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## The Effectiveness of Using a Virtual Laboratory in Distance Learning on the Measurement Materials of the Natural Sciences of Physics for Junior High School Students

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### ABSTRACTS

The purpose of this study was to analyze the effectiveness of the use of a virtual laboratory on the measurement material of junior high school in physical sciences distance learning. The method used is quantitative. The results showed that the use of a virtual laboratory for distance learning on the measurement material for Natural Science Education in Physics for Junior High School was effective, as evidenced by the increase in the percentage to 54%. It was found that through virtual laboratory media students saw and took direct measurements so that the material presented could be easily understood by students. From the results, distance learning using virtual laboratory media can be one solution in the implementation of learning so that the essence of learning can still be achieved even though learning is carried out remotely.

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## 1. INTRODUCTION

Distance learning is learning that is not face-to-face between educators and students, carried out outside the teaching environment with independent learning using techniques that have been specifically designed (Abidin et al., 2020). Distance learning as one of the diversions of the conventional education system must be supported by adjustments to the learning media used. Learning media as an intermediary tool for providing information to achieve learning objectives (Krismayanti & Sudibyo, 2021). In general, the purpose of learning Physics in Junior High School is to increase creativity and scientific attitude as a provision of knowledge to create simple technological works related to human life (Haniyah et al., 2021).

One of the problems in learning Physics is that learning places more emphasis on formulas and theories, not prioritizing concepts associated with the phenomena experienced. In learning, students do not get direct experience so that students still think that physics is a difficult subject (Lesmono et al., 2021). The core component of learning physics is experimental (Wilcox & Lewandowski, 2018). Learning in the scope of the laboratory must be supported with the right tools and materials (Bernhard, 2018). The implementation of experiments in distance learning must be planned with an appropriate system without the presence of a laboratory. One solution that can be used is the use of a virtual laboratory as a combination of technology, pedagogy and human resources to create a virtual interactive space that can be adapted to learning needs (Prieto-Blázquez et al., 2009).

The results of research conducted by (Putri & Hamid, 2016) showed that students' understanding of concepts was higher in classes who did practicum with virtual laboratories compared to conventional classes. In research by (Yusuf & Widyaningsih, 2018) virtual laboratories can develop students' skills in conducting experiments. In research by (Swandi et al., 2014) virtual laboratory-based learning is able to make students more active. but as shown in research conducted by (Maesaroh & Yusuf, 2016) With all the advantages possessed by virtual laboratories it cannot be make sure that the learning with the virtual lab is compared to the experiment in the real lab. Direct school learning is a good choice in education, conditions that do not allow for learning in schools are a driving force for the development of media used in learning. A virtual laboratory is used as an alternative if learning through the laboratory cannot be carried out or has limitations. A virtual laboratory is used as an alternative if learning through the laboratory cannot be carried out or has limitations. With the help of laboratories in distance learning allows students to carry out experimental activities wherever needed (Hermansyah et al., 2017).

From the research that has been done before, there has been no research that discusses the use of virtual laboratories in distance learning, therefore the purpose of this study was to analyze the effectiveness of the use of a virtual laboratory on the measurement material of junior high school in physical sciences distance learning.

## 2. THEORITICAL FRAMEWORK

### 2.1. Calipers

A caliper is a tool that can be used to measure the depth of the hole, thickness, length, and outer or inner diameter of an object's hole. The caliper has an accuracy of 0.1 mm or 0.01 cm (Pratiwi et al., 2017).

## 2.2. Micrometer

Micrometer is a tool to measure the thickness and length of objects as well as the depth and diameter of the hole. The accuracy possessed by a micrometer is higher than that of a caliper, the accuracy is 0.01 mm or 0.001 cm (Pratiwi *et al.*, 2017).

