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Development of Virtual Laboratory System Using EWB and Zoom Cloud in Dynamic Electricity Practicum as a Learning Solution in the Covid-19 Pandemic

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Abstract *– Covid-19 Pandemic has changed our education system, especially on practicum activity. This study aims at developing a virtual laboratory system using EWB and Zoom Cloud applications in a valid, practical and effective dynamic electricity practicum as a practical solution during the Covid-19 pandemic. The method used in this study is a modified Research and Development (R&D) method consisting of identification of potential and problems, data collection, data for development, product design (draft I), validation, design revision, draft II, limited scale trial, product revision 1, draft III, broad-scale trial, product revision 2, and the final product. The trial sample in this study was class X students of SMK Negeri 2 Kendari in the Electrical Power Installation Engineering department the eligibility criteria with an internal consistency coefficient of 0.92 for the material and 0.84 for the media. After going through a validation test, the product developed is then tested on a limited and wide scale. From the results of trials on a limited scale, is was obtained that regarding the practicality value of the product 54.55% students' responded "very support" and the rest 45.45% responded "support", while in a large-scale trial of 77.50% students agreed on "very support" response, and 22.50% gave a "support" response. The effectiveness of the product is seen from the student's response and the classical completeness score where 100% of the students gained a practicum score of >75. Therefore, it can be concluded that Virtual Laboratory can be utilized as a learning solution during the COVID-19 pandemic at SMK Negeri 2 Kendari.*

Keywords: *covid-19 pandemic; dynamic electricity; EWB; virtual laboratory system; zoom cloud*

I. INTRODUCTION

The spread of Covid-19 viruses in 2019 made all activities in the world slow down and even had to stop for a moment, in order to break the chain of the spread of Covid-19. The implementation of lockdown period in various countries requires all activities to be

centered at home and then dominantly used the internet to continue most of daily works (Thelwall & Thelwall, 2020). Indonesia, as one of the affected countries, faced many challenges from the Covid-19 pandemic in various aspects. This research focused on the education aspect which is one of the benchmarks for the human development index in the world (Elistia & Syahzuni, 2018).

During the Covid-19 period, education must be carried out from home, so it must be based on online learning (Khasanah et al., 2020), which is in line with the policy of the Ministry of Education and Culture (Kemendikbud RI) through circular letter number 4 of 2020. The learning system policy implemented in this pandemic does not only covers the teaching of subject matter in the class, but also the practicum carried out in the laboratory.

Practicum activities in schools during the pandemic are very difficult to conduct because they require tools and materials that must be demonstrated directly by teachers and students, especially in experimental activities in physics, chemistry, biology, and several other experimental practicums. Based on the results of initial observations at SMK Negeri 2 Kendari in the Electrical Power Installation Engineering Department, dynamic electricity practicum is one of the most difficult practicums to do during this pandemic because in this practicum students are required to make simple circuits as the basis for advanced construction for electronic stuffs.

Virtual laboratory-based practicum media can be the solution for this problem. Practical innovations with virtual laboratories have been recommended to reduce costs and simplify maintenance of laboratory facilities while still giving students access to the same practice as conditions in real laboratories (Wolf, 2010).

The development of virtual laboratory in this study uses the Electronic Work Bench (EWB) and Zoom Cloud applications. EWB is an electronic laboratory in computers (Setiawan & Susilo, 2017) and Zoom Cloud Meeting is an application that is used as a medium of remote communication by combining video conferencing, chat, online meetings and mobile collaborations that can accommodate up to 1000 participants together in one virtual meeting (Monica & Fitriawati, 2020; Syam et al., 2015).

This study aims to create a valid, practical and effective system of virtual laboratory-based practicum assisted by EWB and Zoom Cloud applications on the practicum of dynamic electricity for students in class X SMK.

This virtual laboratory-based practicum is a learning innovation that can be a solution during the Covid-19 pandemic. The pandemic condition requires learning to be done from home and it is very impossible to carry out face-to-face directly in real laboratories.

The maximum use of virtual laboratory-based practicum media during this pandemic is expected to give a positive impact on the use of technology and the internet for students. In addition, there has been no development of a virtual laboratory system using EWB and Zoom Cloud in dynamic electricity labs. The final objective of this research is the creation of a practicum atmosphere without being hindered by the Covid-19 pandemic and increasing students' mastery of physics concepts.

