

**ANALYSIS OF PHET SIMULATION-BASED LABORATORY VIRTUAL PRACTICUM
GUIDE TO IMPROVE CRITICAL THINKING SKILLS OF SOUTH SUMATRA
VOCATIONAL SCHOOL STUDENTS**

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ABSTRAK

Penelitian ini merupakan penelitian eksperimen yang bertujuan untuk melihat hasil belajar dan meningkatnya kemampuan berpikir kritis peserta didik di Kelas eksperimen 1 (kelas X TITL 1) SMK Negeri Sumatera Selatan pada tahun ajaran 2021 – 2022. Mengingat masih dalam kondisi pandemi covid 19 maka penelitian ini dilakukan di laboratorium fisika secara virtual pada bulan April – Mei semester genap menggunakan panduan praktikum dan media PhET dengan materinya listrik arus searah yakni hukum Ohm dan hukum Kirchoff. Populasi penelitian adalah kelas X TITL dengan sampel penelitian di kelas X TITL 1 sebagai kelas eksperimen 1 (menggunakan media PhET) dan X TITL 2 sebagai kelas eksperimen 2 (tidak menggunakan media PhET). Dengan hasil analisis setelah menggunakan panduan praktikum membuktikan kebenaran hipotesis yang dinyatakan oleh penelitian yaitu adanya pengaruh positif dalam penerapan kegiatan pembelajaran secara virtual di laboratorium fisika SMKN Sumsel menggunakan media PhET sebagai media simulasi sehingga tujuan pembelajaran fisika dalam meningkatkan kemampuan dan ketrampilan berpikir kritis cukup tercapai di kelas X TITL 1 sebagai kelas eksperimen 1.

Kata Kunci: virtual lab, panduan praktikum, simulasi phet dan berpikir kreatif

ABSTRACT

This study is an experimental study that aims to see the learning outcomes and increase the critical thinking skills of students in experimental Class 1 (Class X TITL 1) SMK Negeri Sumatera Selatan in the academic year 2021 – 2022. Considering that it is still in the covid 19 pandemic condition, this research was carried out in a virtual physics laboratory in April – May of the even semester using practicum guides and PhET media with direct current electricity materials, namely Ohm's law and Kirchoff's law. The study population was Class X TITL (electrical installation engineering) with research samples in Class X TITL 1 as experimental class 1 (Using PhET media) and X TITL (electrical installation engineering) 2 as experimental class 2 (not using PhET media). With the results of the analysis after using the practicum guide to prove the truth of the hypothesis stated by the researchers that there is a positive influence in the application of virtual learning activities in the Physics Laboratory of SMKN Sumsel using PhET media as a simulation medium so that the learning objectives of physics in improving the ability and critical thinking skills are quite achieved in Class X TITL (electrical installation engineering) 1 as an experimental class 1

Keyword: virtual lab, practicum guide, Phet simulation and thinking creative

INTRODUCTION

In the learning process, learning objectives are often formulated in the form of learning objectives the purpose of learners in schools operationally is to teach participants to be able to gain knowledge, presumably can be an experience for students in the form of

ways.important way for their needs thus in the process of teaching and learning, the expected goal of the teacher is the material given can be mastered to student and no change in the participants themselves both in knowledge, understanding and skills.

Physics is a natural science, physics is a theory that explains simple natural phenomena

and tries to find connections between realities. Physics is to describe and analyze the structure and events in nature, engineering and the world around us (Mulyasa 2006:110)

Physical science is a part of natural knowledge that is not only theoretical but also the process of discovery through experimental activities and work in the laboratory which is called practicum. Practicum activity is a form of learning that involves students working with objects, materials and laboratory equipment that can be done individually or in groups. (Mulyasa 2006:115)

In learning physics researchers get two things from the observations of researchers in School Menengah vocational State (SMKN) Sumsel, especially classroom learning X TITL 1 and X TITL 2 (electrical installation engineering) (kelas X TITL 1 dan 2). First, physics learning through the application of active learning is more avoided by teachers. Second, learning activities are more centered on the teacher where trying to explain the material while the activity learners just take notes. Learning activities are dominated by explaining, practice answering questions, and completing tasks. It is this kind of learning that has an impact on learning outcomes learners the X Class Titles 1 and 2 SMKN Sumsel for subjects fisika still a lot average value obtained under the Kriteria Minimum Completeness (KKM).

