The evaluation on the use of e-learning media to improve HOTS through authentic and holistic assessments

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Abstract. This study aims to improve students’ Higher Order Thinking Skills (HOTS) through the use of e-learning. The type of research used is Participatory Action Research (PAR) which refers to the Davison, Martinsons & Kock model. The subjects used were 11 students majoring in Department of Physics Education at the Universitas Papua who programmed basic physics courses with two lecturers as instructors. The students consisted of 6 female and 5 male, with an average age of 19 years. The research instruments are in the form of HOTS questions and online questionnaires about the effectivity and practicality of using e-learning. Students’ HOTS assessment were done authentically and holistically by looking at the various effects of optimizing the use of e-learning that can improve student HOTS. The results showed that the use of e-learning media consisting of various supporting devices such as modules, animation, simulation, multimedia, and online virtual laboratories could increase students HOTS. Students give agreeing responses to the use of e-learning media. It can be concluded that e-learning can improve HOTS ability and students agree the learning process. This study's recommendations are the need for sufficient internet access and affordable fees, especially for students.

1. Introduction

The use of e-learning, especially in tertiary institutions, is very important in order to increase students’ interaction with lecturers. The availability of unlimited learning resources may give a chance for sharing resources with more advanced universities. So far, the application of e-learning in several universities, especially at the Universitas Papua, has not been effective because of the limited resources availability. Learning through e-learning can be built through various supporting devices such as Learning Management System (LMS). One type of LMS that is commonly used in e-learning is Moodle application. Moodle is a license-free program (open source) that can be utilized in online learning [1].

The use of Moodle as e-learning is very suitable in online learning because it is equipped with various extraordinary features [2], [3]. Optimizing the use of e-learning needs to be done by involving various parties, especially lecturers and students, so that various abilities of students can be developed. Students are required to think comprehensively in solving problems. One of the most important thinking skills that should be trained for them as a provision to face the work world is the ability of Higher Order Thinking Skills (HOTS) [4]. According to revised Bloom’s taxonomy, the thinking processes are divided into six levels, namely C1 (remembering), C2 (understanding), C3 (applying), C4 (analyzing), C5...
(evaluating), and C6 (creating). The first three levels are categorized as Lower Order Thinking Skills (LOTS), while the next three levels are categorized as HOTS [5].

Lecturers can assess each assignment given and display the results of the assessment directly through e-learning, so that the assessment is meaningful and comprehensive [6], [7]. These meaningful and comprehensive assessments are known as authentic and holistic assessments. Authentic assessment is a meaningful and direct assessment. Authentic means actual, true, or valid. Authentic assessment is often contrasted with the use of standardized norm tests in the form of multiple choice questions, matched, short answers, and true or false choices because these forms of assessment are judged to be unable to provide a direct and real picture of students' thinking and understanding abilities in mastering subject matter [8]. Meanwhile, evaluation in the form of authentic assessment aims to make students able to think with science and shape their HOTS abilities [9]. Measurement of student learning outcomes especially HOTS ability needs to be measured thoroughly throughout the process and after learning through holistic assessment [10]. Holistic assessment refers to a direct approach in assessing student learning outcomes [11]. HOTS measurements in this study are related to physics material. Most students assume that physics material is difficult to learn because it consists of various abstract concepts and is difficult to describe directly. Studying physics requires the ability to think logically, critically, creatively, and objectively [12]. By practicing these abilities, it is hoped that students can develop HOTS.

In fact, the implementation of HOTS especially in physics learning still found various evaluation questions that did not train the students' HOTS abilities. Most of the questions are more likely to require the ability to remember. The ability to remember is based on memorizing answers that are contrasted to authentic and holistic assessments, so that it is not effectively used as an evaluation tool especially to measure students' HOTS ability. Authentic and holistic assessment is very important, especially to measure students' HOTS ability. Through this assessment, it is expected that HOTS ability can be assessed objectively and efficiently not only based on the final results or existing products. Therefore, through the use of E-Learning media, it is expected to be able to improve and measure students' HOTS abilities through authentic and holistic assessments. This study aims to evaluate the use of e-learning in order to increase students' HOTS.

2. Methods
The method used is Participatory Action Research (PAR) with quantitative descriptive analysis. PAR facilitates the involvement of students in research conducted in order to obtain effective results [13], [14]. The subjects used were 11 students majoring in Department of Physics Education at the Universitas Papua who programmed basic physics courses with two lecturers as instructors. The students consisted of 6 female and 5 male, with an average age of 19 years. PAR prioritizes interpretative aspects of students and educators (in this case, researcher as lecturer) in the purpose of making improvements to the way or techniques in delivering the learning materials as well as solving learning problems faced by students collaboratively and andragogical related to HOTS problems. Students' HOTS assessment is done authentically and holistically by looking at the various effects of optimizing the use of e-learning that can improve student HOTS based on PAR stages. The PAR stages used refer to the Davison, Martinsons & Kock model as shown in Figure 1 [15].