In this study, a virtual laboratory system was designed using the EWB application combined with Zoom Cloud. Electronics Workbench (EWB) is a simulation program for electronic circuits that is used to design and analyze circuits, both basic analog and digital circuits without using an experimental board (Muliyani et al., 2017.). EWB is used to facilitate dynamic electricity practicums both for teachers as facilitators or mentors as well as for students as practitioners, so that it can still be carried out effectively during the Covid-19 pandemic and create the same practicum process as laboratories in schools.

Zoom Cloud serves as a remote interactive communication medium between teachers and students when conducting experiments using EWB. Zoom Cloud Meetings (ZCM) is an online meeting application with the concept of screen sharing. This application allows users to meet face to face with more than 100 participants. Not only on a PC (Personal Computer) or laptop, this application can also be downloaded on a smartphone, so that students who mostly have smartphone communication devices become supporters of the use of internet technology developments in learning (Liu & Ilyas, 2020) especially during the Covid-19 pandemic at the moment.

The use of EWB in the development of a virtual laboratory is not only an effort to overcome technical practicum problems during this pandemic, it is also an effort to answer problems in several schools which are still limited in the completeness of laboratory practicum materials and equipment. The lack of availability of laboratory equipment, especially in electrical circuit experiments, can be overcome by using simulation media. According to Hutagalung et al, (2020), Electronic Worbench (EWB) can improve students' learning outcomes. It can be seen from the difference in learning outcomes in the experimental class that uses EWB and Circuit Maker learning media with students' learning outcomes in the control class without the provision of media (Hutagalung et al., 2020) . Based on that condition, this study aims to develop a virtual laboratory system using EWB and Zoom Cloud applications in a valid, practical and effective dynamic electricity practicum as a practical solution during the Covid-19 pandemic.

II. METHODS

The method used in this study is a modified Research and Development (R&D) (Yani et al., 2011.) method consisting of

identification of potential and problems, data collection, data for development, product design (draft I), validation, design revision, draft II , limited scale trial, product revision 1, draft III, broad-scale trial, product revision 2, and the final product. The R&D method can be seen on this picture below.

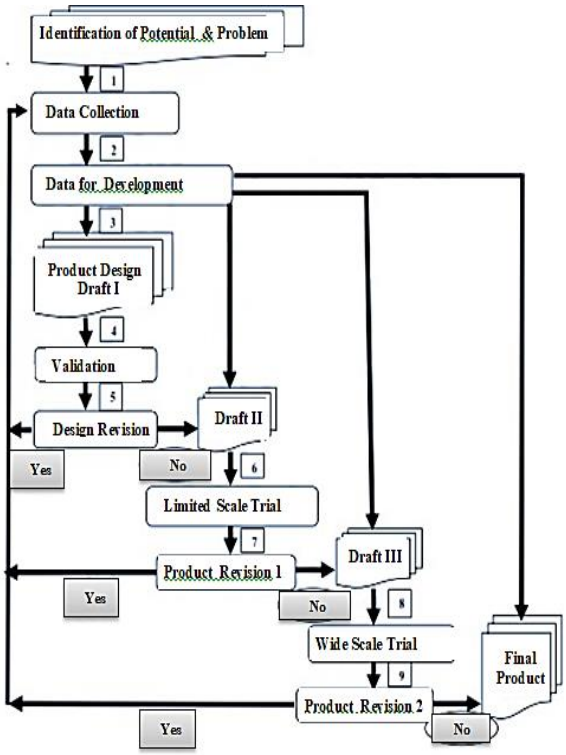

Figure 1. The Modiefied R&D Method

The subjects of this study were Class X students of the Electrical Power Installation Engineering Department at SMK Negeri 2 Kendari in the Academic Year of 2021/2022. The data collection instruments in this study consisted of product validation sheets and questionnaires that were used to obtain information on the practicality and the effectiveness of the product.

The data were analyzed quantitatively. Product validation is carried out by testing expert understanding with the analysis of the Gregory model (Wahyuni et al., 2019). The ptracticality was tested by analyzing the range of scores of teachers and students' questionnaires, and the effectiveness of the product was determined using average classical mastery of students (Yuniarti et al., 2012). Product feasibility indicators can be measured through the following criteria: ***Valid*** if the results of the expert understanding analysis show the Gregory index > 0.8 or are in the high category, ***Practical*** if the responses by teachers and students show a score of 2.51 with the criteria of "supporting" and or "strongly supporting", and ***effective*** if the evaluation of the practicum simulation shows classical completeness ≥75% and students achieve a score of > 75 (Wahyuni et al., 2019) .

