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The Effect of HOTS-Oriented Blended Learning Student Worksheets on Students' Cognitive Learning Outcomes on Work and Energy Materials

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Abstract

This study aims to determine the effect of HOTS-oriented blended learning student worksheets on students' cognitive learning outcomes on work and energy materials for class X MIPA at SMAN 1 Gadingrejo in the 2020/2021 academic year. The research design used is a quasi-experimental form of nonequivalent control group design. The sample in this study was class X MIPA 5 (experimental class) and class X MIPA 4 (control class). The experimental class was treated using HOTS-oriented blended learning worksheets, while the control class was treated using the HOTS-oriented student worksheets. The test instrument used is in the form of a description of 5 questions. Based on the research results that have been done, the average N-Gain in the experimental class is 0.46 in the medium category. In the control class, the average N-Gain is 0.34 in the medium category. The results of the independent sample t-test showed that the significant value of 0.05 was 0.002. It shows an effect of using HOTS-oriented blended learning student worksheets on students' cognitive learning outcomes on work and energy materials.

Keywords: Cognitive Learning Outcomes; HOTS; Student Worksheet of Blended Learning; Work and energy

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INTRODUCTION

21st-century learning is learning designed for future generations by utilizing technology and information that continues to develop. Supported by Farisi's (2016) opinion, information and communication technology development is an important phenomenon predicted to be the main feature in 21st-century learning. According to (Sugiyarti et al., 2018), the demands of 21st-century learning, namely technology-based learning to develop student learning skills.

21st-century learning design incorporates technology in developing skills that focus on critical thinking, problem-solving, communication, and collaboration (Voogt & Roblin, 2012). Therefore, the government designed 21st-century learning to the 2013 curriculum based on students (Sugiyarti

et al., 2018). To achieve the expectations of 21st-century learning and the 2013 curriculum, it is necessary to properly involve Information and Communication Technology (ICT) and the role of the teacher as a facilitator must have skills in learning, namely being able to present learning by providing meaningful learning experiences for students and fun learning.

One of the appropriate uses of ICT and learning for teachers to present to students is blended learning. Blended learning is mixed learning (offline and online). By utilizing flexible technology, students can manage the time and place to optimize their learning (Juniati & Huda, 2018). However, students are also required to be active, creative, and innovative, so that they need teaching materials, namely Student Worksheets.

Student worksheets include activities that actively involve students, such as experiments, discussions, or practice questions to help students learn in a focused way (Sampurno et al., 2015). It is in line with Damayanti et al.'s (2013) opinion that student worksheets are one of the important teaching materials in achieving the success of learning physics. Student worksheets need to be based on higher-order thinking skills to achieve successful learning.

Higher-order thinking skills include creative and critical thinking, analysis, visualization, and problem-solving (Ramos et al., 2018). The indicators that must be achieved in the Higher Order Thinking Skills (HOTS) of students according to Anderson & Krathwohl (2001), namely analyzing (C4), evaluating (C5), and creating (C6). Higher Order Thinking Skills (HOTS) indicates success in creating students who can solve problems in every event encountered so that learning outcomes can significantly improve (Cahyawati & Sholeh, 2020).

Learning outcomes are abilities that are obtained by each individual after carrying out the learning process that will be stored for a long time or will not be lost because learning outcomes participate in shaping the personality of each individual who always wants to achieve better results to produce behavior, knowledge, and skills, to be better (Sjukur, 2013). Learning outcomes in the cognitive domain, according to Anderson & Krathwohl (2001), consist of 6 levels, namely remembering (C1), understanding (C2), applying (C3), analyzing (C4), evaluating (C5), creating (C6). Based on an interview with a physics teacher for class X at SMAN 1 Gadingrejo, learning physics does not use any student worksheets, in which the learning only provides material and does assignments or questions from the teacher.

Related to the above explanation, based on research Istiyono et al. (2014), students at the high school level tend to still think at a low level, especially in Physics subjects. The achievement of physics achievement in the cognitive aspect always decreases. Therefore, efforts to improve Higher Order Thinking Skills (HOTS) to achieve improved learning outcomes are supported by media and teaching materials. (Ichsan et al., 2019).

The HOTS-oriented blended learning student worksheet presents a form of blended learning by utilizing flexible technology in time and place. In addition, this student worksheet also presents activities that involve students to be active and innovative such as experimental activities, discussions, and practice questions. This student worksheet is also HOTS oriented, which includes creative thinking, analysis, and problem-solving to achieve improved learning outcomes.