![Figure 1. The PAR Stages of the Davison, Martinsons & Kock Model](image-url)
2.1 Diagnosing
In this stage, the researcher identifies problems related to some obstacles during the learning of basic physics course in Department of Physics Education of the Universitas Papua. Those are used as a basis for finding important points to be corrected in the research. At this stage, an analysis of initial abilities and characteristics of students is carried out. The initial ability of students who incidentally come from various high schools has a high heterogeneity because they come from various group of knowledge. This becomes the basis for the researcher to determine the starting point of learning. Moreover, it is necessary to know the students’ attitude towards the material that will be learned and the way they learn.

2.2 Action Planning
At this stage, the researcher compiles a learning implementation plan contained in the Syllabus and Lesson Plan. At this stage, the subject matter is also prepared in the form of learning materials and learning media which will be studied online through e-learning. The learning materials are designed by incorporating various materials content and assignments oriented to HOTS. It is expected that these learning materials can develop the students’ HOTS ability. HOTS questions are also prepared for each topic studied. During the planning stage, a research instrument in the form of a questionnaire was given to students. The questionnaire grids are showed in Table 1 [16].

| Aspects       | Item Number | Statement                                                                 |
|---------------|-------------|---------------------------------------------------------------------------|
| Effectivity   | +1          | The use of e-learning media increases the learning enthusiasm             |
|               | +2          | E-learning media can help to obtain information about physics learning     |
|               | +3          | The e-learning media stimulates curiosity                                 |
|               | +4          | E-learning media can create an atmosphere of independent learning         |
|               | +5          | E-learning media can help to develop analytical thinking skills           |
|               | +6          | E-learning media can help to develop evaluation skills                    |
|               | +7          | E-learning media can help to develop the ability to create               |
| Practicality  | -8          | E-learning media is difficult to use                                      |
|               | +9          | The combination of foreground and background of e-learning media is        |
|               | +10         | Hyperlinks between files in e-learning media are easily accessed          |
|               | +11         | Pictures, illustrations, graphics or videos in e-learning media attract    |
|               | +12         | The material in the e-learning media is presented sequentially            |
|               | +13         | Text or writing in e-learning media is easy to read                       |

2.3 Action Taking
At the beginning of the meeting, a pre-test was given to determine the students’ initial ability about HOTS. At this meeting, the researcher also delivered a description of lecture that will be implemented including the application of online learning through e-learning. Also at this meeting, the researcher explained to students about how to access and learn using e-learning. At the next meeting, online learning would be carried out through e-learning. At the end of each topic, the students’ HOTS ability was assessed. The assessment is done authentically and holistically through observation and evaluation of student activities. Each student activity can be observed directly through e-learning.

2.4 Evaluating
This evaluation is carried out to assess students’ HOTS during the learning process. HOTS assessment is carried out on each topic of discussion. The HOTS level is categorized as in Table 2.

| Interval (Meaning: Im: ideal mean; Isb: ideal standard deviation) | Interval Value | Category   |
|-------------------------------------------------------------------|----------------|------------|
| Im + 1,5 Isb < 0                                                  | 75 < 0         | Very high  |
| Im + 0,5 Isb < 0 ≤ Im + 1,5 Isb                                  | 59 ≤ 0 ≤ 75    | High       |
| Im - 0,5 Isb < 0 ≤ Im + 0,5 Isb                                  | 42 < 0 ≤ 59    | Enough     |
| Im - 1,5 Isb < 0 ≤ Im - 0,5 Isb                                  | 26 ≤ 0 ≤ 42    | Low        |
| 0 ≤ Im - 1,5 Isb                                                  | 0 < 26         | Very low   |
2.5 Reflection
This stage is the final part of the action that has been passed by carrying out a review of the learning process through a wide group discussion (plenary discussion). In this phase, all criteria in the principles of lecture are discussed again, including problems or obstacles that occur during lecture that are then communicated to students and partner lecturer. The researcher then do reflection towards the learning process that has been carried out, including consideration and input to improve the model that has been applied.

3. Result and Discussion
The first stage carried out in this study is the analysis of initial abilities and characteristics of students. The results of the initial analysis conducted showed that the initial abilities of students are varied. Those various abilities are dominantly influenced by students who incidentally come from various senior high school backgrounds. This becomes the basis for researchers to determine the starting point of learning, namely doing a pre-test to obtain their HOTS abilities. The description of the activities at the initial meeting was the introduction of e-learning including the use of various learning facilities which consisted of learning materials and learning media in the form of virtual experiments, exercises that were done interactively, and discussion facilities through discussion forums provided. At this stage, the enthusiasm of students in following the material can be clearly seen. At the next meeting, basic physics learning was carried out through e-learning. Students are given the opportunity to learn using e-learning. In every meeting, an assessment is conducted to evaluate the students’ HOTS ability (Table 3).