The caliper and micrometer are measuring tools that are studied in physical science measurement materials. Measurement is the systematic determination of numbers for an object. According to research conducted by (Nasution, 2019) mastery of measurement greatly influences student learning outcomes in Physics lessons on the material of quantities and units. Mastery of measurement is directly proportional to the ability of students in the material of quantities and units. The relatively small scale of the measuring instrument is one of the obstacles in explaining the concept of measurement, because students have difficulty observing the measurement results so that learning is less than optimal (Ropii, 2019). Therefore, through the virtual laboratory used in the measurement material of Natural Sciences of Physics, it is hoped that it can overcome these obstacles and maximize experiments carried out in distance learning.

## 3. METHODS

The method used is a quantitative. The data obtained came from the group's pretest and posttest scores which were collected by questionnaire. This instrument is used to measure the effectiveness of using virtual laboratories in learning according to students. Questionnaires are data collection by giving questions to predetermined subjects related to the research topic under study. First determine the subject in this study, the subjects of this study were 13 seventh grade students of Junior High School in Subang, Indonesia. After that all subjects were asked to fill out a pretest questionnaire to analyze the effectiveness of distance learning according to students. Learning using virtual laboratory media begins after the completion of the pretest. After learning, all students were asked to fill out a post-test questionnaire.

## 4. RESULTS AND DISCUSSION

### 4.1. Demographics

Distance learning in one of the junior high schools in Subang, Indonesia is carried out through WhatsApp group media and Google Classroom. The use of distance learning media cannot be separated from the main problem, namely internet connection. This condition makes interaction between teachers and students only through WhatsApp group media and assignments are carried out through Google Classroom. Prior to data collection, the seventh grade students who were the subjects had studied the measurement material through the WhatsApp group media.

In distance learning, students learn through textbooks and questions given, so that students do not receive maximum learning because they do not interact directly with the teacher. This problem in learning occurs because of the internet connection, the teacher cannot hold face-to-face meetings via video conferencing. In the measurement material the teacher cannot conduct experiments on the tools used in the measurement so that students do not feel firsthand how to use the measuring instrument in the measurement material.

## 4.2. Phenomena in the learning process

From the demographics of students shown, distance learning requires the right media for measurement material so that students can understand deeply about the material provided. This study tries to use virtual laboratory media in explaining how to use long measuring instruments, namely callipers and micrometres. The first stage of learning is to prepare in advance the learning media that will be used. In the study, the learning media used was a virtual laboratory. After that determine the subject that will be used in this research. Before learning is done, students are first given a pre-test in the form of a questionnaire regarding the effectiveness of the distance learning that has been done. after that learning is done through virtual laboratory videos given to the subject on how to use measuring instruments as a substitute for practicum in a real laboratory. At the end of the lesson, students are given a post-test to determine the effectiveness of using a virtual laboratory in measuring materials.

## 4.3. Analysis of research data

The data collection process is carried out online through several platforms such as Zoom Meeting, Google Form and WhatsApp groups. **Table 1** shows the results of the pre-test analysis of learning effectiveness with categories of effective, less effective, and ineffective. **Table 2** shows the results of the pre-test analysis which contains 9 questions regarding distance learning carried out, the questionnaire given is in the form of a yes or no choice.

The results of the pre-test data show in **Table 1** that distance learning is currently less effective, as seen from the highest percentage of 54%. In **Table 2** Most of the respondents did not understand the material given as evidenced by the percentage of 92%, while 69% of respondents stated that they did not know how to use the calliper and micrometre after learning is done. After the pretest, students are given learning about measurement materials through video media and a virtual laboratory.

**Table 3** shows the results of the posttest analysis regarding learning using a virtual laboratory, a questionnaire containing one question containing effective, less effective, and ineffective choices. **Table 4** shows the results of posttest analysis regarding the effectiveness of using virtual laboratories in learning, the questionnaire given contains 9 questions consisting of yes or no choices.

From the posttest results in **Table 3**, it can be seen that the percentage of respondents who answered distance learning was less effective, from 54 to 23%. Most of the respondents felt that distance learning conducted through virtual laboratories was effective.