In addition to these two things based on the results of the initial test analysis provided by researchers to learners in kelas X Titles 1 and 2 SMK State Sumsel found many potential misconceptions (misunderstanding)

on learners. There are still many potential misconceptions about the concepts of electrical voltage, electric current, and the concept of direct current electrical circuits. For example wrong understanding of current consumption model, understanding of current as the cause of

voltage, and misconceptions about the characteristics of direct current electrical circuits.

Based on the results of observations and temuan tersebut, peneliti seeks to find ways for learning outcomes and mastery of concepts learners in the classroom X titles 1 and 2 SMK State Sumsel in accordance with what is expected. One alternative solution to the problem is to provide an opportunity learners to learning and interact with laboratory. Because it is still in the condition of the covid 19 pandemic outbreak, students are not allowed to learn face to face directly but must learn online, so learning through the laboratory is done online or virtually.

Virtual laboratory compared with physics practicum is easier to do with the help of guidance and safe in safety-friendly praktikan (Masita et al., 2020). In the implementation of virtual laboratories can attract interest learners because when the experiment was conducted outside the school laboratory without borrowing tools and efficient time in the process of implementation. Practicum activities in the virtual laboratory have provided positive responses and increased students' thinking creativity (Gunawan et al, 2017). The laboratory must have complete tools to support the ongoing practicum process (Elisa et al., 2017). According to (Sari et al., 2015), nearly 80% of learners who take the virtual lab say it is engaging, highly usable and easy to implement, thus supporting learners' cognitive and emotional graduation.

The use of virtual laboratories to facilitate students in conducting virtual experiments that can not be done with real laboratories. According to (Gunawan et al, 2017) proses learning is done with virtual experiment activities. Virtual laboratories as an alternative if real laboratory equipment is not available at school so that learning objectives can be achieved (Gunawan et al, 2017).

Thus, the implementation of practicum in Physics Laboratory is very important in order to support learning and give emphasis on process aspect. It is based on learning objectives. The purpose of learning is that students can improve their work skills and be able to build curiosity about scientific matters. Low interest and less motivated to physics lessons due to difficulties in understanding the concepts and theories of physics as a result of constraints felt by students when using practical tools in real laboratories result in their low understanding of physics practicum (Supardi et al., 2015). In line with the above opinion according to (Mugi et al, 2021) in his research, physics is still considered difficult to understand plus the lack of completeness of laboratory equipment and rarely do lab work. With the covid pandemic condition in 2019 especially now that it has to be done online

Physics as a process that improves the thinking ability of students, so that they are not only able and skilled in the field of psychomotor, but also able to think systematically, objectively, and creative. Practicum activities in the laboratory virtually by using the practicum guide in this study aims to invite students to enjoy physics lessons, easy to understand, and master the concepts and materials of direct current electricity in the hope that students are able to think critically and the results of learning physics for the better.

The use of Virtual computer lab including using Physics Education and Technology (PhET). According to Ashar (2012), especially for subjects fisika, teachers have been helped by the Learning media in the form of simulations that have been provided by web site special sites Physics Education Technology (PhET). With a research-based approach that combines the results of previous research allows the students to connect real-life phenomena and the underlying science, ultimately deepening their

understanding and increasing their interest in Physical Science.

In line with the above opinion, Adams (2010). Phet simulation is very effective and able to become a gateway to enlightenment of abstract concepts, making it easier for students to find concepts and improve student learning outcomes. Virtual lab PhET can be used online or offline. PhET was created by the University of Colorado, USA which is accessed through computers, tablets and smartphones for free.

This is confirmed from the results of research (Adams, 2010) Student engagement and learning with PhET interactive simulation which states learners can answer the conceptual exploration he once asked himself. The advantage obtained in the implementation of practicum in the laboratory virtually with Phet simulation media is not bound by time and freedom in choosing a place to finally be able to increase the absorption of the material is much higher than in the classroom and can be applied to real life (Martnez Borreguero et al., 2011).

From the description of the background, it can be understood that practicum activities in the laboratory virtually by using practicum guides and PhET in this study aims to invite students to enjoy physics lessons, easy to understand, and master the concepts and materials of direct current electricity in the hope that students can improve critical thinking skills and physics learning outcomes for the better.

METHOD

The research method used in this study is an experimental method that uses three stages of research, namely the preparation stage, the implementation stage and the data processing stage.