III. RESULTS AND DISCUSSION

This research was conducted with several stages of development according to the modified R&D in Sugiyono (2018), namely:

1. Identify potentials and problems

From the interview results, it was revealed that the learning conditions during the pandemic were not optimal by only using videos from You Tube. Despite the efficiency in some operational costs, the pandemic has caused high electrical laboratory maintenance costs, resulting in limited tools and practicum materials in the laboratory that were not yet available to support electricity learning.

Therefore, the initial idea was obtained to develop a virtual laboratory-based practicum media using the EWB and Zoom Cloud platforms.

2. Data collection

At this stage, data collection is carried out by considering the need for using media that can overcome the ineffectiveness of practicum during the COVID-19 pandemic and facilitate the delivery of material with abstract concepts. Electronic Workbench 5.12 was chosen as the software for the laboratory and Zoom Cloud as a virtual platform. In collecting the data on the needs of this practicum media, validation instruments were also prepared for the feasibility of the media and the feasibility of the material on the module.

3. Data for development

After choosing EWB as the practicum media, the researchers looked for information about supporting computer/PC hardware and software that can be used to design virtual practicum media using EWB and Zoom Cloud. To be able to run the Electronics Workbench 5.12 program on a computer, the following hardware specifications are required: Hard disk capacity required is 50 MB, Windows-based operating system (Windows 9x, XP, Window 7 32 Bit), processor at least equivalent to Intel Pentium III, minimum memory of 64 MB RAM (Windows 9x), 256 Win XP, 1 GB Windows 7, 800 x 600 screen resolution (Suraya, 2014). The Virtual laboratory system developed with EWB software was then combined with Zoom Cloud as a platform for conducting online or virtual practicums.

4. Product design (Draft I)

The design is carried out through several stages, namely the preparation of the subject matter, the preparation of scripts or experimental procedure flows that are adapted to the components or features in the EWB, the preparation of the overall module script, and the final editing of the module. EWB and Zoom Cloud are things to pay attention to when working in a real laboratory and the simulation features in EWB, learning objectives, materials, dynamic electricity practicum simulation with scientific methods, and evaluation. All the systematics of the material are fully integrated into the module accompanied by pictures and descriptions of each feature for both EWB and Zoom Cloud.

5. Product Validation

The virtual laboratory design using EWB and Zoom Cloud was validated by 2 media experts and 2 material experts. These experts assessed each component in the virtual laboratory according to the instrument for assessing the feasibility of practicum media from those analyzed with the Gregory model. Based on the results of the analysis, it was found that in the validation of the material the consistency coefficient was 0.92; this shows that the material compiled in the virtual practicum module using EWB and Zomm Cloud is feasible. In media validation, the internal consistency coefficient is 0.84,

which means that the practicum media using EWB and Zoom Cloud is reliable and feasible. This is based on Ruslan's (2009) statement that internal consistency between the two experts can also be referred to as reliability.

6. Design revision

Some inputs from material experts were used as the reference for revising the draft, for instance clarity of learning objectives in the module which must include usability learning objectives. In the visual component, the content of the material should display more diverse colors so that it attracts students to study the module in conducting simulations. In media validation, experts provide input to add media link autorun. Data collection was carried out again to find the required data according to the input. The data used in the design revision is to clarify the purpose of the practicum on the module and display a more colorful image.

7. Draft II

At this stage, the product has passed the validation test and improved several inputs from experts, both for materials and media.

