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Enhancing Physics Conceptual Understanding: The Effectiveness of Olabs Media in High School

Abdul Hamid[1], Mawarni Saputri[1,2], Khairatun Nisa[1], Musdar[1]
[1]Program Studi Pendidikan Fisika, Universitas Syiah Kuala, Jl. Jl. Teuku Nyak Arief, Kopelma Darussalam, Kec. Syiah Kuala, Kota Banda Aceh, Aceh, Indonesia

[2]E-mail: mawarni_saputri@usk.ac.id

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Abstract. Olabs, a virtual laboratory, remains underutilized by physics teachers at SMAN 8 Banda Aceh City, despite its potential to enhance students' understanding of physics concepts. This study investigates the effectiveness of Olabs in improving students' concept comprehension. Using a quantitative approach with a quasi-experimental design, 30 students were assessed before and after using Olabs. Results indicate a significant improvement in concept understanding, with an average N-Gain of 0.73, demonstrating the effectiveness of Olabs in physics education.

Keywords: effectiveness, olabs media, understanding of physics concepts

1. Introduction

In addressing the needs of the industrial revolution 4.0 for education, educational institutions must continue to innovate to improve the teaching and learning process and students' concept understanding. Understanding the concept is the key to learning, because the main goal of learning is that students understand the concept [1]. Understanding concepts is very important in the learning process, students who understand a concept will achieve the main goal of learning [2].

Understanding physics concepts in depth often requires practical experience involving experiments and direct observation [3]. Based on the results of preliminary observations and interviews with physics teachers at SMAN 8 Banda Aceh City, it turns out that they have not utilized the use of virtual laboratories to support the physics learning practicum process. Whereas with the virtual laboratory, students can interactively explore physics concepts in a safe and controlled environment, allowing them to link theory with practical experience without having to rely on physical laboratories that may be limited in resources or time.

A virtual laboratory is a computer-based medium that contains simulated activities to illustrate reactions that may not be seen in real situations [4]. With virtual laboratories, it is possible to explore phenomena that only occur briefly or dangerous phenomena by modifying existing variables [5].

One of the latest and feasible virtual laboratories used today is Olabs. Olabs*(Online Laboratory)* is a virtual laboratory developed to provide simulated experiments in the field of science that can be used by teachers if real equipment is not available. Olabs is a technological development in the field of education that is expected to help teachers in meeting the needs of practicum implementation in schools [6]. The Olabs application is available anytime, anywhere, and without any distance or time limitations. This is beneficial for students and laboratory assistants [7]. Olabs has main characteristics which are

interactive, accessible, practical, learner-oriented, and collaborative.

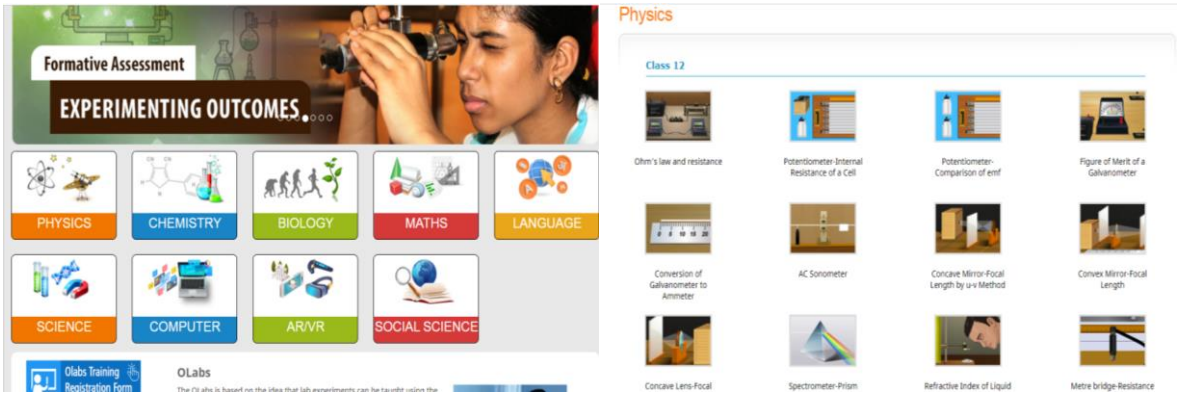

Figure 1. Olabs Display

Based on the results of previous research conducted [8], it shows that there is an effect of using the Olabs-based virtual lab practicum application on learning outcomes. Then, the results of research [9] showed that there were differences in the average science process skills before and after learning Olabs Virtual Laboratory assisted online. Based on this description, no one has tested the effectiveness of Olabs in increasing students' understanding of concepts, so this research is deemed necessary.

2. Method

The approach used in this research is a quantitative approach. This type of research is *quasi experiment* with *one group pretest-posttest design* method . The number of research samples was 30 students. The instrument used was a multiple choice test on the dynamics material. The test was given at the beginning and end. The purpose of done a pretest is to find out the initial concept understanding of students before being given treatment. While the purpose of done the posttest is to see how the effectiveness of used Olabs in physics learning on students' concept understanding. Then the data was analyzed used Normality Test, homogeneity test, single sample t-test and N-Gain test. The calculation of N-Gain value [10]:

$$Gain = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{criterion pretest score}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

3. Result and Discussions

The results of the study obtained a mean *pretest* value of 25.3. After being given treatment using Olabs media, then the researcher conducted a final test*(posttest*) and obtained a value of 79.6. This shows that the posttest value is higher than the pretest can reflect an increase in the understanding or skills of students during the intervention or learning period. Furthermore, pre-test and post-test data were analyzed using normality test, homogeneity test, t-test, and N-gain test.

