The Effect of HOTS-Oriented Blended Learning Model on Work and Energy Materials Using Google Classroom for Students' Critical Thinking Skill

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ABSTRACT

This study aims to determine the effect of HOTS-oriented blended learning model student worksheets on work and energy materials assisted by Google Classroom on critical thinking skill. This research was conducted at SMAN 1 Tanjung Bintang using a quasi-experimental form of non-equivalent control group design with purposive sampling technique. The sample of this research is students of grade X MIPA 2 and X MIPA 3. The data were tested by N-gain analysis, independent sample T-test, and Effect size test. The average N-gain in the experimental grade is 0.64 in the medium category. The results of the independent sample T-test showed that there was a difference in the average N-gain of students' critical thinking skill in the experimental grade and the control grade, which showed that the treatment had a significant effect. The magnitude of the effectiveness of using Effect size shows a value (d) of 0.91 with a higher category. The results of the research in the experimental grade showed an increase in students' critical thinking skill that were higher than the control grade, this means that there is an effect using the HOTS-oriented blended learning model worksheet assisted by Google Classroom on improving students' critical thinking skill.

Introduction

Advanced technology and education are heavily influenced by global developments in the learning paradigm in the 21st century. Teachers must be able to implement academic content to a higher level, including developing 21st century critical skill using various reasoning abilities, not just mastering subjects (Erlina et al., 2018). ICT skills are embedded within other 21st century competences, such as critical thinking, problem-solving, communication, and collaboration (Voogt & Roblin, 2012). 21st century learning is supported by the rapid development of information and communication technology (ICT). Learning is designed to incorporate technology in developing abilities that focus on critical thinking, problem solving, communication, and collaboration. Based on this design, the demands of 21st century

learning are technology-based learning to develop learning abilities and the government is designing 21st century learning in the 2013 curriculum that focuses on students.

Teachers must have the ability to become facilitators to achieve expectations for 21st century learning and the 2013 curriculum using ICT appropriately in presenting meaningful and enjoyable learning. One of the uses of ICT to use a blended learning model. Blended learning is an alternative solution to overcome the weaknesses of face-to-face and online learning to produce effective, efficient and fun learning sequences for students (Abdurrozak et al., 2016).

The use of instructional media can support and develop various student interactions and skills

(Schuchard et al., 2017). Online learning in blended learning requires learning media by utilizing technology, namely using Google Classroom media. Teachers and students can use Google Classroom anytime, anywhere with a computer or smartphone. Google Classroom was chosen to implement aspects of lesson planning, aspects of design and creation of materials, aspects of delivery methods, aspects of learning interactions, aspects of learning evaluation and learning implementation criteria as learning media as a whole are quite effective (Artiningsih & Nurohman, 2019). The next learning media is in the form of teaching materials that can be used as a learning reference so that what is taught by the teacher can be systematically conveyed to students.

Teaching materials used in schools have not been adapted to train students in critical thinking, so students still find it difficult when formulating problems, hypotheses, determining and analyzing data, and concluding a problem (Kaniawati et al., 2021). These difficulties occur because the use of teaching materials has not been able to optimize students' critical thinking skills. Teaching materials to support students at SMAN 1 Tanjung Bintang in learning are in the form of student worksheets made by the teacher. These teaching materials are still lacking in training students' critical thinking skills because they only describe material and there are no activities for students, worksheets is one of the teaching materials that is very important for the success of learning physics, worksheet must be based on HOTS to achieve the expected learning success (Wusqo et al., 2021).

The results of observations made by researchers at SMAN 1 Tanjung Bintang are that offline learning is still enforced with 1 hour of lessons which was 45 minutes cut to 30 minutes. Conventional worksheets supporting learning that is used in learning only contains a summary of the material, examples of questions, and functions as a complement to textbooks. The worksheets does not involve physical phenomena that students often encounter in everyday life. During learning, teachers rarely involve students in carrying out experimental or practicum activities, so students become less active and do not practice students' critical thinking skills. Based on this background, a study was conducted to determine the effect of the HOTS-oriented blended learning model with the assistance of Google Classroom on students' critical thinking skills.

