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Virtual Lab Development to Support Automotive Electrical Practicum Course

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ABSTRACT

Throughout 2020, what was implemented at UM had an impact on the learning of practical subjects. Practical learning that has been carried out in laboratories/workshops must switch to an online system. One of them is the Body Electrical Practicum course, 3 credits/6 JS. Due to the nature of courses that are usually carried out by laboratories to provide effective skill acquisition and hands-on experience, it is often difficult to make these laboratories accessible online. Therefore, the solution offered in this research is to develop virtual lab-based learning content to complement the learning content that has been implemented so far. The purpose of this research is (1) to produce appropriate learning media (2) to test the effectiveness of the developed media. This research method uses research and development of the ADDIE model which consists of analysis, design, development, and implementation. Meanwhile, the data analysis used is in the form of a percentage that describes the size of the feasibility of the virtual lab developed according to experts, and the tow tail test is used to test the effectiveness. Based on the feasibility test from the experts that the developed media is suitable for learning in electrical courses in the Department of Mechanical Engineering, State University of Malang with minor revisions. While the results of the effectiveness test show that the media developed is very effective, as evidenced by an increase in the value of the respondents who are the object of the test.

Keywords: Virtual lab, Electrical system, Interactive media, Electrical body

INTRODUCTION

The outbreak of the Corona Virus Disease (Covid-19) has presented its own challenges for the world of institutional education, especially higher education [1]. Anticipating virus transmission, State University of Malang (UM) responded to this by issuing Circular Letter number 27.3.3/UN32/TU/2020 dated March 27, 2020 to carry out all recovery activities from home through various applications that make it easier for students and lecturers to continue learning wrong. a platform that is used through sipejar. The automotive engineering education study program during the COVID-19 pandemic has implemented a practice and theory learning system with an online system.

Problems arise when lecturers and students carry out practical learning, one of which is standard body electricity. Due to the nature of the courses that laboratories typically administer to provide effective skill acquisition and hands-on experience, it is often difficult to make these laboratories accessible for online access. Either the actual lab needs to be enabled for remote access or it needs to be replicated as a fully software-based virtual lab is still relatively lagging behind when using new technological approaches (especially for remote learning). Therefore, the solution offered in the learning innovation grant scheme (Inobel) is to develop virtual lab-based learning content to complement the learning content in the student application.

Based on the results of research it can be concluded that students who learn to use virtual labs are higher than students who are taught conventionally [2][4]**.** Learning using virtual labs/interactive multimedia helps students to recall basic concepts that have been previously accepted better than conventional learning [5][7]. Computer simulation can be used as an alternative learning media because it can help students overcome their weaknesses in theory and develop understanding of abstract concepts [8]. So it can be concluded that the use of interactive simulations in the form of virtual labs helps students visualize problems and their solutions, and can also foster a positive attitude towards practical courses.

Through the developed media, the working process or working principle of an electrical system can be observed more clearly than still image media. Students can look at the material more real, especially a work process of the electrical system, where electricity is an abstract material. Departing from that, the author conveys the idea of using the Livewire program as a medium for learning electricity as a means to present simulations and analysis for students of the light vehicle engineering program in a more varied manner. The variations here are not only in terms of the realm of learning involving the cognitive, affective, and psychomotor domains but also in terms of the types of learning activities and their alignment with the objectives of electricity learning. In addition, the

development of this media also started from previous research [9] which used adobe flash player for electrical materials, which suggested using other media because there were several weaknesses in the media, including it was difficult to modify teaching materials, knowledge of programming languages was needed and students tend to be passive.

Meanwhile, the resulting product is in the form of an electrical circuit program that has been designed for practical purposes in the laboratory using Livewire Software. This learning media supports hyperlinks so that in one layer/view it can contain various kinds of electrical material so that it is more complex than other electrical software programs (Proteus, Multism, flash player). Meanwhile, the Proteus, Multism, flash player electrical programs do not have a menu for hyperlinks.

Furthermore, the resulting electrical circuit drawing is adjusted to the teaching aids and electrical practical equipment in the automotive engineering education study program with the presentation of this course covering Ohm's Law as the basis for making parallel series circuits of lamps based on Ohm's law, Circuit drawings and diagnosis of various types of lighting system circuits, Circuit drawing and circuit diagnosis of various sign systems, Circuit drawing and circuit diagnosis of various Wiper and washer systems, Circuit drawing and circuit diagnosis of various preheating systems, Circuit drawing and circuit diagnosis of various central lock systems, Circuit drawing and circuit diagnosis of various Power window systems , Circuit drawing and circuit diagnosis of various BCM systems, Circuit drawing and circuit diagnosis of various Keyless entry systems, Circuit drawing and circuit diagnosis of various Alarm systems, Circuit drawing and circuit diagnosis of various systems Audio.

The objectives of this research and development are as follows: (1) Produce appropriate learning media based on virtual labs in automotive electrical courses in the automotive engineering education study program, (2) test the effectiveness of the products developed.