The data collection techniques in the form of test methods given to the learner. The test

method is in the form of a description test to determine the students' critical thinking ability. Furthermore, the data were analyzed quantitatively with reliability test, difficulty level, differentiating power, normality test data, hypothesis test and test n-gain

The study was conducted at SMKN South Sumatra, Jalan Basuki Rahmat, Palembang, from April to May 2022. Based on the formulation of the problem and the purpose of this study is to know the picture of the learning outcomes of students who are taught using PhET simulation. The study population was Class X TITL (Electrical installation engineering) 1, X TITL (Electrical installation engineering) 2 dan X TITL (Electrical installation engineering) 3 (Table 2) with the research sample is Class X learners Title 1 total of 34 and X TITL 2 totaling 34 students (Table 3).

Types of research descriptive quantitative with descriptive analysis that describes the average score, standard deviation, variance and frequency distribution to know how much physics learning outcomes obtained by students after being taught using PhET Respondents in this study were identified based on certain criteria to support the validity of the data. The criteria mentioned in this study include the population and sample of the study. The operational definition of variables is intended to limit the focus of the question so that there is no misunderstanding between the author and the reader. The operational definition of the variables in this study is related to the research in this study. Online learning Model is an electronic device-based learning model where learning is done online using gadgets.

Research design in this study using research design One Group Pretest-Posttest Design, namely research before treatment there is a Pretest and after treatment is given a Post test. as in Table 1 below.

Table 1 Desain Penelitian One Group Pre test – Post test

O1 pre test	X	O2 post test
<i>Desain Penelitian One Group Pre test-Post test Design (Sugiyono 2016)</i>		

Description:

O1 = Pre-test

O2 = Post-test

X = Guided online learning Model through zoom media with virtual practicum using phet simulation application.

Furthermore, the research design (research design) used in this study is the design *One Group Pre test Post test Design*. In this project, the group 1 (Experiment 1) subjected to treatment using Phet simulation and group 2 (experiment 2) was not subjected to treatment using Phet simulation then the measurement of variables.

Table 2 Research Design

Kelompok	Perlakuan (Variabel bebas)	Post Test (Variabel Terikat)
Eksperimen 1	X1	Y1
Eksperimen 2.	X2	Y2

Description

X1 : Treatment using Phet simulation

X2 : Treatment does not use Phet simulation

Y1 and Y2 : Teaning outcomes (increased ability to think kreatif)

In this study the necessary data using Vir lab practicum guidelines, and tests (pre-test and post-test) in improving critical thinking participants as research instruments. The results of observations on the implementation of learning are analyzed by calculating the observation results based on the average value of the direct current electrical material, namely Ohm's law and Kirchoff's law. Psychomotor

learning outcome analysis techniques are assessed using a complete learning approach with reference criteria. Reference completeness learning set at SMKN Sumsel by 75%.

RESULT AND DISCUSSION

Learning problems associated with slow understanding peserta didik the concept of abstract theory needs to be addressed. If this is left unchecked, the effectiveness and efficiency of learning is low. In the end, this will result in low student achievement. Therefore, it is necessary to seek systematic efforts to improve the effectiveness and efficiency of learning. One effort is to develop a model-based learning PhET.

Using practicum guide in virtual laboratory for students it will be easier to understand abstract concepts, and ultimately improve learning outcomes. The plan of the defenderran physics in a virtual laboratory which is interactive, will be able to increase motivation learners, more interesting and challenging for students (Wena, 2014:208). Before being carried out pre test in Class X TITL 1 and 2 as experimental class 1 and Experiment 2, students' understanding of direct current electrical concepts such as Ohm's law and Kirchof's law, level of understanding of participants education under the KKM standard. The Predicate score and kategorian percentage assessment results belteach students Class X TITL 1 and 2 SMKN South Sumatra as in Table 3 below.

Table 3 Predicate Activeness Learners

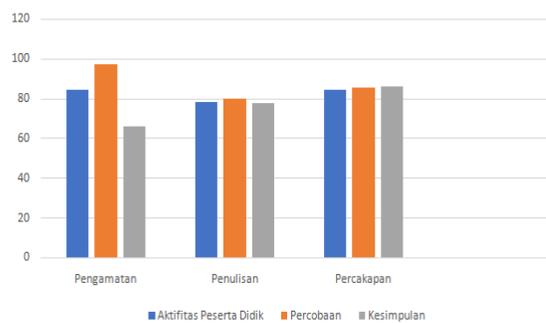
Number 0 – 10	Number 0 – 100	Description
9 – 10	90 – 100	Very good
8 – 8,9	80 – 89	Good
7 – 7,9	70 – 79	Enough
6 – 6,9	60 – 69	Less
0 – 5,9	0 – 49	Failed

Based on the table above, to determine the results of the data from the implementation of observations of the observation activity students

in Class X TITL 1 (experimental class 1) during the learning process can be calculated by giving a score based on the assessment instructions in accordance with the assessment of observers in teaching and learning activities.

