abilities of the experimental class and control class students after learning are homogeneous or tend to be the same.

c. Hypothesis testing

Hypothesis testing was tested on the *pretest* and *posttest* values in each of the experimental and control classes. In this study the hypothesis test used is the *U*-test because based on the results of the normality test and homogeneity test of the results of the *pretest* and *posttest of the* two classes of samples obtained data not normally distributed but have the same or homogeneous variants, which means the data testing is performed using nonparametric statistical tests in the form *U*-test *(Mann-Whitney U)*. Hypothesis testing using *SPSS 24*. Hypothesis testing using the *U*-test was conducted to determine the effect of the *treatment* given to the experimental class on physics learning outcomes. Comparison of the results of the test analysis of the *pretest* and *posttest* data of the control class and the experimental class is presented in Table 7.

Table 7. *U*-Test Results *Pretest* Score of Experiment Class and Control Class.

Class	N	z count	df	*Asymp Sig (2-tailed)*	α	Information
Experimen Control	23 22	-0,595	43	0,552	0,05	No different

Table 8. *U*-Test Results *Posttest* Score of Experiment Class and Control Class.

Class	N	z count	df	*Asymp Sig (2-tailed)*	α	Information
Experimen Control	23 22	- 1,784	43	0,074	0,05	No different

Based on the analysis in Table 7. is significant value gained 0.552 which means greater than the significance level $\alpha = 0{,}05$, resulting in acceptance of H_0 Acceptance H_0 given the information that the average of data *pretest* cognitive abilities between the two classes are relatively similar samples. So it can be concluded that there is no difference in physics learning outcomes of students between the experimental class and the control class or the initial ability of the experimental class and control class students before getting *treatment* is the same. Based on the analysis in Table 8. is significant value gained 0.074 resulting in acceptance of H_0. Acceptance H_0 give the information that the average of data *posttest* cognitive abilities between the two classes is relatively similar samples. So it can be concluded that there is no difference in students' physics learning outcomes on the material dynamics of rotation between the experimental class with *blended learning treatment* and the control class with conventional learning *treatment.*

Improved physics learning outcomes seen from the results of *N-gain pretest* and *posttest* experimental and control classes. The average *N-gain* scores of the experimental class and the control class are presented in Table 9.

Table 9. *N-Gain* Average *of* Experiment Class and Control Class.

Class	N	*Pretest* Average	*Posttest* average	*N-Gain*	Information
Experiment	23	38,0	64,6	0.38	Average
Control	22	35,2	58,8	0,33	Average

Based on Table 9. it is known that the average *N-gain value of* the experimental class and the control class are in the moderate classification How much difference the improvement in physics learning outcomes of students in the experimental class and the control class can be seen through the effect size or *effect size*. The data used to calculate the *effect size* is the *N-gain* data *of the* two sample classes. Data from the calculation of *effect size is* presented in Table 10.

Table 10. *Effect Size* Calculation Results.

Class	Average N-Gain	Class Variance	*Effect size*	Information
Experimen	0,38	0,04	0,22	Low effect
Control	0,33	0,06		

Based on Table 10. it can be seen that the *effect size* value obtained is 0.22 which is in the low effect classification. So it can be concluded that the difference in the physics learning outcomes of the experimental class and the control class is not significant.

Discussion

This study aims to determine the effect of *blended learning* on improving student learning outcomes in physics. This research is a quasi-experimental study (*Quasi Experiment*) with a research method in the form of *Pretest-Posttest Control Group Design.* The sample in this study consisted of the experimental class and the control class. The experimental class is class XI ipa 5 with a total of 23 students who were given rotational *learning* with *blended learning,* and the control class is class XI ipa 6 with a total of 22 students with conventional learning. In this study, there are two variables, namely the independent variable, namely *blended learning* and the dependent variable, namely learning outcomes. The instrument used in this study was a test instrument to measure students' physics learning outcomes. The test instruments used were *pretest* and *posttest* questions. *Pretest* questions are given before both samples are given *treatment* and *posttest* questions are given after both samples are given *treatment.* The material in this study is the rotation dynamics which are sub-chapters of the subject of rotational dynamics and equilibrium of the rigid objects with sub material discussed, namely torque, moment of inertia, relationship of torque to moment of inertia, torque relationship with angular acceleration, Newton's second law of rotational motion, and the law of conservation of angular momentum.

