Blended Learning: Its Effect towards Higher Order Thinking Skills (HOTS)

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Blended Learning: Its Effect towards Higher Order Thinking Skills (HOTS)

Abstract—This study aimed to determine the students' HOTS after applying blended learning model. This research was a quasi-experimental type of pre-test post-test control group design. The population in this study was all students of Teaching and Education Faculty in Universitas Papua who programed general physics courses which consisted of 6 classes. The purposive sampling technique was used to determine 2 research samples, namely biology education class as an experimental class taught using blended learning and mathematics education class as a control one. The online learning media used through blended learning include the use of e-modules, experiments through virtual laboratories, and e-books that can be accessed online through e-learning. The instrument used in this study was HOTS which consisted of 24 multiple choice items that had met valid and reliable criteria. The data of students' HOTS was obtained from pre-test and post-test scores. The analysis technique was in the form of gain and effect size test as well as prerequisite test and hypothesis testing. The prerequisite test was the normality test done through Kolmogorov-Smirnov test and homogeneity test done through Levene's Test of equality error variance. Hypotheses were analyzed using t-test with a significance level of 0.05 with the assistance of SPSS program. The results of the analysis showed that there were differences in the average post-test scores of the experimental class was 66.52 ± SD 17.69 and the control class was 42.01 ± SD 22.55, the gain score of the experimental class was 0.58 (medium) and the control class was 0.24 (low), and the effect size of the experiment class was 2.39 (high) and the control class was 0.53 (medium). The result of normality and homogeneity test of HOTS data showed normal and homogeneous results so that it could be proceed with hypothesis testing through t test. The result of the t-test analysis with a significant value (2 tailed) was 0.00 less than 0.05 or there were significant differences. It can be concluded that students' HOTS taught through blended learning is better than conventional models.

Keywords— blended learning, e-learning, HOTS, and online learning media

1 Introduction

The problem that exists in several universities, especially in eastern Indonesia, is the suboptimal use of internet media or e-learning in the learning process. This can be seen from ineffective management of e-learning sites on several campuses as well as at the Universitas Papua. E-learning facilities provided have a very limited access, both in terms of resources and website management. The use of e-learning must be supported by a variety of resources including the readiness of lecturers and students to organize the online learning. Answering the challenges of education today, educational institutions try to facilitate students to have extensive knowledge and skills, especially in using technology as one of the tools to solve problems [1], [2]. Students are required to

be able to develop their abilities in learning, especially utilizing technology as a source of learning [3], [4]. One alternative that can be used is the provision of e-learning facilities.

E-learning is an online learning media through the use of internet technology that allows learning materials to be accessed anytime and anywhere [5]. E-learning can be built through various basic engines or known as Learning Management System (LMS). There are many LMS applications that can be used as e-learning platforms, one of which is Moodle [6]. Moodle is equipped with various features that support online learning, so it is suitable to be applied especially in tertiary institutions. Moodle is the best e-learning platform in terms of flexibility and ease of use compared to other LMS [7]. Completeness of features in e-learning such as the availability of reading resources, worksheets, online practice questions, and discussion forum facilities are very important as a means of lecturer and student interaction. Moodle has a complete set of features that support learning especially for students in tertiary institutions because they are demanded to be creative and able to deepen their understanding of learning material [8]. Through Moodle LMS e-learning, learning material can be developed with a variety of learning resources including computer media that can be quickly updated by lecturers. By optimizing the use of e-learning, the students can learn well.

In fact, the use of e-learning is still found obstacles. Students still find it difficult to focus attention on the learning material provided in e-learning [9], [10]. Some students still experience difficulties in understanding the learning material through e-learning because of the absence of the instructor face to face in classroom [4]. In learning activities, there is a need for face-to-face meeting in the classroom so that lecturers can consider various needs of students [11]. The solution that can be done to overcome these problems is to combine e-learning with face to face meeting in classroom [12]. Merging online learning with face to face meeting in class is expected to control activities as well as motivating students to not get bored during the learning process [13]. The incorporation of learning is known as a blended learning model. Blended learning combines three learning activities namely face-to-face learning, learning that is facilitated through e-learning, and independent learning [14]. The integration is carried out through conventional learning or that has commonly been done (face to face in class) and online learning (through e-learning).