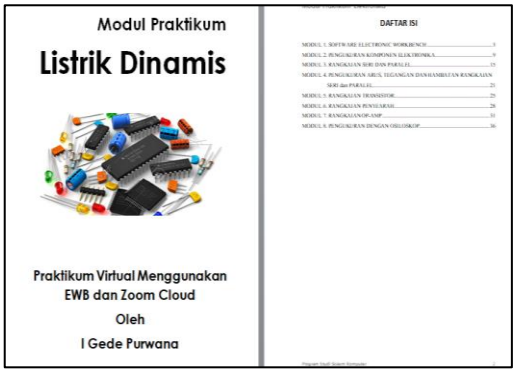

Figure 2. Revised Module Cover Display

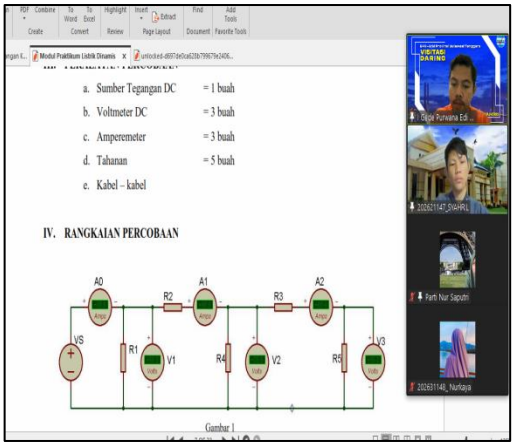

Figure 3. Display of Revised Module Contents

8. Limited scale trial

The virtual laboratory design using EWB and Zoom Cloud which have been validated by experts and revised, was then tested to class X students of the Electrical Power Installation Engineering department at SMK Negeri 2 Kendari with a sample of 22 students on a limited scale trial. Based on the results of data analysis, 54.55% students responded "very supportive" and the rest responded "supportive" about the virtual laboratory practicum media using EWB and Zoom Cloud.

9. Product revision 1

Input from students at the limited scale trial stage was then used as a guide for improving the product. Data collection was done again for product improvement. After that, the data collected was adjusted based on the input from students in the form of various simulations using media such as oscilloscopes and other controllers on the EWB, and

increasing observational data as a form of practicum evaluation in the module.

10. Draft III

In this section, the products that have passed validation from experts, have been tested on a limited scale and have been revised are ready to be tested on a wide scale trial. The improved product from the student's revision was tested extensively and can be seen in the following figure.

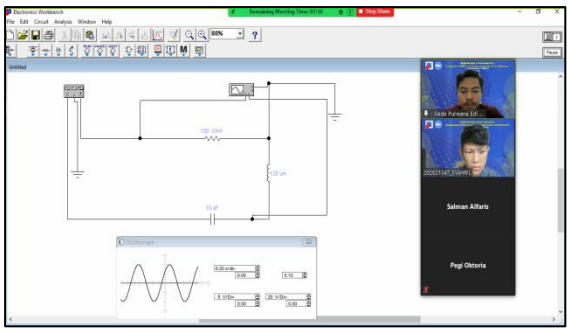

Figure 4. Oscilloscope Simulation Variations

11. Wide-scale trial

At this stage the revised virtual laboratory product was then tested on a wide scale on 40 students. Based on the results of the analysis, 77.50% of students gave a "very supportive" response, while 22.50% of students gave "supportive" response, and no student thought that it is "less supportive" or "Not Supportive". In accordance with the acceptance indicator score 2.51, then in a wide-scale trial, the virtual laboratory media using EWB and Zoom Cloud was accepted as a practical practicum media on Dynamic Electricity material during the Covid-19 Pandemic. The percentage of students' responses has increased compared to the scale trial. In simple terms, it can be seen in the following diagram.

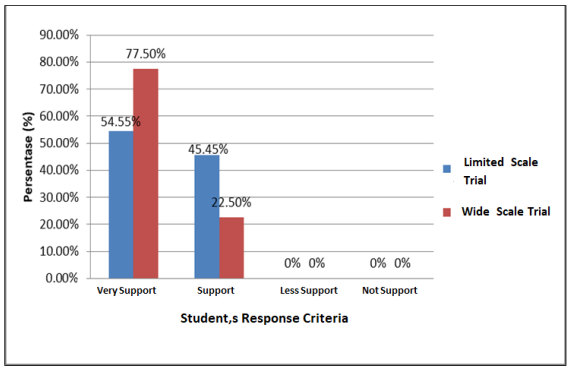

Figure 5. Students' Responses for Limited-Scale and Wide-Scale Trials

In addition to the practicality of using the media from students, the teacher's observation and assessment data on students' learning outcomes also plays a role in determining the effectiveness of the media with students achieving classical completeness > 75% with a score of > 75.

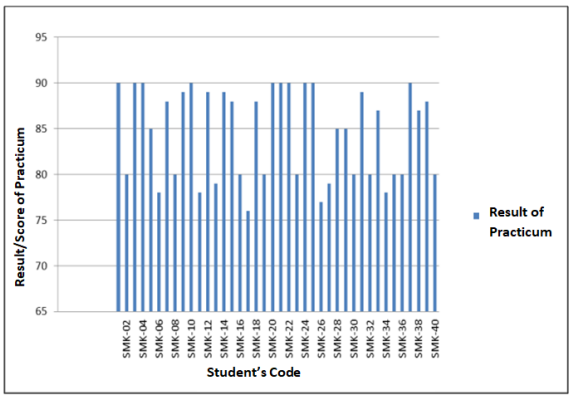

Figure 6. Students' Practicum Results

From the diagram, it can be seen that the observational data on students' responses to several aspects of the assessment during the practicum were very good and tended to be in the "Yes" observation assessment category; only some students were less active in giving feedback during the practicum. This

is also directly proportional to the practicum results obtained by students. The diagram shows that students' classical completeness is at a percentage of 100% with a value or score > 75. This is in line with the research (Faour et al., 2018) which states that the use of virtual laboratories has a better effect than interactive demonstrations using real laboratory equipment on understanding the concept of direct current electric circuits. This is also supported by the research (Islahudin et al., 2020) revealing that there is a significant effect of using virtual laboratories based on EWB (Electronics Workbench) in improving physics learning outcomes of the students.