Based on the background described, research was carried out with the title "The Effect of HOTS Oriented Blended

Learning Worksheets on Students' Cognitive Learning Outcomes on Work and Energy Materials". This study aims to determine the effect of HOTS-oriented blended learning student worksheets on the cognitive learning outcomes of work and energy materials.

METHOD

The design of this study used a quasi-experimental form of nonequivalent control group design. There are two groups in this design, namely the experimental group and the control group. Then the two groups were given a pretest to determine the initial state and post-test due to student learning.

The population in this study were all class X MIPA at SMAN 1 Gadingrejo for the 2020/2021 academic year. The sample of this research was taken using the purposive sampling technique, namely sampling with consideration of student activity according to physics subject teachers. Two groups were taken as samples, namely the experimental class (class X MIPA 5), and were treated using the HOTS-oriented blended learning student worksheet created by Dwi Riska Aprilia, Drs. Feriansyah Sesunan, M.Pd., and Wayan Suana, S.Pd., M.Sc. from Physics Education, University of Lampung in 2019. The control class (class X MIPA 4) used the HOTS-oriented student worksheet published by Intan Pariwara.

This study uses data collection techniques to measure learning outcomes in the cognitive domain in a description of 5 questions. The pretest and post-test items refer to the indicators of cognitive learning outcomes, namely analyzing (C4), evaluating (C5), and designing (C6).

This research took place for 3 meetings (1 face-to-face meeting and 2 online meetings) with a time allocation of 3x35 minutes in one meeting in the experimental class. Students are given a pretest online before face-to-face, and then they analyze a phenomenon on the student worksheet. In the offline stage, the teacher reviews the material and information previously obtained by students regarding work and energy, and then the students conduct experiments according to the student worksheet. After face-to-face, in the online stage, students work on the questions in the student worksheet and are given a post-test.

In the control class, the learning activities took place for 3 meetings (3 online meetings) with a time allocation of 3 x 35 minutes in one group. In the first meeting, students were given a pretest. Then students were given a phenomenon, answered questions based on the phenomenon, studied the business material, and did the exercises on the student worksheets. Students were given a phenomenon in the second meeting, answered questions based on the phenomenon, studied the energy material, and did the exercises on the student worksheets. In the third meeting, the teacher reviewed the business and energy materials, and the students post-tested.

The data obtained from the research is quantitative. Testing and data analysis were carried out using the SPSS version 21.0 application. The tests carried out were in the form of validity and reliability tests for the instrument, followed by N-Gain calculations, quantitative data tested by descriptive statistics, normality test to determine whether the sample came from a normally distributed population or not, homogeneity test to determine whether the experimental class and control were homogeneous or not, and test the hypothesis using the independent sample t-test.

Hypothesis testing can use an independent sample t-test. This test is used to determine whether or not there is a difference in the mean between the two groups.

Statistical hypothesis in this study:
H_0 : There is no effect of HOTS-oriented blended learning student worksheets on students' cognitive learning outcomes
H_1: There is an effect of HOTS-oriented blended learning student worksheets on students' cognitive learning outcomes
Hypothesis testing criteria, namely:

1. H_0 is rejected if the significant value is > 0.05
2. $H_1$is accepted if the significant value is <0.05

RESULT AND DISCUSSION

Instrument testing was carried out outside the research sample, namely at SMAN 5 Bandar Lampung in class XI MIPA 6 and SMAN 1 Gadingrejo in class XI MIPA 6 with 33 respondents.

The test instrument for students' cognitive learning outcomes is a description of 5 questions. This question is tested for validity and reliability, which is used for pretest and post-test. The results of the validity and reliability test of the instrument can be seen in Tables 1 and 2.

Table 1 Instrument Validity Test Results

Question Number	***Pearson Correlation***
1	0.605
2	0.641
3	0.392
4	0.768
5	0.347

Table 1 shows that of all the 5 items, the Pearson Correlation value is >0.3440 (r_{table}). That is, the five questions can be said to be valid.

Table 2 Instrument Reliability test results

Cronbach'Alpha	***N of Items***
0.596	5

Table 2 shows the Cronbach'Alpha value in the reliability test of the cognitive learning achievement test instrument for effort and energy material, which is 0.596, which is included in the sufficient category. So, the validity and reliability results showed that the five questions were worthy of being used as instruments in the pretest and post-test.

Based on the research done, the N-Gain results obtained from the pretest and post-test results from both classes (experimental and control) are obtained to determine students' cognitive learning outcomes. The N-Gain data for the experimental and control classes can be seen in Table 3.

Table 3 N-Gain Test Results

Class	**N-*Gain***
Experiment	0.46
control	0.34

Table 3 shows that the average N-Gain of the experimental class is greater than the control class but with the same category, which is moderate.
After that, the data from the normality test can be seen in Table 4.