Blended learning optimizes the integration between oral communication in face-to-face learning in the classroom and written communication on e-learning. Blended learning utilizes various technologies in learning including chatting, email, online forums and the use of ICT media such as multimedia, simulation, animation, or virtual laboratories. Blended learning is not seen as learning that is fully implemented online, but as a complement to lessons that are carried out face-to-face in the classroom [15]. In blended learning, students have ample opportunities to learn from various learning resources provided through e-learning.

One of the facilities in e-learning is the opening of discussion forums between lecturers and students or among students itself that are not limited by time and place [16]. The combination of face-to-face learning directly with e-learning is one alternative solution to facilitate students in order to develop their understanding about the learning

materials. Blended learning can create an atmosphere of independent learning that facilitates students in finding new ideas of understanding.

The application of blended learning is expected to improve the ability of students to understand the learning materials. One of the students' abilities that can be developed through blended learning is Higher Order Thinking Skills (HOTS) [17]. HOTS is an important skill that is trained for the students because with this ability they can solve various problems encountered [18]. Through HOTS, students can think critically, creatively and innovatively. HOTS is the highest level of Bloom's taxonomy in the cognitive domain, namely analyzing (C4), evaluating (C5) and creating (C6) [19]. Students need to be trained to develop their HOTS through a variety of innovative applications that are students-centered.

Blended learning is one of students-centered learning. It is an innovative learning that is effective in developing students' HOTS because they can learn according to their speed level in understanding the learning material [20]–[22]. HOTS can be trained to students through the presentation of various learning resources that demand their ability to be able to solve problems, especially about HOTS [23]. Presentation of learning resources consisting of various HOTS problems in e-learning media through the application of blended learning is expected to develop the students' HOTS in this study.

This research was conducted at the Faculty of Teacher Training and Education in Universitas Papua. The results of observations so far in the Teaching and Education Faculty of the Universitas Papua have found that the students' HOTS was relatively low. This was influenced by various factors such as lack of motivation and interest of students to learn and develop their abilities. Furthermore, lack of facilities and infrastructure to support the implementation of lectures as well as environmental conditions also affected students' learning habits. The limitations of online learning support facilities also became obstacles faced by students in accessing various learning resources [24]. Students are not accustomed to learn through e-learning so they need to be introduced. Therefore, students need to be trained in accessing various learning resources through learning facilities in the form of e-learning in which there are various learning resources that can be widely accessed via internet. The combination of e-learning with face-to-face learning in class or blended learning is expected to be effective in developing students' HOTS.

2 Methodology

2.1 Research Design

This research was a quasi-experimental type of pre-test post-test control group design. The population in this study was all students of Teaching and Education Faculty of Universitas Papua who programed general physics courses consisting of 6 classes. There were 2 samples in this study, namely Biology Education Class with 29 students as experimental class and Mathematics Education class with 24 students as Control class. Purposive sampling technique was used to determine the research sample. Students from biology education class were chosen as an experimental class because of the

consideration that the basic abilities of their physical material are relatively less compared to students majoring in mathematics education. In the experimental class, blended learning is applied. The online learning media used through blended learning included the use of e-modules, experiments through virtual laboratories, and e-books that can be accessed online through e-learning. Meanwhile, in the control class, students attended face-to-face learning as usual through lecture, demonstration, discussion and question and answer methods. The materials provided in both classes were related to various HOTS issues, so students were expected to develop their HOTS.

Stages implemented in the implementation of blended learning were (1) providing information; lecturers prepared learning material that was integrated into e-learning so that students could learn it even before face-to-face learning was carried out, (2) guiding students; lecturers discussed the learning materials both in face to face meetings and discussion forums or via video conferences that were followed by students on e-learning, (3) provide training; students were given trainin to clarify the material that had been learned, then it could also be discussed both at face-to-face meetin and in e – learning class, and (4) assessing; lecturers conducted assessments directly both face-to-face in class and online. The assessment can be automatically carried out through e-leaning as in multi e choice questions or other objective questions. The research activities carried out in the experimental class and the control class displayed in Table 1 [25].