Methods

The method applied in this study was to use a quasi-experimental form with a nonequivalent control group design. The research was conducted at SMAN 1 Tanjung Bintang in the even semester of the 2021/2022 school year. The research sampling in this study was grade X MIPA 2 as a control group with a total of 36 students and X MIPA 3 as an experimental group with a total of 36 students. The sampling technique was carried out by purposive sampling technique (Sugiyono, 2014). The research instruments used in this study included learning implementation plans (lessons plan), student worksheets, and students' critical thinking skill test in the form of pretest and posttest questions. Instruments in the form of pretest and posttest questions were tested for validity and reliability tests first. The data processing techniques used in this study included the N-gain test, normality test, homogeneity test, hypothesis testing, and effect size test using SPSS 21.0 software. The N-gain test was carried out to find out an overview of the increase in students' critical thinking skills with the N-gain groupification as shown in Table 1.

Table 1.
N-gain Criteria

N-gain	Criteria
N-gain > 0,7	High
0,7 > N-gain > 0,3	Middle
N-gain ≤ 0,3	Low

(Hake, 1999)

The normality test was carried out to find whether the sample data is normally distributed. Hypothesis testing is also carried out by looking at the results of the data normality test. If the data is normally distributed then a hypothesis test will be carried out using the independent sample t-test, but if the data is not normally distributed then a Mann Withney u test will be carried out.

Result and Discussions

Before the question instrument is used in the implementation phase, the instrument is tested find out whether or not the instrument is used. Tests were carried out on objects outside the research sample, namely students in grade XI IPA 2 who had studied work and energy material, taken from 32 respondents with a total of 5 description questions.

As for the results of the instrument test, namely the data on the results of the validity test showed that 5 items were declared valid use Pearson Correlation >

0.349, the 5 items were tested for reliability. Cronbach's Alpha value of the reliability test results of critical thinking questions there are 5 items with a value of 0.511. The Cronbach's Alpha value is between 0.400 and 0.600, which means it is quite reliable. Quantitative data on students' critical thinking skill in the experimental and control grade can be seen in Table 2.

Table 2
Data on Critical Thinking Skill in Experimental and Control Group

Parameter	Experiment		Control	
	Pre	*Post*	*Pre*	*Post*
Minimum score	15	40	5	20
Maximum score	35	90	35	80
Mean	23.75	72.36	21.81	60.00

The increase in critical thinking skills can be seen from the students N-gain scores. The results of the pretest and posttest values were analyzed using the N-gain calculation to see how much difference the increase in scores before and after being given treatment, can be seen in Table 3.

Table 3
Mean of Critical Thinking Skill Data

Group	N-gain	Categori
Experiment	0.64	Middle
Control	0.48	Middle

The data tested for normality is the N-gain of the critical thinking skills of each group. The results of the normality test using the Kolmogrov-Smirnov test assisted by SPSS 21.0 media can be seen in Table 4.

Table 4
Normality Test Results

Group	Kolmogrov Smirnov Sig.	Category
Experiment	0.200	Normally distributed
Control	0.198	Normally distributed

Based on the N-gain normality data for students' critical thinking skills in Table 4, the N-gain significance value in the experimental and control group is > 0.05, the data is normally distributed. The data is normally distributed which is one of the conditions for fulfilling it to test the hypothesis using the independent sample t-test.

In this study, the data that was tested for homogeneity was the N-gain mean of critical thinking skill each group. The results of the N-gain homogeneity test for critical thinking skills can be seen in Table 5.