12. Product revision 2

The results of the analysis of the questionnaire responses and inputs at the wide-scale trial stage were then used for product improvement guidelines. Therefore, data collection was carried out based on the input from students and the results of teacher observations so that the data on evaluations obtained were appropriate for the improvement of the virtual laboratory.

13. Final product

After the product was revised, the virtual laboratory system was finalized using EWB and Zoom Cloud on Dynamic Electricity Material which included providing cover and instructions for use so that it was easier for students to understand the practicum module in conducting simulations, including an autorun link on the module to make it easier for students to access when opening the EWB which is already integrated with Zoom Cloud, and a user guide at the end of the module page. The display of the virtual laboratory final product using EWB and Zoom Cloud is presented in the following image.

Figure 7. Final Product Display

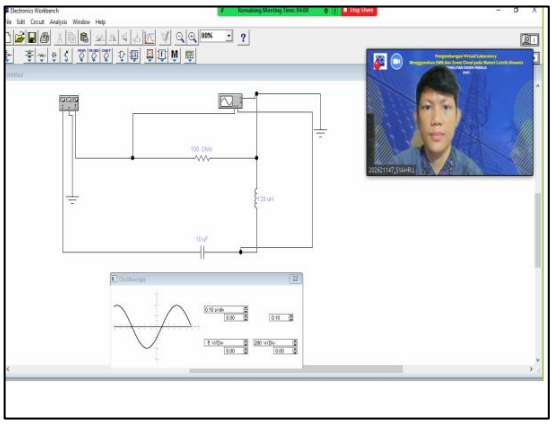

Figure 8. Final Product Display

The results obtained from the development of virtual laboratories in this study on the effectiveness of student practicums are in line with the research revealing that virtual laboratories can improve students' competence in terms of cognitive (minds-on), and psychomotor (Jaya, 2013). The virtual lab has shown the suitability of the material with the basic

competencies. The virtual lab is very useful in practicum (Masril et al., 2018). In addition, the virtual laboratory gave the positive effect on students' conceptual understanding (Gunawan et al., 2018)

More specifically, the development of using EWB in this study also had an impact on students' practicum results which were correlated with science process skills. Dani (2017) states that there is an increase in students' science process skills by using the EWB simulation software learning media because students can directly assemble themselves according to the modules that have been given. This software is also very good to use for schools that lack KIT facilities (Dani et al., 2017; Khaerunnisa, 2017). These results are also in line with the research that states that students' learning outcomes show better results after being given treatment in learning using the Electronics WorkBench (EWB) software learning media (Suraya, 2014).

The combination of EWB with Zoom Cloud also has a good impact on the students' practicum process through the virtual laboratory in this study. This is supported by research which states that online learning based on zoom cloud meetings has a positive effect on improving students' learning outcomes, so that online learning based on Zoom Cloud Meetings can be an alternative online learning media while studying from home (Liu & Ilyas, 2020). Learning with Zoom Cloud video conferencing can support distance learning and make it easier for students to absorb learning material delivered by educators because it is more real-timed and interactive as a learning medium (Ismawati & Prasetyo, 2020). The validity of the product in this study is also in line with the results of expert assessments of media products, virtual laboratory teaching materials on the concept of dynamic electricity are very suitable for use in physics learning activities in high school (Rahayu et al., 2019)

IV. CONCLUSION AND SUGGESTION

From the results of data collection and analysis, it can be concluded that the development of a Virtual Laboratory system using EWB and Zoom Cloud at the Dynamic Electricity Practicum is feasible as a learning solution during the COVID-19 pandemic at SMK Negeri 2 Kendari, and the Virtual Laboratory system was developed in this research is practical and effective for use based on the limited and wide-scale trials that have been carried out.

Suggestions that can be given for further research are that the virtual laboratory development process can be done by combining various platforms that are integrated into one virtual laboratory, not only focusing on one type of subject.

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