RESEARCH METHOD

The development method used in the ADDIE Model. The ADDIE model was chosen in developing this media because this model has been common and is often used in developing media for learning and is widely known. The stages of ADDIE research and development are shown in Figure 1 as follows:

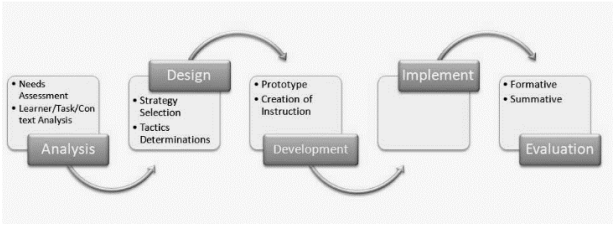

Figure1. ADDIE method

Based on the figure 1, the steps of the development model can be explained as follows:

Analysis: thinking about new products (models, methods, media, teaching materials) to be developed, Identify products that are in

accordance with student goals, learning objectives, identify learning content/materials, and identifying the learning environment and delivery strategies in learning.

Design a new product concept on paper, Designing new product development tools, and the design is written for each learning unit. Instructions for implementing the design or manufacture of the product are written in detail.

Development: Develop product kits (materials/materials and tools) needed in media development, at this stage, products (materials/materials, tools) are started to be made according to the structure of the model and creating instruments to measure product performance.

Implementation: Starting to use a new product in a learning or real environment, Looking back at the goals of product development, interaction between students and asking for feedback early in the evaluation process.

Evaluation: Measuring the achievement of product development goals, Measure what students have been able to achieve with formative tests and summative tests.

The design in this study was carried out individually (Reviewer), small groups (10 students) and large groups (24 students). The instruments used in data collection are questionnaires and tests. The data analysis technique used is descriptive statistical data analysis in the form of quantitative data to see the percentage of answers from experts and students.

The formula for processing data per item:

$$P = \frac{x}{xi} X100\%$$

Information:

P = Percentage of questionnaire data per item

x = respondent's answer in one item

xi = The number of ideal scores in one item

100% = Constant

Meanwhile, as a basis for making decisions to revise livewire-based learning media products, the assessment qualification criteria are used in Table 1

Table 1. Criteria for the effectiveness of electricity learning media

Percentage	Information
81 % - 100 %	Very valid, can be used without revision
61% - 80%	Valid and usable after minor revision
41% - 60 %	Less valid but usable after major revision
21 % - 40%	Very invalid or should not be used
0%- 20%	Invalid or cannot be used

RESULT AND DISCUSSION

Based on interviews conducted by researchers with respondents on 21-23 April 2021, it was found that students found it difficult to understand electrical concepts. In addition, students also stated that the learning carried out by teachers had been carried out well, but students felt that they needed certain

facilities that can be manipulated in learning activities.

From the results of the interview, the researchers then observed the class electricity learning which was held on April 24-30, 2021. Based on the results of the observations, the identification of the problem was obtained as follows.

1. The learning carried out by the teacher has not been maximal in applying learning media that helps students understand electrical concepts well. Although, the learning steps carried out by the teacher are in accordance with the expected learning steps, and the teacher has applied learning media several times. However, the implementation of interactive learning media that supports students' thinking stages in learning electricity will certainly affect students' understanding of the electrical concepts studied. This is because interactive learning media has benefits in facilitating the interaction between teachers and students so that learning activities will be more effective and efficient.
2. Students are less motivated in learning electricity. Students' motivation to learn electricity certainly plays an important role for students' success in learning electricity. This is because students carry out the learning process. One way that can be taken to increase students' motivation to learn electricity is by applying interactive learning media in learning activities.

Table 2 Results of phase I product trials

Instrument	Instrument Details	Mean	Description
The Validity of Learning Media	Instrument Validity Sheet	3.6	Valid
	Material Expert Questionnaire	76,3%	Valid
	Media Expert Questionnaire	78,5%	Valid
Practicality of Learning Media	Teacher Questionnaire	79,8%	Valid
	Student Questionnaire	87.5%	Valid

Based on Table 2, it can be explained that the questionnaire used to assess learning media is quite valid with an average score of 3.6 so that the questionnaire can be used to collect research data. Then the learning media assessed to the material expert got a score of 76.30%, assessed to the media expert got a score of 79.84%, was assessed by subject teachers to get a score of 79.84% and the 10 students got a score of 87.50%. So it can be concluded that in the early stages of this media assessment the average answer is valid with minor revisions and can be used in learning.

In Table 3 it can be explained that after the media was tested in stage I, it produced suggestions and revisions from experts. Revisions from these experts were followed up to improve the media that had been

developed. Then the results of the revision were re-analyzed to the material experts getting a score of 83.50%, media experts 87.04%, subject teachers 87.64% and student trials 10 people got a score of 90.63%. So that the final product of the development of this learning media is valid and can be used in learning without revision. In addition, there was an increase in student learning achievement seen from the pre-test and post-test scores, namely the difference was 40.9 and the opinions of students who had participated in this livewire learning on average agreed that the media could make it easier for students to learn about electricity.