Table 5
Result of Homogeneity Test Data

Levene Statistic	df_1	df_2	Sig.
1.925	1	70	0.170

Based on Table 5, it can be seen that the significant value of the homogeneity test results for critical thinking skills is 0.170. Based on the decision-making rules, a significant value > 0.05 means that the data is homogeneous. Based on the normality test, it was obtained that the data were normally distributed, so the hypothesis testing was carried out using the independent sample t-test. The following table shows the results of the independent sample t-test.

Table 6
Result of Independent Sample T-Test

	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	1.925	0.170	3.869	70	0.000

Based on Table 6, the results obtained are in accordance with the decision-making rules, if the sig. > 0.05 then H_0 is rejected whereas if the sig. < 0.05 then H_1 is accepted. Table 6 shows that the sig. is 0.000, then H_1 is accepted, meaning that it can be concluded that there is an effect of the use of HOTS-oriented blended learning worksheets assisted by Google Classroom on students' critical thinking skills on work and energy material.

The effect size calculation is carried out to find out the effectiveness of the learning method or model that has been tested and applied to students. The effect size can be found by getting the mean and std. Deviation from the independent sample t-test that has been done previously. The results of the test can be seen in Table 7.

Based on Table 7, it was found that for the experimental group the mean was 0.641 and the std. deviation is 0.147 while the mean control group is 0.488 and std. deviation of 0.186. when calculated with an online effect size calculator, it produces Cohen's d of 0.91 and an effect size of *r* of 0.41. The provisions

of the effect size table if the value of d is in the interval $0.8<d<2.0$ or more than 0.8 then it can be categorized as large, because the d obtained in this data is 0.91 then it is categorized as having a higher effect size. The learning that has been applied is very effective because the Cohen's d obtained at the effect size is high.

Table 7

Cohen's d Effect Size Results

Group	Mean	Std. Deviation	Cohen's (d)
Experiment	0.641	0.147	0.91
Control	0.488	0.186	

The HOTS-oriented blended learning model worksheet used in this study has a blended learning design with several activities. Worksheet refers to the phase of the knowledge dimension according to Anderson & Krathwohl (2001), namely factual, conceptual, procedural, and metacognitive. Supported by the blended learning phase according to Grant Ramsay in Susandi (2017), namely at the seeking of information phase in pre-face-to-face online activities the steps of student activity are seeking information from various sources such as the internet, books, or others. At the acquisition of information phase in face-to-face activities, students carry out experiments according to the activities in the worksheet. The next stage is synthesizing of knowledge in student activities at the post-face-to-face online phase, namely concluding or synthesizing the acquisition of information they have obtained.

The process of learning activities in the experimental group at the seeking of information phase in pre-face-to-face online activities assisted by Google Classroom is that students are given phenomena in everyday life in the form of pictures and videos. One of the phenomena is a large rock falling from a certain height and a certain speed and then hitting a small rock at the bottom of the height so that the small rock is crushed. This will be the initial provision for students to formulate problems and make hypotheses. Students are trained to play an active role and find as much information about the material being studied on their own in order to be able to answer questions about the phenomena given by discussion activities. So that the pre-face-to-face online stage contains information search activities to provide students with initial knowledge to continue to the next phase.

The next phase is the Acquisition of information phase in face-to-face activities, students carry out experimental activities, collect data, analyze data, and make conclusions. The experiments carried out by students were experiments regarding kinetic energy and potential energy in objects. Through this experimental activity, it is hoped that students will gain concrete knowledge through observations that students do alone with their group mates, presented in front of the group, then other groups criticize the results of the experiment.

The next activity is the synthesizing phase of knowledge in post-face-to-face online activities assisted by google grouprooom, at this phase the teacher evaluates the extent to which the knowledge and concepts they have mastered by providing questions to strengthen their concepts, so that students indirectly connect previous knowledge and the new knowledge they have acquired by experimenting. The learning process using google Classroom has various features that can be used to support the learning process when it is carried out to support online learning and offline learning is enforced, where 1 hour lesson time which was 45 minutes becomes 30 minutes. When learning online, the google Classroom application makes it very easy for teachers and students to carry out more in-depth learning. This is because both teachers and students can carry out learning activities in google Classroom, such as discussing, submitting assignments, and assessing assignments can be done anywhere without being bound by time limits or group hours.