Before being given *treatment* both classes of samples were given a *pretest* to find out the initial ability between the experimental class and the control class. The *pretest* questions used in the experimental class and the control class are the same problem. The questions given are at C1 through C4 cognitive level because educators usually only use questions up to the C4 level for rotational dynamics material, and viewed from the contents of the material and the basic competencies available in the rotation dynamics material are not emphasized to cognitive levels C5 and C6.

Based on the analysis of the results of the *pretest* using the *Levene* test *it is* known that the initial abilities of the experimental class and the control class are the same. The initial abilities of the experimental class and control class students are the same because the two classes have not received material related to the dynamics of rotation. The results of testing the hypothesis of the *pretest* using the *U*-test showed that there were no differences in the results of the *pretest* between the experimental class and the control class on the material of rotational dynamics.

After the two classes were given a *pretest* then *treatment was* carried out on both sample classes. The provision of *treatment is* carried out twice in each class. At the first meeting discussed the material torque, moment of inertia, the relationship of torque to the moment of inertia, and the relationship of torque to angular acceleration. At the second meeting discussed Newton's second law material on rotational motion and the conservation of angular momentum law.

In the experimental class given treatment in the form of learning *blended learning* with a scientific approach. Learning *blended learning* is a combination of face-to-face learning with learning *e-learning*. In the learning process, the Internet is used as a support tool as well as on environmental *e-learning* used type of asynchronous learning (*asynchronous*). The use of *blended learning* aims to make students more active in the learning process and can access learning material from various sources both books and the internet so that it can improve student physics learning outcomes.

At the initial stage, the educator performs apperception to link the initial abilities possessed by students to the learning material as well as linking that in events that occur in the environment there are phenomena that use the concept of physics. For example, in the moment of force, apperception is done by asking one of the students to come forward and move the classroom door to open and close again. Then educators (Q_1) ask students (Q_2)

Q_1: "What causes the door to open and close?"
Q_2: "Because pushed", "because it is given a Force"
Q_1: "Yes, because they are pushed, they are given a Force. This means the classroom door can be opened and closed due to the force exerted in the form of pushes and pulls. "Other than the force of physics, what else works when the door is opened and closed?"
Q_2: (students don't answer)

The question and answer process carried out during apperception aims to build the knowledge possessed by students based on examples of events that occur in everyday life with the material to be studied. After students respond to apperception from educators, then educators provide guidance to enter the core learning of *blended learning* with a scientific approach to the concept of torque to be studied and directs students to prepare *gadgets* both laptops and cellphones as media aids in accessing the internet during learning.

In the observing phase where the educator asks one of the students to come forward and demonstrate pushing the door with different styles ie the force is applied to the door handle/door slot with when the door is pushed in the force given further from the door handle or closer to the hinged door. Students who are asked to move forward then demonstrate what has been instructed by educators and other students to observe the demonstration conducted by one of the students. In the questioning phase, after the demonstration is done then the educator (Q_1) asks the students (Q_2)

(Q_1): "Is it the same when the door is pushed in the force applied to the door handle / door slot with when the door is pushed in the force exerted further from the door handle or closer to the door hinge?"
(Q_2): "It's different when the door is pushed from the door handle, it is lighter than being pushed close to the door hinge."
(Q_1): "So why are the door handles away from the door hinges?"
(Q_2): "so it's easy to open the door"

When educators ask these questions all students have not been able to answer these questions based on the concept of torque. This is because to answer the question must use the concept of torsion while students have never gotten torsion material in physics learning before. When students have difficulty answering these questions then educators direct students to open the internet to gather information about the material dynamics of rotation.

In the information gathering phase, students are directed to play an active role in discovering their own concepts related to force moment material, moment of inertia, and the relationship between force moment with angular acceleration through various sources both in the form of material from textbooks, online modules, and learning videos. Educators ask students to open the internet and look for material related to the dynamics of rotation with the aim of growing curiosity in students in solving problems given by educators and then students can find their own solutions to problems previously discussed at the apperception and demonstration stages so that students' knowledge not only limited to the explanation given by educators.