Table 4 Data Normality Test Results

No.	**Data Type**	***Asymp. Sig.* (2-*tailed*)**	
		Experiment Class	**Control Class**
1	*Pretest*	0.479	0.231
2	*Posttest*	0.226	0.135
3	N-*Gain*	0.282	0.393

Based on Table 4, it can be seen that Asymp.Sig.(2-tailed) in the pretest, post-test, and N-Gain data in the experimental and control classes is greater than 0.05, and it can be said that all data are normally distributed.

Then the results of the homogeneity test can be seen in Table 5. Based on Table 5, it can be seen that the significant value of the homogeneity test results of cognitive learning outcomes is 0.329. Based on the decision-making rules, the significant value > 0.05, it can be concluded that the data is homogeneous.

Table 5 Homogeneity Test Results

Levene Statistic	**df_1**	**df_2**	**Sig.**
0.968	1	67	0.329

After the data is declared to be normally distributed and homogeneous, the independent sample t-test can be seen in Table 6. Table 6 shows that the value of sig. is 0.002, which means that it can be concluded that there is an effect of using HOTS-oriented blended learning worksheets on students' cognitive learning outcomes in the matter of work and energy.

Table 6 Test Results Independent Sample T-test

t-test for Equality of Means				
T	df	Sig.(2-*tailed)*	95% *Confidence Interval of diffrence*	
			Lower	*Upper*
3.309	67	0.002	0.488	0.197

The results of the descriptive statistics test can be seen in Table 7.

Table 7 Quantitative Data Descriptive Statistics Test Results

Statistical Parameters	**Experiment Class**		**Control Class**	
	Pretest	***Posttest***	***Pretest***	***Posttest***
Number of samples (N)	35	35	34	34
Lowest score	25	50	19	45
The highest score	75	95	65	80
Average score	45.00	70.43	45.06	63.68
The difference between the average pretest and post-test	25.43		18.62	
Standard deviation	12.410	9.730	10.943	10.099
Maximum score	100	100	100	100

Based on the study results in Table 7, it is known that the average value of the increase between the pretest and post-test scores in the experimental class treatment using the HOTS-oriented blended learning student worksheet is 25.43. While in the control class treatment using student worksheets published by Intan Pariwara, the average value of the increase between the pretest and post-test scores was 18.62. Then, based on the N-Gain test that has been carried out, the average N-Gain for the experimental and control classes is shown in Table 3 with a medium category. It means an increase in students' cognitive learning outcomes in the experimental and control classes, where the experimental class's increase is higher than in the control class. It aligns with Dewa et al.'s (2020) research, which states an increase in students' cognitive learning outcomes in physics learning.

The increase in students' cognitive learning outcomes can be seen from the achievement of indicators on each item. Indicators of cognitive learning outcomes in each item are analyzing (questions number 2 and 5), evaluating (questions number 1 and 4), designing (question number 3). It is supported by the results of research by (Wibowo & Suhandi, 2013) that the increase in cognitive learning outcomes is marked by an increase in the achievement of the observed cognitive learning outcomes indicators. The graph of the average achievement of each indicator can be seen in Figure 1.

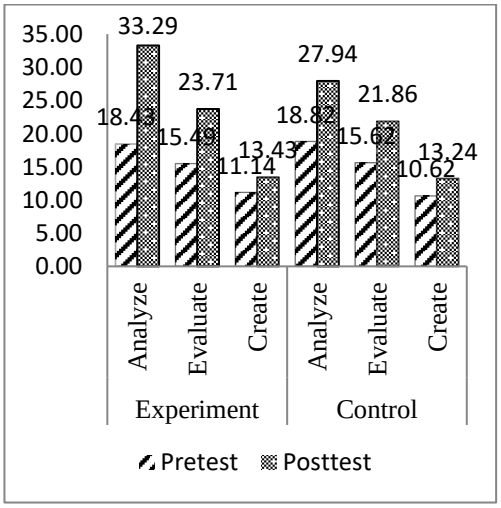

Figure 1 Percentage of Average Achievement Indicators of Cognitive Learning Outcomes

Figure 1 shows that the indicator of cognitive learning outcomes that have the highest achievement is the analyzing indicator (C4), which obtains an average achievement of 33.29 in the experimental class and 27.94 in the control class. At the same time, the indicator that has the lowest achievement is the design indicator (C6). It is in line with Amarulloh et al.'s (2020) research, which states that the highest increase in the cognitive domain is in the analyzing indicator and all indicators studied have increased.