Table 1. Design of Learning Process

ctivity	**Experiment**	**Contr**
Pre-test	The initial HOTS test is carried out conventionally using a paper based test.	The initial HOTS test is carried out conventionally using a paper based test.
Treatment	1. Face-to-face learning is continued through e-learning. 2. Students access learning resources provided through e-learning. 3. Assessment is done online through e-learning. 4. Students who don't understand can ask questions in e-learning class. 5. Discussions can be done in class and through e-learning (chat & discussion forums). 6. Quizzes are conducted through e-learning with feedback.	1. Conventional face-to-face learning. 2. Students learn through learning resources that are provided directly without going through e-learning. 3. Assessment is done directly in classroom. 4. Students who don't understand can ask questions in classroom.
Post-test	The final HOTS test is done through e-learning	The final HOTS test is done conventionally

2.2 Data Collection and Analysis

The variables in this study consisted of independent and dependent variables. The independent variable was blended learning using online learning media including e-modules, experiments through virtual laboratories, and e-books. The dependent variable was students' HOTS. The instrument used in this study was HOTS which consisted of 24 multiple choice items. Before applying the instrument, validity and reliability test were performed. The results of validation analysis of HOTS questions done by the validator showed that the value of Aiken V was range from 0.76 to 1.00 which showed valid results. Meanwhile, the reliability value was in the range of 0.67 to 0.80 or reliable enough. HOTS questions included three aspects namely analyzing, evaluating and creating. The analysis aspect consisted three sub-aspects, namely differentiating, sorting, and articulating. The evaluation aspect consisted of two sub-aspects, namely checking and criticizing. The aspect of creating consisted of three sub aspects, namely formulating, planning, and producing.

Students' HOTS data were obtained from pre-test and post-test scores. Calculation results were obtained from the reduction of post-test and pre-test scores in the form of gain scores. The analysis technique used to determine the gain score is shown as in equation (1) [26].

$$< g >= \frac{\% < S_f > \quad \% < S_i >}{100 \quad \% < S_i >} \tag{1}$$

The <g> is the normalized gain, <Si> is pre-tets score, and <Sf> is post-test score. The criteria for <g> score displayed in Table 2.

Table 2. Normalized average score criteria

Value <g>	Categories
<g> >0,7	High
0,3 < <g> ≤ 0,7	Medium
<g> ≤ 0,3	Low

The effectiveness of learning can be seen based on the score of effect size [26]. The effect size score can be determined through equation (2).

$$d = \left(m_A - m_B\right) \Big/ \left[\left(sd_A^2 + sd_B^2\right)/2\right]^{1/2} \tag{2}$$

d is the effect size score, m_A is the average gain score of experimental class, m_B is the average gain score of control class, sd_A is the standard deviation of the experimental class, and sd_B is the standard deviation of control class [27]. The effect size scores are categorized as in Table 3 [28].

Table 3. Effect Size Category

Effect Size	Categories
d < 0,2	Small

0,2 < d < 0,8	Medium
d > 0,8	High

The hypothesis in this study whether there is a difference of HOTS between the control and experimental class. Hypothesis testing is done using the gain score obtained. Data were analyzed using prerequisite tests to determine hypothesis testing techniques. The normality test was carried out using Kolmogorov-Smirnov test and the homogeneity test was analyzed using Levene's Test of equality error variance. If normal and homogeneous data were obtained, this would be continued with parametric statistical tests using t-test with a significance level of 0.05 assisted by SPSS program.

3 Results

At the initial meeting of the research, both classes were given a pre-test. In the control class, learning was done as usual through face to face meeting in the classroom. On the other hand, in the experimental class, it was first conveyed to students that learning would be carried out through directly face to face and e-learning. At this stage, it has been explained about ways to access e-learning because they have not experienced using e-learning before. The appearance of general physics courses in e-learning is shown in Figure 1.