At the time of the process, of gathering information most students follow the directions of educators to find their own solutions to the problems provided by opening the internet, discussing with other students and confirming the results obtained to educators. But there are still students who abuse the use of *gadgets* not to search for material but to open social media and play *online games.*

At the stage of gathering information that is done and assisted with confirmation from the educator, students can conclude that based on the formula moment force (torque) $\vec{\tau} = \vec{r} \times \vec{F}$ physical quantities that work when the door is open not only the force but also the arm moment, and the door handle is located far from the hinge the door because the bigger the arm / the distance to the door handle, the less force is needed to open the door.

After the students get the solution of the problems discussed in apperception, the next step is to associate the students to process the information that has been collected to find a solution to the problem in the worksheet. Educators distribute LKS and ask students in groups to complete the material from LKS that has been distributed based on the physics concepts that have been obtained and with the help of the internet and discuss with members of their respective groups.

After the entire group has finished completing the worksheet given, the educator appoints one student from each group's representative to come forward and provide an explanation (communicate) of what they have obtained so as to equate the perceptions of all students and also the educator with the existing concepts. Each group representative explained the different sub materials, and after each group delivered the results obtained, the students gave clarification related to the concepts that the students conveyed.

From the learning done in the experimental class using *blended learning* with the help of *quipper school*, each student contributes in completing the worksheets provided and is eager to find information in the form of material, online modules, watching learning videos, and reviewing material or practice questions that are given by students.

In the experimental class learning process, most students are more active in learning. However, there are still some students who abuse the use of *gadgets* not to find learning material but to explore social media or play *games* when out of the supervision of educators. In addition, students are not familiar with the use of *blended learning* in learning physics so students need to make many adjustments during the learning process.

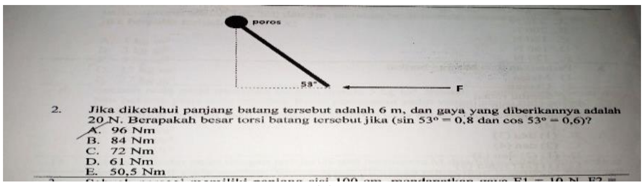
After the educator gives an explanation of the material that needs to be delivered, then the educator gives exercises and questions to be done by students. The assignment of experimental class assignments was carried out using a *quipper school* online class which used questions that were already in the physics curriculum at the *quipper school*.

In the learning control class conducted in the form of conventional learning. Conventional learning referred to here is learning with the lecture method commonly used by physics educators when delivering learning material in class. The submission of learning using the lecture method is more centered on the educator. Educators provide material explanations directly. Students do not need to search for or find their own facts or concepts because they have been delivered by educators. Learners only need to understand and record explanations from educators and then ask questions if there are explanations that are not understood by students.

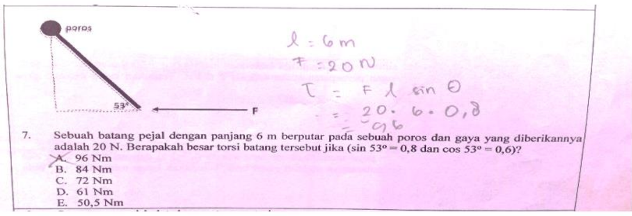
In the learning process some students are seen to record explanations written by educators on the board, when educators provide explanations students are more focused on recording what is written on the board so that when educators provide concepts that are not written on the board students will forget, and when learners lag behind in recording the material written on the board, students will decide not to take notes and choose to copy the notes of other students after learning is finished. Some students look bored and chat and fall asleep when educators give explanations.

After being given *treatment* in the form of different learning between the experimental class and the control class, then a *posttest was* conducted to determine the effect after being given a learning treatment in improving the physics learning outcomes of the experimental class and the control class. The *posttest* questions used are the same questions as the *pretest* questions, but the questions have been randomized in order. In the experimental class the *pretest was* conducted using virtual class in the *quipper school* application and the *posttest* control class was in writing.

Based on the analysis of the results of the *posttest* using the *Levene* test *it was* found that the ability of the experimental class and the control class after being given treatments were the same. The results of testing the hypothesis of the *posttest* using the *U*-test showed that there was no difference in the *posttest* results between the experimental class and the control class on the material of rotational dynamics. Improved student physics learning outcomes can be seen based on the results of the *pretest* and *posttest* answers of the experimental class and control class students.