Several things can lead to an increase in students' cognitive learning outcomes in the experimental class that applies higher HOTS-oriented blended learning worksheets, namely 1) students discuss and exchange information with their friends, so that students can think more critically in thinking and acting, especially in expressing their opinions. It agrees with Narayanan & Adithan (2015) that students who can communicate and present coherent information to others are high-order thinking skills; 2) There are activities and questions in the LKS referring to higher-order thinking skills so that they can make students more active and train students to have thinking skills. It is following the advantages of the Student Worksheet stated by Setiono in (Nurhidayati et al., 2017), namely worksheets can make students more active, give the student's learning experience, and can be used as an evaluation tool to determine the learning outcomes on cognitive aspects; 3) The existence of technology that can provide convenience in learning activities. It is supported by the opinion of Juniati & Huda (2018) which states that by utilizing technology, the learning system can be flexible so that students can optimize their learning.

The HOTS-oriented blended learning student worksheet used in this study has a blended learning design in the form of online before face-to-face-face-to-face-online after face-to-face. In addition, this worksheet has a knowledge dimension stage according to Anderson & Krathwohl (2001), namely factual, conceptual, procedural, and metacognitive. Supported by Grant Ramsay's theory in (Maya, 2020), students take action steps at the online stage before face-to-face, namely looking for information from books, the internet, or other sources. Meanwhile, in the face-to-face stage, students carry out activity steps; namely, students conduct experiments. Then at the online stage, after face-to-face, students take action steps, namely concluding or synthesizing.

At the online stage before face-to-face, students are given phenomena in the form of pictures, then students answer the questions in the student worksheet. In addition, students are also given an observation of phenomena in videos, namely a large stone falling from a certain height and a certain speed and then hitting a small stone at the base of the height so that the small stone is crushed. This phenomenon is an initial provision for students to propose problem formulations and hypotheses.

So, at the online stage, before face-to-face, students will look for information, and that information will be the initial provision for students to move to the next stage.

Then at the face-to-face stage, students carry out experimental activities, collect data, analyze data, and make conclusions. Students conducted two experiments, namely 1) calculating power when climbing stairs; 2) conducting experiments on kinetic and potential energy on objects. Through experimental activities, students will gain real knowledge. The following are student activities when conducting experiments shown in Figures 2 and 3.

Figure 2 Students Conduct Experiments Regarding Kinetic and Potential Energy on Objects.

Figure 3 Students Conduct Experiments on Power

The next stage is online after face-to-face. At this stage, students evaluate the extent to which the concepts have been mastered. Students have indirectly connected previous knowledge and new knowledge with students being given concepts mastery questions. In addition, students are also given reinforcement to strengthen the concepts that students already have.

The researchers also found several obstacles during the study, including students being less active in conducting online learning activities. The solution is that the teacher motivates students to be active in online learning and frequent discussion activities with their friends. It can help students train students to be more active in participating in learning.

Based on the analysis of research results using reference theory, it can be concluded that there are differences in cognitive learning outcomes between the use of HOTS-oriented blended learning student worksheets in the experimental class and student worksheets published by Intan Pariwara in the control class. Likewise, with the results of statistical tests and hypothesis testing, the problem formulation in this study was answered; namely, the HOTS-oriented blended learning student worksheets affected students' cognitive learning outcomes in the matter of work and energy. It is in line with Sarwinda & Meilana's (2019) research, which states that HOTS-based science worksheets affect students' cognitive learning outcomes. This study is also in line with Aunillah et al. (2019) research, which reveals that learning using LMS-based blended learning with a scientific approach can improve students' cognitive learning outcomes.

However, this study does not align with Karsono's (2017) research, which revealed that the HOTS-based Student Worksheet did not affect learning outcomes. Because of several factors, including 1) students' cognitive development, namely the lack of prior knowledge of students and the delivery of information that is a personal presentation where students only pay attention to the messages contained in the animation; 2) the use of question instruments which are only in the form of multiple-choice with four options which cause students to underestimate

so that students are less serious in participating in learning; 3) learning media that is still too simple, causing students' low comprehension of the material.

CONCLUSIONS

Based on the research and discussion results, it can be concluded that the HOTS-oriented blended learning student worksheets affect the cognitive learning outcomes of work and energy materials. It can be seen from the significance value of 0.002 at the 95% confidence level. In addition, the increase in the average N-Gain of the experimental class using the HOTS-oriented blended learning student worksheet with an average N-Gain of 0.46, compared to the control class using the HOTS-oriented worksheet with an average N-Gain of 0.34. Thus, learning by using HOTS-oriented blended learning worksheets for work and energy materials can be used as an alternative to improve student cognitive learning outcomes.

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