Table 3. The Distribution of Students’ HOTS Assessment in Each Meeting

| HOTS Categories | Number of Students/Grades Pre-Test | Lesson 1 | Lesson 2 | Lesson 3 |
|-----------------|-----------------------------------|----------|----------|----------|
| 0 > 75          | Very high                         | 0        | 0        | 2        | 5        |
| 59 < 0 ≤ 75     | High                              | 0        | 1        | 1        | 2        |
| 42 < 0 ≤ 59     | Enough                            | 4        | 4        | 5        | 3        |
| 26 < 0 ≤ 42     | Low                               | 4        | 4        | 2        | 1        |
| 0 < 26          | Very low                          | 3        | 2        | 1        | 0        |

Average ± Standard Deviation (SD) 37.50 ± SD 12.50 42.05 ± SD 16.08 48.86 ± SD 11.80 69.32 ± SD 19.66

Highest Score/Lowest Score 50.00/12.50 75.00/12.50 62.50/25.00 87.50/37.50

Table 3 shows that there is an increase in the students’ HOTS ability. There were no students who got a very high category of HOTS score for their pre-test, as well as in the meeting 1. However, there was already 1 student who had a high category of HOTS score. The increase in the HOTS score was seen to be significant at meetings 2 and 3, where most of the students received high and very high categories of HOTS score. The average of students’ HOTS score in the pre-test is 37.50 ± SD 12.50 or low category, and it increases in every meeting. In addition, there was also maximum HOTS score obtained in each meeting. At meeting 3, the average HOTS score was 69.32 ± SD 19.66 or in the high category. HOTS analysis of students is reviewed in every aspect and sub-aspects as shown in Figure 2.

Figure 2. This Description Aspects and Sub-Aspects of HOTS
Figure 2 shows that there was an increase in students' HOTS scores in every aspect and sub-aspect of HOTS. In the analyze aspect, there was an increase in student scores consistently, such as in the differentiating sub-aspect, 45.45 was obtained at the pre-test, 63.64 in learning 1, 72.73 in learning 2 and increasing to 90.91 in learning 3. Similarly, the organizing sub-aspect also had an increase. However, the attributing sub-aspects obtained relatively the same scores for each meeting. The score obtained was 45.45 in the pre-test, 45.45 in learning 1, 36.36 in learning 2, and 45.45 in learning 3 or in the fair category. Moreover, in the evaluating aspect, it has increased in each sub-aspect. The increase scores are categorized into high and very high categories. Whereas in the create aspect, the students' score increased especially in the sub-generating aspects which categorize into high category. However, students get relatively low grades in the planning and generating sub-aspects. Although students’ scores increase in high category for the generating sub-aspect in learning 3, but they were still in a low category for the planning and producing sub-aspects. The results of description analysis of the students’ HOTS ability in every aspect and sub-aspects showed that the students still get difficulties in the creative aspects, especially in the sub-aspects of planning and producing. This sub-aspect is the highest level of HOTS according to Bloom's taxonomy. Students need to be given questions at the HOTS level so they can be trained to develop their cognitive abilities and also they can compete in TIMSS [17]. Students who have difficulty in answering usually they lack of practice in working on problems. Students need to be trained to solve problems that demand their HOTS abilities. Giving HOTS problems to the students can gradually develop their abilities [18], [19]. Presentation of HOTS questions can begin with problems that are directly related to events in daily life so that students can abstract their knowledge of the material being studied [20]–[22]. Therefore, lecturers are required to be able to present various learning resources related to HOTS issues so that students can be trained and have HOTS abilities.

In the final stage of learning, an analysis of student responses towards e-learning is carried out. The student responses aims to determine the effectivity and practicality of using e-learning media. The results of students’ assessment responses were analyzed using the Rasch Model analysis via Winstep application as shown in Figure 3.

![Figure 3. The Results of Students’ Assessment Responses](image)

The Rasch Model analysis results showed that the person measure score was +1.49 logit more than 0.00. This showed that majority of students giving ratings strongly agree to the given questionnaire statement. In figure 3, it can be seen that in the upper right, there are 5 students (04, 01, 06, 09 and 03) who have high levels of ability. Those five students gave a high response rating from all questionnaire
statements. In the lower right, there is only 1 student (11) who gives a low rating of each response statement given. When it was reviewed, the activity of that student is indeed not actively participating in online lecture. So, extra attention is needed from the lecturer to provide guidance for the student. It is undeniable that some students still find it difficult to adapt in using e-learning fully. If they are given a choice, there are still most of them who prefer to study face to face as usual compared to learning through e-learning, because the learning situation in the classroom cannot be replaced [23]. In Figure 3, the right side shows that it is difficult for students to agree to S12 statement about material in the e-learning media presented sequentially. The statement is difficult to approve because the e-learning media that is designed consists of various reading sources or supporting media to support students’ learning activities. The reading source is connected to various subject matters on the internet. Students can access various materials that are presented openly.

4. Conclusion
The analysis results of the research data indicate that the use of e-learning can improve students’ HOTS abilities. The increase in student HOTS is seen in every aspect and sub-aspect of HOTS. Students actively learn and do the assignments given through e-learning. The analysis results of the students responses to the effectivity and practicality of e-learning, in general showed that the students approve the learning process. The obstacle obtained in this research was the lack of supporting facilities for implementing online learning such as inadequate internet access in various locations and relatively expensive access fees, especially for students.

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