Based on the results of hypothesis testing using the independent sample t-test in Table 6, a significance value of 0.000 is obtained. These results state that H_0 is rejected and H_1 is accepted. These results indicate that there is a difference in the N-gain mean of students' critical thinking skills in the experimental group and the control group so that it is known that there is an influence in the application of HOTS-oriented blended learning model worksheets assisted by google Classroom on improving students' critical thinking skills. Based on the results of the pretest and posttest of the two groupes that were carried out before and after being given treatment, different N-gain values were obtained, which can be seen in Table 3. In the experimental group, the N-gain mean in critical thinking skills was 0.64 in the middle category. and the N-gain mean in the control group is 0.48 in the middle category. These results indicate that the increase in critical thinking skills in the experimental group using the HOTS-oriented blended learning model worksheet treatment is higher than the increase in critical thinking skills in the control group using conventional worksheet. The increase in students' critical thinking skills can be seen from the improvement in every aspect when given pretest and

posttest questions. In general, the ability to think critically in the experimental group and the control group has increased with different increases. The increase in critical thinking skills in the experimental group was higher than the control group. Improving critical thinking skills in the experimental and control group can be seen in Figure 1.

Figure 1

The Percentage Mean of Critical Thinking Skills
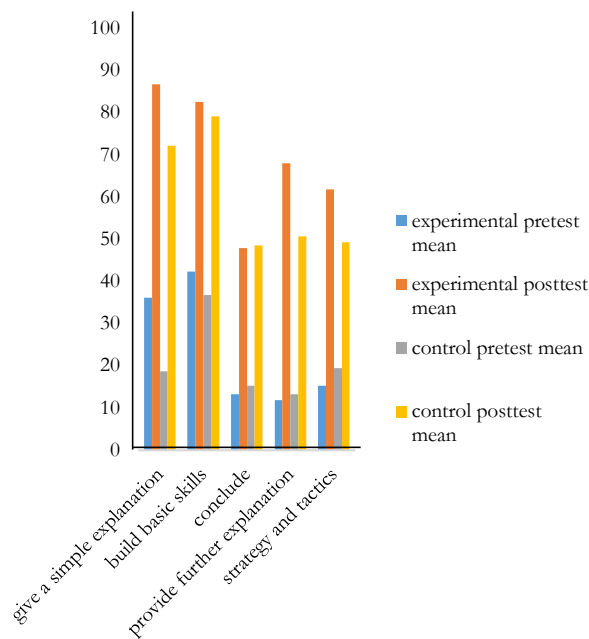
Based on Figure 1, in the experimental group and the control group there is a significant difference in improving aspects of critical thinking skills. The aspect of providing simple explanations (elementary clarification) and the aspect of building basic skills (basic support) experienced the highest increase in the experimental group and the control group, but the increase in the experimental group was greater than that of the control group. This increase occurred because students were given the opportunity to play an active role in learning using worksheet by providing a video or phenomenon and presented problems in everyday life that required students to analyze, make hypotheses, and solve problems with various strategies so that students could argue and discuss. Students are also given the opportunity to conduct experiments in learning so that they can build students' basic skills. This is in line with the results of research (Hatiti et al., 2021) worksheet is a teaching material that can improve learning outcomes because students discuss and exchange information obtained with other students, the ability to communicate information obtained is a thinking ability.

The aspect of providing simple explanations (elementary clarification) has increased because teachers provide learning experiences that are designed in the form of group discussions accompanied by worksheets that can help students understand the material and build their own knowledge with the teacher's guidance (Kristiyani et al., 2020). The high achievement of these indicators is due to the students' ability to formulate and analyze the questions presented very well after the learning process, students more easily understand material and concepts (Susilawati et al., 2021).