In **Table 4**, From the percentage of 85% of respondents found it easy to understand the material given. It was found that through virtual laboratory media students saw and took direct measurements so that the material presented could be easily understood by students. Through interactive virtual laboratories that present interesting pictures or symbols and writing, students can understand more deeply so that memories are stored longer (Dwiningsih et al., 2018).

The data as many as 62% of respondents stated that the virtual laboratory is easy to understand, there is no visible difference when compared to the results of the pretest. Meanwhile, as many as 54% of respondents stated that the virtual laboratory was easy to operate, when viewed from the results of the pretest, there was no improvement. This can happen because most of the respondents are using a virtual laboratory for the first time so adjustments are needed in use.

The data above shows that the virtual laboratory media used in distance learning is clearly legible 85% and attractive 77%. It can be seen from the percentage of "Yes" answers to each question asked. From these results, it was found that the media used had good quality and

could attract students' attention in the learning process. Learning media is one of the communication media as an intermediary in providing information, therefore the writing used must be considered (Dwiningsih *et al.*, 2018).

The data illustrates that 92% of respondents stated that the media used was interactive in learning, while 8% of respondents stated that the media used was not interactive. Through virtual laboratory media, teachers have more opportunities to interact with students during learning, so that if students encounter problems in learning, teachers can directly detect and help.

As many as 62% of respondents can understand how to use calipers and micrometers, from the percentage above it can be illustrated that learning through virtual laboratory media can be an alternative in distance learning and to overcome equipment shortages.

The data shows that 85% of respondents stated that distance learning through virtual laboratory media was able to increase students' interest in learning. In general, the percentage can describe that even though learning is carried out remotely, learning can still be made as interesting as possible to increase student motivation in learning. Selection of the right learning media can motivate students because of increased perceptions (Swandi *et al.*, 2014).

**Table 1.** Analysis of learning effectiveness pretest results.

No	Questions	Answer		
		Effective	Less Effective	Ineffective
1	How effective is distance learning?	38%	54%	8%

**Table 2.** Pretest result analysis.

No	Questions	Answer	
		Yes	No
1	Is distance learning understandable?	8%	92%
2	Do you easily understand distance learning materials?	54%	46%
3	Is distance learning easy to understand?	62%	38%
4	Is distance learning media easy to operate?	62%	38%
5	Are the texts and writings on distance learning media clearly legible?	54%	46%
6	Is the distance learning media attractive?	31%	69%
7	Is distance learning media an interactive medium in learning?	62%	38%
8	After distance learning do you understand how to use caliper and micrometer?	31%	69%
9	Did distance learning media increase your interest in learning?	54%	46%

**Table 3.** Analysis of the results of the virtual laboratory effectiveness posttest.

No	Questions	Answer		
		Effective	Less Effective	Ineffective
1	How is the effectiveness of learning using a virtual laboratory?	69%	23%	8%

**Table 4.** Posttest result analysis.

No	Questions	Answer	
		Yes	No
1	Is learning to use a virtual laboratory understandable?	85%	15%
2	Is it easy for you to understand the learning material through the virtual laboratory?	77%	23%
3	Are the instructions for using the virtual laboratory easy to understand?	62%	38%
4	Is the virtual laboratory easy to operate?	54%	46%
5	Are the text and writing in the virtual laboratory clearly legible?	85%	15%
6	Is the virtual laboratory appearance attractive?	77%	23%
7	Is the virtual laboratory an interactive medium in learning?	92%	8%
8	After using the virtual laboratory, do you understand how to use a caliper and a micrometer?	62%	38%
9	Does the virtual laboratory increase your interest in learning?	85%	15%

## 5. CONCLUSION

Based on the results of the study, it was concluded that the use of a virtual laboratory for distance learning on the measurement material for Natural Science Education in Junior High School Physics was effective, as evidenced by the increase in the percentage to 54%. The percentage of data shows that the virtual laboratory is able to increase students' understanding and interest in learning. These data prove that distance learning using virtual laboratory media can be a solution in implementing learning, so that the essence of learning can still be achieved even though learning is carried out remotely.

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## 6. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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