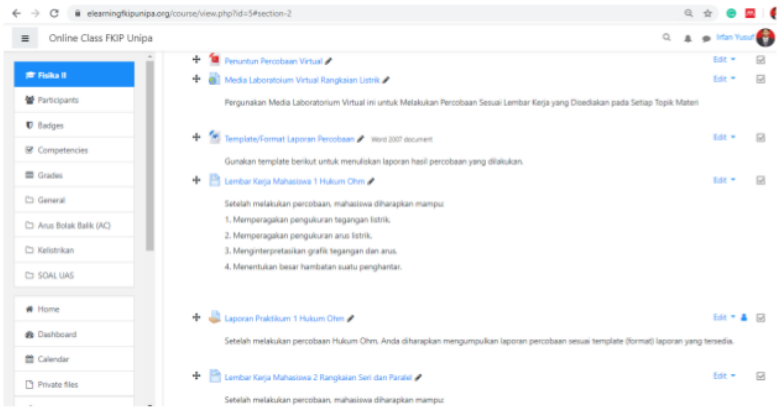

Fig. 1. The display of learning materials through e-learning

Figure 1 shows various learning resources and assignments that would be delivered during learning through e-learning. Learning resources provided in e-learning consisted of various learning media such as animation, simulation, interactive multimedia, and virtual laboratory media. Lecturers and students could also have virtual meetings through video conference facilities provided as shown in Figure 2.

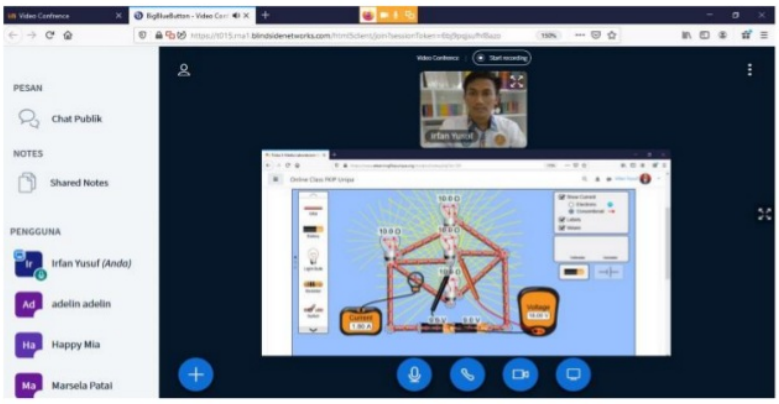

Fig. 2. Virtual meeting through e-learning

Lecturers and students can interact virtually. Lecturers can deliver learning materials virtually and discuss directly with students. This virtual meeting was held on every topic of material especially those related to physics experiment material assigned to students. The learning material given were the same both in the experimental and control class, namely general physics material in electrical circuits related to various HOTS problems. In the control class, the learning material was delivered directly face to face in the classroom. The research results in the experimental class taught using blended learning model and in the control class taught using conventional model are shown in Table 4.

Table 4. Pre-test, Post-test and HOTS Score

Group	HOTS Score		N-g		Effect size	
	Pre-test	Post-test	Value	Categories	Value	Categories
Experiment	31.03 ± SD 11.33	66.52 ± SD 17.69	0.58	Medium	2.90	High
Control	31.60 ± SD 16.02	42.01 ± SD 22.55	0.24	low	0.30	0,53

Table 4 showed that the pre-test scores between the two classes, namely experimental and control class, were relatively similar. However, there were differences in the average of post-test score in experimental class was 66.52 ± SD 17.69 and the control class was 42.01 ± SD 22.55, the experimental class gain score was 0.58 (medium) and control class was 0.24 (low), and the effect size score of experimental class was 2.39 (high) and control class was 0.53 (medium). The difference in the score of HOTS appeared in the post-test that the experimental class was higher than the control class. The gain score and the effect size score of the experimental class were also greater than

the control class. The difference in the students' HOTS scores viewed from each aspect and sub-aspects of HOTS can be seen in Table 5.

