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Development of Learning Media Based on Electrical Control Techniques Simulator to Improve Learning Achievement (Studies on Electrical Power Installation Engineering Subjects for Class XI Students at Rejang Lebong Vocational School)

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Abstract

This research aims to describe the development of Electrical Control Techniques Simulator-based learning media which can improve student learning achievement in the Electrical Power Installation Engineering subject and describe the effectiveness of developing Electrical Control Techniques Simulator-based learning media in improving student learning achievement in the Electrical Power Installation Engineering subject. In this research, R&D (Research and Development) design was used with the ADDIE model. The research subjects were class XI students majoring in Electrical Power Installation Engineering at Rejang Lebong State Vocational School. The data collection technique used is qualitative, namely collecting data by conducting observations, questionnaires and quantitatively by collecting pretest data before learning takes place and post-test after learning using learning media. Data analysis used average values and t-test. The validation instrument for material and media experts in research is the Likert scale. The results of the scale trial carried out on 60 students, consisting of 30 students (XI TITL2) in the control class and 30 students (XI TITL1) in the experimental class at SMKN 1 Rejang Lebong with the results of the post-test t test analysis showing sig (2-tailed) is 0.000, meaning the sig (2-tailed) is smaller than <0.05, meaning there is a significant difference between the experimental class and the control class. The conclusions of this research are: (1) The Electrical Control Techniques Simulator-based learning media developed is suitable for improving student learning achievement in the class XI Electrical Power Installation Engineering subject. (2) Development of Electrical Control Techniques Simulator-based learning media is effective in improving student learning achievement.

A. Introduction

The development of science and technology has brought very significant changes to various dimensions of human life, both in economic, social, cultural and educational terms (Bernacki et al., 2019; Cattaneo et al., 2022). Therefore, so that education is not left behind by developments in science and technology, adjustments need to be made in learning media. Apart from that, developments in science and technology are increasingly encouraging reform efforts in the use of technological results in the learning process through learning media (Akram et al., 2022; Marini et al., 2022; Rahmatullah et al., 2022). Along with this development, learning media has also experienced a lot of development until it is able to meet the factors

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needed by a media, namely according to learning objectives, student characteristics, the type of learning stimulus desired, learning situations and the breadth of the reach that the media wants to serve (Marpaung et al., 2023; Miftah & Rokhman, 2022; Rahma, 2022).

Electrical Power Installation Engineering is one of the productive subjects in the field of electricity studied at Vocational High Schools (SMK) with the Electrical Power Installation Engineering skills program. Because this subject is one of the skill competency subjects that must be studied by students majoring in Electrical Power Installation Engineering, students must be able to understand it in order to achieve a competent score for this Electrical Power Installation Engineering subject (Cahyani et al., 2020; Mahadiraja & Syamsuarnis, 2020; Setiawan et al., 2021). For this reason, students are expected to play an active role in the learning process, which of course requires varied and creative learning strategies. Despite the fact that currently the learning methods that are often used in schools are still monotonous and result in students playing a passive role, so that learning achievement is only seen in the ability to memorize how circuits work theoretically without understanding the working principles of circuits in accordance with the provisions of the General Electrical Installation Regulations. Apart from that, students' ability to grasp the material presented will certainly not meet the requirements because students are less involved in learning, this situation will make students bored and it will certainly be difficult for them to understand the material presented by the teacher, this will affect student learning achievement.

Electrical Control Technique Simulator is a simulator used to design and analyze an Electrical Power Installation control system. The Electrical Control Technique Simulator makes it possible to make control installation systems much more complex and easier to understand and carry out by high school students in the field of vocational technology. Using this media can also help teachers open up broad communication opportunities for students so that students play an active role in learning and are able to collaborate with fellow students in group collaboration. Apart from that, this simulator media also has interesting characteristics and functions for students to use. The Electrical Control Technique Simulator is equipped with various components that can simulate how they work in a circuit that has been designed by students later. Electrical Control Technique Simulator-based learning media is an alternative learning tool that has quite unique and interesting characteristics, namely that it can be used not only during class hours but can also be used outside class hours, one of which is during independent learning at home. According to Sardiman (2010), this situation means that students can learn indirectly, namely actively interacting using media or other learning resources, so that the learning process can occur anytime and anywhere.