2. Jika diketahui panjang batang tersebut adalah 6 m, dan gaya yang diberikannya adalah 20 N. Berapakah besar torsi batang tersebut jika (sin 53° = 0,8 dan cos 53° = 0,6)?
A. 96 Nm
B. 84 Nm
C. 72 Nm
D. 61 Nm
E. 50,5 Nm

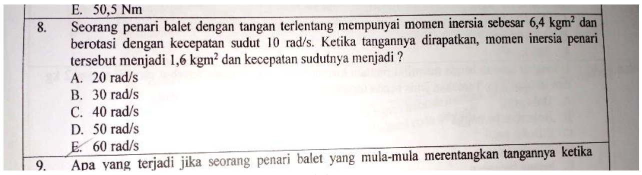
(a)


7. Sebuah batang pejal dengan panjang 6 m berputar pada sebuah poros dan gaya yang diberikannya adalah 20 N. Berapakah besar torsi batang tersebut jika (sin 53° = 0,8 dan cos 53° = 0,6)?
A. 96 Nm
B. 84 Nm
C. 72 Nm
D. 61 Nm
E. 50,5 Nm

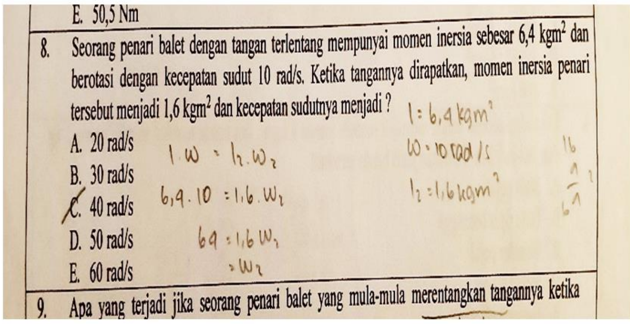
(b)

Figure 1. (a) results of the control class *posttest* answers (b) the results of the experimental class *posttest* answers.

Figure 1. (a) and Figure 1 (b) show the students' answers in solving the rotational dynamics problem on the indicator of the moment of force (torque) before giving *treatment (pretest)* and after giving *treatment (posttest)*. Based on students' answers before being given *treatment*, students answer originally and are not in accordance with the concept of force moments on an actual object. The answers given by students were not appropriate and the students did not write down the equation used to solve the problem and chose answers randomly. Meanwhile, after giving *treatment*, students can already write equations and lead to the concept of the moment of force used, that is, the magnitude of the force moment on an object will be the same as the multiplication of the force with the arm moment of the object $\left(\tau = \vec{F}r\sin\theta\right)$ so that students get the correct answer.


8. Seorang penari balet dengan tangan terlentang mempunyai momen inersia sebesar 6,4 kgm² dan berotasi dengan kecepatan sudut 10 rad/s. Ketika tangannya dirapatkan, momen inersia penari tersebut menjadi 1,6 kgm² dan kecepatan sudutnya menjadi ?
A. 20 rad/s
B. 30 rad/s
C. 40 rad/s
D. 50 rad/s
E. 60 rad/s

(a)


8. Seorang penari balet dengan tangan terlentang mempunyai momen inersia sebesar 6,4 kgm² dan berotasi dengan kecepatan sudut 10 rad/s. Ketika tangannya dirapatkan, momen inersia penari tersebut menjadi 1,6 kgm² dan kecepatan sudutnya menjadi ?
A. 20 rad/s
B. 30 rad/s
C. 40 rad/s
D. 50 rad/s
E. 60 rad/s

(b)

Figure 2. (a) results of the control class *posttest* answers, (b) the results of the experimental class *posttest* answers.

Figure 2 (a) and Figure 2 (b) Showing the answers of students in the control class and experimental class in the *posttest* problem of rotational dynamics in the indicators of the law of conservation of angular momentum. It is known that the control class students' answers are still wrong and the students have not written down the equations used to solve the problem. In contrast to the answers of students in the experimental class who can write the equations used and produce correct answers, this can be caused by differences in learning, in the experimental class students discover their own concepts, theories, and facts and build their own knowledge from the stage of gathering information where participants students are asked to recognize the problems given by educators. This is consistent with the opinion of Trianto (2007: 106) which states that the learning process basically emphasizes the importance of students building their own knowledge through the active involvement of the teaching and learning process. Emphasis on learning students actively needs to be developed, creativity, and active students will help them to stand alone in the cognitive life of students. Through the learning phase combined with *blended learning*, students develop concepts or obtain facts related to learning material, so that in solving the cognitive abilities of students the experimental class can analyze correctly compared to the control class.