- 1) Activity A is activity do observation consisting of visual observation in terms of reading 84.21%, activity attention to the lesson 97.37% , and pay attention to the work of friends 65,79%. The average observation activity of 82,45%.
- 2) Activity B make an experiment which consists of creating a network 78,35%, calculating voltage 76, 58%, dan and calculate the current strength as big as 77,83%. Average activity achievement make an experiment as big as 79,45%.
- 3) Activity C namely activity draw conclusions like concept of ohm's law known for 84,55%, kirchoff's law concept 85, 58%, dan analysis of the overall results of the experiment 85,75%. Average activity achievement draw conclusions as big as 86,43%.

Grafik Aktifitas Siswa di Kelas Ekperimen 1



It seems activity do observation learners in learning activities relatively higher and more interested in responding to the subject matter received by the teacher through the media PhET with an average value of 83.35%. Followed by activity make an experiment with an average value of 79,45% is the result of observation value with criteria enough good as a motivational value and passion in experimenting share participants in virtual lab activities with practicum guidance as a guideline in practicum with Phet simulation as a learning

medium. For activity draw conclusions it turns out that students in Class X TITL 1 is an increase in understanding and mastery of the concept of direct current electrical material after the post test 10 multiple choice questions with an average value of 86.43%.

Thus, despite theiatan learning physics practicum in a virtual laboratory turns out that students are more interested and enthusiastic is quite high, proven experimental class in Class X TITL 1 increased yang is quite significant from the initial survey which is considered not to understand and difficult but after being taught using practicum guides with PhET media as a learning medium, during the learning process it is clear how the enthusiasm of attention and concern will learn physics quite high with good results so that the desired research objectives in this study are quite successful. Test Data Results experimental Class 1 and experimental Class 2

The data collected from the answer sheet of the initial test and the final Test will be analyzed to test the hypothesis and answer the formulation of the problem posed.

This Data was obtained by spreading the question sheets in the experimental class and control class where the number of questions given there are 5 questions and the maximum score for the assessment of the questions is at 100. The questions were given to students twice, namely the initial test and the final Test. The value of the difference between the fin Test and the initial test is what will then be the data of the test results beakjar (list of test results test questions experimental class and experimental class 2 in Chapter Appendix 3 and Appendix 4). Furthermore, the data of student learning outcomes are then arranged in a frequency distribution for the experimental class and experimental class 2

In the implementation of this test then to test the hypothesis of the data that has been obtained need to be analyzed using the T-Test (Student-t) and F test (Fisher).

Table 4 Frequency Distribution Of Experimental Grade Test Scores

Test score	fi	xi	xi ²	fi.xi	fi.xi ²
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50 – 55	4	52,5	2756,25	210	11025
56 – 61	8	60	3600	480	28800
62 – 67	6	65	4225	390	25350
68 – 73	9	70	4900	630	44100
74 – 79	3	75	5625	225	16875
80 – 85	6	81,7	6674,89	490,2	40049,34
Amount	36			2425,2	166199,34

Table 5: Frequency Distribution Of Experimental Grade 2 Test Scores

Test Scores	fi	xi	xi ²	fi.xi	fi.xi ²
40 – 44	2	40	1600	80	3200
45 – 49	8	45	2025	360	16200
50 – 54	4	50	2500	200	10.000
55 – 59	4	55	3025	220	12100
60 – 64	1	60	3600	420	25200
65 – 69	6	65	4225	390	25350
70 – 74	3	70	4900	210	14700
Amount	34			1880	106750

CONCLUSION

Results score analysis average based on observation of the activity of learners is Activity A is activity do observation of the average observation activity of 82,45%. Activity B make an experiment with average activity achievement make an experiment as big as 79,45%. Activity C namely activity draw conclusions Aanalysis of the overall results of the experiment average activity achievement draw conclusions as big as 86,43%.

With the results of the analysis after using the lab guide prove the truth of the hypothesis stated by the peneliti namely the existence of pengaruh positive in the application of virtual learning activities in the Physics Laboratory of SMKN Sumsel using media PhET as a simulation media so that the purpose of physics learning in improving the ability and skills of thinking kritis is quite achievable in Class X TITL 1 as experimental class 1.

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