Table 5. Differences in pre-test and post-test average score in control classes and experimental classes on HOTS aspect and sub aspect

Aspect	Sub Aspect	Average			
		Control Class		Experimental Class	
		pre-test	post-test	pre-test	post-test
Analyze	Differentiating	65.28	70.83	62.07	96.55
	Organizing	61.11	61.11	50.57	77.01
	Attributing	51.39	65.28	54.02	89.66
Evaluate	Checking	23.61	31.94	29.89	56.32
	Critiquing	31.94	37.50	33.33	56.32
Create	Generating	8.33	33.33	6.90	63.22
	Planning	6.94	25.00	9.20	54.02
	Producing	4.17	11.11	2.30	39.08

Table 5 shows that in every aspect and sub-aspect of HOTS, the experimental class was higher than the control class. There was an increase in the average of pre-test scores in every aspect and sub-aspects of HOTS in the experimental class while in the control class, the score improvement was not seen or relatively the same between the pre-test and post-test scores. Among the eight sub-aspects of HOTS, the highest average score was in the analyze aspect.

Significant differences of HOTS post-test scores between the experimental and control class could be measured through hypothesis testing. Before determining the hypothesis testing technique used, the prerequisite test which consisted of the normality and homogeneity test had to be done. The results of the normality test are presented in Table 6.

Table 6. Result of normality test analysis in the control class and experimental class

Group	Kolmogorov-Smirnov		
	Statistic	df	Sig.
Control_Class	0.16	24	0.10
Experimental_Class	0.08	29	0.20

Table 6 shows that the significance value of the control class is 0.10 and the experimental class is 0.20 greater than 0.05. The results of the analysis showed that the HOTS post-test score of control and experimental class came from populations that were normally distributed. The results of homogeneity variance test from both groups are presented in Table 7.

Table 7. Analysis of variance homogeneity test results

Based on Mean			
Levene Statistic	**df1**	**df2**	**Sig.**
1.52	1	51	0.22

Table 7 shows that the significance value of 0.22 is greater than 0.05. This result indicated that HOTS data of students i homogeneous. The results of normality and homogeneity test of HOTS were rmal and homogeneous, so that it could be continued with hypothesis testing by using t test. Independent t-sample test was used to determine the significance of the speci differences between the two groups which were analyzed partially. T-test results can be seen in Table 8.

Table 8. Independent samples t-test analysis results

HOTS	t-test for Equality of Means		
	t	**df**	**Sig. (2-tailed)**
Equal variances assumed	-4.43	51	0.00
Equal variances not assumed	-4.33	43.19	0.00

Table 8 shows that there were significant differences in students' HOTS between the experi tal and control groups. This is evidenced by the results of the t t analysis with a significant value (2 tailed), which is 0.00 less than 0.05. Based on the test results, it can be concluded that the students' HOTS taught through blended learning is higher than conventional models.

4 Discussion

Blended learning in general physics at the Universitas Papua has the advantage on preparing a variety of HOTS-oriented learning resources and the relevance of the material presented very well. However, at the beginning of learning, there is still a need to adapt the learning implementation by students because previously there has never been a lecture based on blended learning. The introduction of features in e-learning is very important so that students can access e-learning resources optimally [29]. Therefore, in the initial stages, researchers provide usage guidelines that can be learned by students while learning through e-learning.

The findings obtained in this study indicate that the students' HOTS in general physics courses after the implementation of blended learning model is higher compared to the conventional one. The implementation of blended learning gives a good impact towards the students' HOTS. Blended learning helps students to develop their HOTS [21]. Students have many opportunities to learn independently through learning resources that are available in e-learning [8]. The learning resources that are available in e-learning include the use of e-modules, experiments through virtual laboratories, and

e-books that can be accessed anytime and anywhere. Learning resources available through e-learning make students become active in learning [30], [31]. Blended learning is very useful for developing students' involvement in lecture because they are required to actively participate in the activities given [32]. If viewed more closely, the steps of learning in the blended learning model are processes to supplement the shortcomings of face-to-face learning in the classroom through e-learning.