With the development of learning media based on the Electrical Control Technique Simulator, it is hoped that there will be an increase in the use of media based on other electrical control simulators in learning activities that involve students and teachers interactively. This learning process will certainly increase teacher creativity in managing learning strategies, because Electrical Software Control Technique Simulator contains various components that can be used to install and simulate controller circuits. Using the Electrical Control Technique Simulator is not complicated, the available components are equipped with symbols and pictures. The controller circuit that has been assembled can be run and observed. So, students can practice creating, running and analyzing controller circuits. Through the use of this Electrical Control Technique Simulator software, it is easier for teachers to convey lesson material to students. The power installation circuit that has been designed can be simulated using the Electrical Control Technique Simulator software so that how the circuit works is easy for students to understand. The more creative the teacher is in developing learning strategies, the more optimally it will be utilized by the students.

Based on the description above, researchers are interested in conducting research on the development of electrical control technique simulator-based learning media to improve learning achievement, research on the class XI Electrical Power Installation Engineering subject, Electrical Power Installation Engineering Department at Rejang Lebong State Vocational School, Curup District, Bengkulu Province.

Based on the description above, this research can formulate, among others: 1) How is development of Electrical Control Techniques Simulator-based learning media can improve student learning achievement in the Electrical Power Installation Engineering subject? 2) How is the development of Electrical Control Techniques Simulator-based learning media feasible in improving student learning achievement in the Electrical Power Installation Engineering subject? 3) How is the development of Electrical Control Techniques Simulator-based learning media effective in improving student learning achievement in the Electrical Power Installation Engineering subject?

The aim of this research is to describe the development of Electrical Control Techniques Simulator-based learning media which can improve student learning achievement in the Electrical Power Installation

Engineering subject. To describe the effectiveness of developing Electrical Control Techniques Simulator-based learning media in improving student learning achievement in the Electrical Power Installation Engineering subject.

B. Research Methods

This research was conducted using a "Research and Development" approach. PThe meaning of research and development (R&D) is the process or steps to develop a new product or improve an existing product (Umar et al., 2023).Research and development is a type of pragmatic research, which is used to test theories and validate practices that are continuously carried out essentially through unchallenging traditions (Budi & Aldianto, 2020). Research and Development is also defined as a process or steps to develop a new product, or improve an existing product, which can be accounted for. These products are not always objects or hardware, such as metal computers for data processing, classroom learning, libraries or laboratories or models of education, learning, training, guidance, evaluation and management (Adomako et al., 2021; Heij et al., 2020).

The product development model used in this research is the ADDIE model. The ADDIE model is considered more rational, logical and complete compared to other educational product development models. The ADDIE model has 5 stages in its implementation, consisting of Analysis, Design, Development, Implementation and Evaluation. In each stage of the ADDIE model there is an output that becomes input to the next stage. The ADDIE model can be used to develop various kinds of educational products, such as models, learning strategies, learning methods, media and teaching materials.

The research and development procedures that will be carried out in this research use an educational product development model which consists of several stages. Evaluation will be carried out at each stage, so that developers can evaluate the effectiveness of the product that has been developed and make revisions for improvements in the following stages. The evaluation process at each stage also helps developers make the right decisions and avoid mistakes in subsequent stages. By using a structured educational product development model, developers can ensure that the resulting product meets user needs and is effective in achieving the desired learning goals.

The subject of media expert validation is carried out to assess the suitability of the product in terms of media presentation which is tested in the field. Evaluation comments and suggestions from validators are used to improve and refine the learning media being developed. Subject Material validation is carried out by experienced basic electrical engineering material experts. Basic electrical engineering material experts will evaluate the material contained in the learning media developed. Basic electrical engineering material experts will evaluate the suitability of the material and whether the material contained in the learning media is in accordance with the basic electrical engineering curriculum and student needs. The population used in this research were teachers and students of class XI Electrical Engineering at SMKN 1 Rejang Lebong and at SMKN 6 Rejang Lebong. Furthermore, the samples in this research, namely the subjects of the research trials, were students majoring in electrical power installation engineering consisting of 2 target vocational schools, namely:

1. State Vocational School 6 Rejang Lebong consisting of 10 students for the experimental class with 1 teacher, and 10 students for the control class with 1 teacher as a limited scale trial site.
2. State Vocational School 1 Rejang Lebong consisting of 30 students in the experimental class with 1 teacher, and 30 students in the control class with 1 teacher as a large-scale trial site.