Furthermore, to find out how much influence the *treatment* given to the experimental class and the control class on the improvement of students' physics learning outcomes, an *effect size* calculation is performed. The resulting *effect size* is 0.22 in the low effect category. This means that the difference in the increase in physics learning outcomes of experimental class students using *blended learning* with control class students using conventional methods is not significant.

Referring to the results of the analysis of the effect of *blended learning* on students' physics learning outcomes, it was found that there was no influence from the giving of *blended learning* treatments to the physics learning outcomes of students. This is different from research conducted by Mila Rahmawati (2013) with the title "The effect of a *quantum teaching*-based *blended learning* model on increasing student interest and learning outcomes.", The results obtained that there is a significant influence in the use of *quantum teaching*-based *blended* learning models on the interests and cognitive learning outcomes of students. The difference in research results is due to the use of different learning methods between the *treatment* given by researchers and the *treatment* given by Mila Rahmawati.

Blended learning can attract learners' attention to become more active and play a large role in learning. This is consistent with the results of research conducted by Mark Angelo S. Enriquez with the title of *students' perceptions on the effectiveness of the use of Edmodo as a supplementary tool for learning* (2014), which states that the d i field of educational technology, recent studies have shown the many benefits of using the internet to provide stronger motivation for learning among students because it allows students to enhance their learning through active participation in discussions and online assignments.

In this research, it is known that *blended learning is* able to attract more students' interest to play an active role in the learning process, but *blended learning* does not have an effect on improving student physics learning outcomes in rotational dynamics material due to the use of *blended learning* that is less suitable to be combined with material rotational dynamics are dominated by various mathematical equations and require more explanation from educators. According to Prof.'s statement Paul Suparno in the XXII (2019) national seminar on Physical Science Week (2019) which stated that "Using technology in learning, must know which material is suitable to be combined with *blended learning.*

The *blended learning* solution used by researchers is the first time applied in learning physics at SMA N 1 Sewon so that the learning process that takes place is not fully run like the scenario that was created. Some students actually abuse *gadgets* for other things when they escaped from the supervision of educators. When doing *online* exams there are still students who have difficulty using *quipper school* so some students often experience the fear of "clicking" during exams as well as being nervous and resulting in lower *posttest* results compared to *pretest* results. In accordance with the calculation *of* individual ***n-gain*** values where there are experimental class students who produce minus values. *Posttest* value is lower than the *pretest* value of these students, resulting in low average learning outcomes of students in the experimental class. In addition, in this study both sample classes experienced an increase in physics learning outcomes. The difference in value between the experimental class and the control class that is not many different results in acceptance of H_0 so that in this study it was found that the giving of *blended learning treatment had* no effect on the physics learning outcomes of students.

CONCLUSION

In this study it was produced that the increase in physics learning outcomes of students was in the medium classification based on the *N – gain* value obtained. This is relevant to the research conducted by Esther Lilis Chorniantini (2017) with the title "the use of *blended learning* learning methods that are equipped with *edmodo* applications on the subject of building flat side spaces in class VII C of SMP Pangudi Luhur 1 Yogyakarta 2016/2017 school year". The research results obtained are the learning outcomes of students in learning using the *blended learning* method which is equipped with an *Edmodo* application in a fairly good category.

Based on research conducted by previous researchers regarding *blended learning* and the use of *quipper school, it was* found that *blended learning* and *quipper school* learning media can improve learning outcomes. In this study trying to find the effect of *blended learning* with the help of *quipper school* media on physics learning outcomes of students. The provision of *treatment is* said to have an effect if there is a difference in the increase in physics learning outcomes of students between the experimental class and the control class which is shown by the acceptance of H_0 on hypothesis testing using the *U*- test. But based on the results of the hypothesis test results obtained acceptance of H_0 which can be concluded that *blended learning* conducted in the experimental class has no effect on student physics learning outcomes compared with conventional learning conducted in the control class. This is because the two sample classes both experienced an increase in learning outcomes in the medium category based on the ***N-gain*** values *of the* two control classes.

ACKNOWLEDGEMENTS

The authors thank the principal, teachers, employees, and students of the N 1 Sewon High School. Thank you for your cooperation.

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