The obstacle that is usually encountered in the face-to-face learning process in classroom is the lack of study time for students [15]. General physics courses are not enough just to be learned through class meetings. The amount of material that must be learned especially the material which is related to the basic understanding must be mastered, so students are expected to be able to learn more independently. If the class meeting starts with an explanation of the material, giving examples of questions, and students discuss in doing the exercises, will make the material given are sometimes not well understood by students. Therefore, students need to be provided with learning resources that can be learned outside the classroom. Through blended learning, the presentation of various learning resources can be provided online through e-learning.

The stages of blended learning begin with the initial presentation of information through e-learning that can be accessed by students before the learning process begins. Students can study independently, conduct discussions, learn to understand the material and try to do the exercises by uploading answers in the links contained in e-learning. Lecturers can track when the students collect their assignments. The submission of assignments in online, makes students becomes more motivated to submit their assignments on time. This can indirectly increase student motivation and learning independence.

Lecturers can guide students in learning both in face-to-face and e-learning classes. Guidance on e-learning class is provided in the discussion forum as well as via video conference which can be attended by all participants online. Discussions on e-learning class are very useful for students, especially if they are shy to ask directly [33]. Lecturers can directly provide answers to various questions of the students. Likewise the tasks done by students, lecturers can verify the answers that have been uploaded. Assignments given can be in term of individual or group. Even though the work is done in groups, the lecturers have to still check whether the students' work is the result of their group's work or the results of a copy from another group. This can be done by providing exercises that can be answered directly by students. The assessment system on the blended learning model can also be done before the learning begins, for example the students collect online assignments, it can indirectly provide an overview to lecturers about the students' HOTS even before the learning begins. Hence, the lecturer can take action immediately, for example by providing explanations of material to groups of students with low ability, and providing enrichment of material to groups of students with high ability. Thus the students' HOTS can improve. Although it looks complicated, this model provides an exciting new learning experience for students.

Blended learning can encourage students to learn more actively. Lecturers as facilitators, provide a variety of innovative learning resources with various HOTS problems through e-learning in order to create a pleasant learning atmosphere [34]. In blended learning, students can develop their HOTS, either through group learning or asking

lecturer directly through discussion forums that are available online. The implementation of blended learning can provide opportunities for students to learn independently. Students can obtain various learning resources through e-learning. Blended learning is very efficient, especially applied to students in tertiary institutions because they are trained to find various kinds of solutions to the problems they face [35]. Blended learning creates good interactions between lecturers and students, this shows that pedagogical content can be applied in learning [36]. This means that blended learning is active-based learning which is very good to be implemented especially in higher education.

Unlike blended learning, conventional learning is only carried out in the form of face-to-face meeting in the classroom. Although the learning resources that are provided vary from HOTS issues, it is still difficult for students to review the material. Nevertheless, there are also some weaknesses of the blended learning model, namely dependence on internet networks, connectivity that is still expensive, resources, hardware and software incompatibility, make some students become stressful when they are given assignments with a limited time [30]. Therefore, educational institution has its own challenges in implementing the blended learning. The main criteria that must be fulfilled are the readiness of the system facilities and careful planning; the development of complete and interesting content; as well as monitoring and routine evaluation of the learning process.

5 Discussion

This study examined the students' HOTS in general physics courses after blended learning model has been implemented. The results of the analysis showed that there were differences in the average post-test scores of the experimental class which is 66.52 ± SD 17.69 and the control class is 42.01 ± SD 22.55, the gain score of the experimental class is 0.58 (medium) and the control class is 0.24 (low), and the effect size of the experiment class is 2.39 (high) and the control class 0.53 (medium). The results of normality and homogeneity test of HOTS are normal and homogeneous, so that it can be continued with hypothesis testing by using t test. The results of the t test analysis with a significant value (2 tailed), which is 0.00 less than 0.05 or there are significant differences. It can be concluded that the students' HOTS taught through blended learning is better than conventional models. Based on these conclusions, it is recommended to lecturers or other teaching staff to be able to apply the blended learning model as an effort to improve students' HOTS.

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