Table 1. Pretest and posttest normality test results.

No	Sample	N	X_{Count}	X_{table}	conclusion
1.	Pre-test	30	8,1	11,070	Normal
2.	Post-test	30	4	11,070	Normal

Based on table 1, it can be seen that the *pre-test* and *post-test* data have a value of $_{xcount} < X_{tabel}$. So it can be concluded that the data is normally distributed.

Table 2. Pretest and posttest homogeneity test results.

No	Sample	n	Dk (n-1)	S^2(Variants)	Standard deviation	F count
1	Pre-test	30	29	60,22	7,76	0,69
2	Post-test	30	29	86,87	9,32	

By used the homogeneity formula, the value of F_{count} = 0.69 is obtained and then compared with the price of F_{table}= 1.85, thus F count < F table, namely 0.69 < 1.85, so the pretest and posttest values are declared homogeneous.

After the data is normally distributed and homogeneous then the data is analyzed using a single sample t-test *(one Sample t- test*) to see the difference in the effectiveness of used Olabs media to improve concept understanding in physics learning at SMAN 8 Banda Aceh. Based on the calculation of the single sample t-test above, it can be seen that the value of $t_{count} > t_{table}$ is 2 > 1.699, then H_a is accepted and H_0 is rejected. So it can be said that the use of Olabs media to improve concept understanding in physics learning at SMAN 8 Banda Aceh is effective. This is said to be effective because during learning students are faced with simulations in the form of imitations such as the actual state of a concept so that students can easily interpret and explain the concept. A diverse approach and differentiation in learning methods can support various learning styles and levels of student understanding [11]. In line with the theory which states that simulation media in the learning process makes students motivated in learning and makes it easier for students to understand basic concepts.

The increase in students' concept understanding before and after learning can be obtained by testing the *N-gain* value of each student. The N-gain obtained by students as a whole can be seen in table 3.

Table 3. N-Gain data of students' cognitive ability.

Category	Amount
High ($g \geq 0{,}70$)	15
Medium ($0{,}30 < g < 0{,}70$)	15
Low ($g < 0{,}30$)	0
Total	30

Based on table 3, it can be seen that the number of students in the high and medium categories is the same, namely 15 students each and no one is in the low category. The average value of N-Gain is 0.73 which is classified in the high category. This high category is because Olabs media often provides virtual simulations and experiments that allow students to engage directly in practicum and experimental activities. Olabs presents information through clear and interactive visualizations, making it easier for students to understand concepts in a real way [12].

High N-gain scores on concept understanding can be caused by a number of factors that reflect improved student understanding after a learning intervention such as effective teaching, material relevance, utilization of educational technology, continuity and repetition, supportive classroom conditions, student involvement in learning activities such as discussions, projects, or experiments, can improve concept understanding [13].

Some other factors that can improve students' understanding of concepts such as active learning methods, the use of learning media with interactive technology, the quality of learning materials, practical experience in experiments and practicums, the ability of teachers in learning, intrinsic and extrinsic student motivation, cooperation and discussion, feedback [14]. From these factors reflect a number of conditions or factors that support the improvement of concept understanding, this can be considered as a positive indicator that the learning strategy applied is effective in improving student understanding so that N-gain is not in the low category. While several factors contribute to the effectiveness of using olabs that is accessibility, hands on learning, personalized learning, visualization,

collaboration, and feedback mechanism. By leveraging these factors, olabs enhance the effectiveness of physics education by providing immersive, interactive, and flexible learning experiences.

From one of the advantages of Olabs media, it has a link to concept understanding where virtual laboratories are often equipped with interactive visualizations, allowing students to see and understand scientific concepts in a clearer and more interesting way [15]. Concept understanding can be measured in various ways, depending on the learning context and the type of concept being measured. In this study, concept understanding is measured by a written test in the form of multiple choice questions that aim to check basic knowledge of certain concepts and measure concept understanding in depth on students' ability to relate these concepts to real situations or practical applications and students are also able to identify and explain the relationship between concepts and understand the structure or hierarchy of the concepts involved.

The results of this study are in line with [16] which states that Olabs media can include flexible access, safety and efficiency, real-time monitoring and feedback, availability of experimental materials and visual concept understanding. Then research [17] shows that learning Pascal's Law used the *Scientific* Approach assisted by Amrita Olabs is better in improving learning outcomes. Based on the description of the results and discussion above, it can be concluded that Olabs media is effectively used to improve students' understanding of physics concepts.

4. Conclusion

By offering interactive simulations and hands-on experimentation, Olabs engage students actively in learning, allowing them to visualize abstract principles in action. The accessibility and flexibility of Olabs enable students to explore and practice at their own pace, reinforcing their understanding through repeated experimentation so that Olabs media is effectively used to improve students' understanding of physics concepts, especially on dynamics material.

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