Table 3. Product trial phase II

Instrument	Details Instrument	Mean	Description
Learning Media Validity	Instrument Validity Sheet	87.04%	Valid
	Material Expert Questionnaire	83.50%	Valid
Practicality of Learning Media	Media Expert Questionnaire	87.64%	Valid
	Teacher Questionnaire	90.63%	Valid
Effectiveness of Learning Media	Student Questionnaire	Pre tes: 34.5 Pos tes: 75.4	Valid
	Instrument Validity Sheet		Valid

The instructional media development procedure carried out in this study was in accordance with the ADDIE development procedure. This can be noted in the previous discussion, namely regarding the results of the instructional media development procedure. So, with the implementation of development procedures in accordance with ADDIE development procedures, valid learning media are obtained, and can be used in learning without revision.

Discussion on the Quality of Learning Media Based on table 1 it is known that the research instrument used is in the quite valid category. Quite valid due to several factors, namely as follows. First, in general, the validator states that the indicators/descriptors, aspects of observation, and statements on the instrument are quite good or good. Second, the validator chooses the option "feasible to use but with revisions" on the choice of instrument feasibility. Third, the indicators/descriptors contained in the instrument of learning media validity have been developed by taking into account the aspects that must be observed in determining the validity of learning media, namely content validity and construct validity [4]. Quite valid with research instruments that are quite valid, the results of measuring the quality of learning media can be accounted for.

The virtual lab-based learning model that has been revised and tested in large groups on students has contributed to improving cognitive knowledge. This research is in line with what was stated that the ability of virtual labs has helped students visually and auditory so that learning becomes easier to accept [10][11]. Therefore, intensive training

is needed on (a) the application of learning tools at least once a week (2) introduction to the principles of the electrical system in the form of modules and practice questions.

Another strategy that can be applied to improve students' abilities in virtual lab learning is technical segmentation. In this technique, how to do learning can be carried out by breaking some material into small parts first by using a module and then proceeding with the application of virtual labs [12]. In this way, students who study become more active and their analytical skills are better than before. The research results are in line with [9][13]That the use of virtual labs for electricity learning becomes easier and students become active, creative and fun. However, there are obstacles when students do not have sufficient equipment. The solution offered is based on research [3][8] it is necessary to develop media that can be used on all devices that every student has, one of which is the development of learning media with the android system. This development is in line with what was stated by [2][11] that students are used to having an Android cellphone and almost 100% can operate it easily.

If this can be implemented properly, a virtual lab-based learning atmosphere will be created that is able to arouse students' enthusiasm to continue learning. This is like what has been stated by [6][9] that the main requirements that must be done in virtual lab learning are the learning context, the scientific concepts being studied, and the ability to interact with technology. For example [3] Finding environmental conditions that support learning on 3D objects helps students understand complex engineering concepts. Besides that [14] Also suggesting a good environment and complete learning tools are the main requirements that must exist if you want to implement a virtual lab into learning. Similarly [8][15] it has shown different learning outcomes in students who are taught with a virtual lab compared to students who are taught manually.

Obtaining valid learning media, due to several factors. These factors are as follows. First, in general, the validator states "good" or "very good" regarding the components of the learning media according to the indicators/descriptors. Second, the learning media was developed in accordance with the aspects of validity measurement proposed by [11], namely the validity of the learning media related to content validity and construct validity. Third, learning media are arranged in accordance with the demands of the curriculum contained in the school.

Third, the learning media is interactive and developed with Livewire. Fourth, the learning media is structured by taking into account the students' thinking level, in accordance with the theory-oriented learning of Jean Piaged, Mayer and Edgar Dale. The acquisition of practical learning media is certainly caused by several factors. These factors are explained as follows. First, the

learning media has been developed in accordance with the practical aspects expressed by [2][16]. Second, learning media are arranged in accordance with the demands of the curriculum contained in the school. Third, the learning media is equipped with its supporters, namely the instructional media manual for teachers so that teachers can use learning media well in the learning activities carried out. Some of these factors cause the developed learning media to meet the aspects of effectiveness (effective). In addition, some of these factors cause an increase in student electrical learning achievement.

Suggestions for lecturers in electricity courses. Before presenting this teaching material in class, it is better to watch this teaching material in its entirety, read other references to better master the material, then prepare learning strategies in the classroom. In order for students to be more focused in doing learning, the lecturer should understand the things that need to be considered by the lecturer before carrying out the learning contained in the teaching materials developed. This learning media is designed as an alternative in online practicum, so that the role of lecturers/instructors is still needed in clarifying concepts, facts and basic principles in the competence of assembling electrical systems. Given the composition of the material contained in this Livewire-based electrical learning media is hierarchical, then in using this media it must be studied sequentially. If the material is not studied in sequence, it is feared that the training participants will find it difficult to meet the standard of completeness (minimum graduation limit).

CONCLUSION

The conclusion of this study is

1. The results of the media feasibility assessment this learning by content experts and media experts is valid and can be used in learning with minor revisions.
2. The results of the virtual lab effectiveness test that was developed were Pretest: 34.5 Posttest: 75. So the virtual lab developed was very effective in being used in learning.

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