In the aspect of building basic skills (basic support) the increase is high because in learning students have carried out discussion activities to design experiments by formulating and making hypotheses, then students carry out experiments according to the teacher's directions and find experimental data (Lina, 2015). Critical people are people who quickly identify relevant information. After students carry out experimental activities and obtain experimental data, students will identify the information obtained with relevant sources, so that students can obtain information to present their experimental results (Permatasari & Trisnawati, 2021).

The lowest aspect of improvement in the experimental and control group is the inferring aspect. This happens because students are not maximal in the learning process, there are still students who do not understand the concept of learning, are not brave enough to argue, and are not maximal in observing and criticizing the results of experiments that have been carried out. The increase in the ability to conclude is in the lowest category of other abilities. Students only choose the correct answer without giving arguments and concepts that have been studied. The low ability to think critically in the aspect of concluding which includes the activities of making and considering decisions is possible because students still have difficulty solving problems that require mathematical reasoning (Lewa et al., 2017). If you review the learning activities that have been carried out, then the students' thinking ability to identify a problem is grown through associating (reasoning) the results of extracting information obtained by students with the phenomena presented by the teacher during learning activities. This means that there are efforts made by the teacher to improve students' thinking skills during the learning process (Hartati & Sholihin, 2015).

Improved ability in the aspect of providing further explanation (advance clarification) is quite good where after conducting the experiment students are required to convey the knowledge they have obtained from the results of the experiment and the material that has

been studied. The critical thinking aspect of providing further explanation can be seen from the ability of students to provide further responses regarding the information provided by associating several concepts. This proves that students' critical thinking skills in this aspect have increased quite well, because in the questions students have to relate several concepts to answer them.

Aspects of critical thinking govern strategies and tactics (strategies and tactics) measured by the ability of students to determine what actions or steps to take based on the information obtained (Andrée & Hansson, 2021). Improving students' strategic and tactical abilities is quite good because in learning students are given problems to solve and contain questions that refer to HOTS, so students can be active and train students to have thinking skills (Nurhidayati et al., 2017). This is in line with the advantages of worksheet is made systematically starting from apperception activities to evaluation, so that it can display a complete learning process, make students independent individually or in groups, and provide learning experiences.

The increase in the learning aspect with the HOTS-oriented blended learning model worksheet assisted by Google Classroom is also due to the use of technology, namely Google Classroom media for learning activities so that it can facilitate learning activities and is flexible. Google Classroom is used in learning to provide a wider variety of learning experiences (Kurniawan & Purworejo, n.d.). Google Classroom assisted learning allows students to actively participate in discussion activities and can develop ideas to answer a problem presented. It is also supported by the opinion that mixed learning is effective and easy for students to follow (Sakliressy et al., 2021). Students can easily discuss with other students about a phenomenon given by the teacher face to face or online

Based on the results of hypothesis testing and the theory used as a reference, it can be concluded that there are differences in the increase in critical thinking skills in groupes that use the HOTS-oriented blended learning model worksheet assisted by Google Classroom and group that use conventional worksheet, where the experimental group has a higher increase than the control group (Narvaez Rojas et al., 2021). which states that there is an effect of HOTS-oriented worksheets on improving students' critical thinking skills (Anggraeni et al., 2019). This research is in line with the research which obtained results that blended learning can significantly improve students' critical thinking skills and is supported by research explaining that with the help of google classroom as a learning medium, it will improve critical thinking skills student (Meriyanti et al., 2021).

Conclusions

The conclusion in this study is that the use of the worksheet of blended learning model on work and energy-oriented HOTS materials assisted by Google Classroom has a significant effect on increasing students' critical thinking skills. This is marked by an increase in students' critical thinking skills, with an N-gain mean in the middle category and the magnitude of the influence using the Effect size produces Cohen's d in the higher category.

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