Data collection techniques in research are as follows:

1. Interview Sheet

   Interview guidelines were carried out to analyze teacher needs and obtain information needed in research on the development of Electrical Control Techniques Simulator-based learning media. Interviews conducted by researchers were semi-structured with teachers at schools.

2. Observation sheet.

   Student needs questionnaire containing questions that are considered capable of analyzing the needs of students at the Electrical Power Installation Engineering Vocational School which is used as a research site.

3. The assessment sheet

   This questionnaire was created to see the feasibility of the Electrical Control Techniques Simulator-based learning media being developed. This feasibility test will be carried out by media experts and material experts. This questionnaire was also created to see students' responses to the Electrical Control Techniques Simulator-based learning media that was developed.

4. Learning Results Test.

   This research used a formative learning achievement test or cognitive domain (Knowledge) in the form of a pretest carried out before learning and a post-test after learning was carried out.

Data analysis techniques are used to analyze data obtained from data collection instruments after the instrument has been tested. The data used to determine the feasibility of the product being developed is seen from the media appearance, programming, learning and content. Learning achievement data was obtained from the results of the pretest and post-test which were used to determine the impact of using the media being developed. In this research the data obtained can be in the form of qualitative data and quantitative data.

InstrumentThe data obtained is then analyzed based on the type of data, namely quantitatively in the form of average feasibility of product trials and learning mediabased on Electrical Control Techniques Simulator by calculating the average answer choices based on the description of the expert and respondent validation instruments. AnalysisdataIn this research, the following average formula is used.

$$Average = \frac{\sum x}{N}$$

Analysis to find out how students respond to the development of learning mediabased on Electrical Control Techniques SimulatorWhich was developed. Classical student response data is analyzed descriptively. This analysis is based on the class average of student responses calculated using the following formula.

$$\bar{X} = \frac{\sum x}{N}$$

Test student learning outcomes from the use of learning mediabased on Electrical Control Techniques Simulatorconsists of knowledge learning outcomes tests to be able to determine the effectiveness of learning media developmentbased on Electrical Control Techniques SimulatorTo improve student learning achievement, a cognitive learning outcomes (knowledge) test is carried out by comparing student learning outcomes in the control class with the experimental class on the material presented using development media.based on Electrical Control Techniques Simulator. Effective in improving students' cognitive learning achievement. The formula used for the t-test on student learning outcomes in the cognitive domain is.

1. Limited Scale t test

$$t_0 = \frac{M_D}{SE_{MD}}$$

with:

$$M_D = \frac{\sum D}{N}$$

$$SE_{MD} = \frac{SD_D}{\sqrt{N-1}}$$

$$SD_D = \sqrt{\frac{\sum D^2}{N} - \left(\frac{\sum D}{N}\right)^2}$$

D = X - Y (X = Results (Pretest, Y = Posttest Results)

2. Wide Scale t test

$$t_0 = \frac{M_x - M_y}{SEM_{xy}}$$

$$M_{x1} = \frac{\sum x2}{N1}$$

$$SD_{x_1} = \sqrt{\frac{\sum {x_1}^2}{N_1}}$$

$$SEM_{x_1} = \frac{SD_{x_1}}{\sqrt{N_1 - 1}}$$

The t-calculated value is compared with the t-table according to the sample of research respondents at the significance level of 0.05 and 0.01. if t table ≤ t-count then Ho is accepted and if t-table ≥ t-count then Ho is rejected and Ha is accepted.

C. Results and Discussion

Development of learning media based on the Electrical Control Techniques Simulator as an inclusive learning development electromagnetic control circuit so when the circuit works well students can find out where troubleshooting is in the circuit so they can minimize failures during practicum, because this software is an electromechanical design system that uses relays, time relay buttons, motors, switches, and several mechanical structures base. Learning Media based on the *Electrical Control Techniques Simulator* is an additional learning resource for students in improving learning achievement and also makes it easier for teachers to explain the material presented in the learning process anywhere and at any time effectively so that the learning achievement obtained can increase.

The product developed in this research is Electrical Control Techniques Simulator-based learning media for class Electrical Control Techniques Simulator-based learning media was developed by taking into account the curriculum, learning objectives and learning outcomes (CP) as well as the learning steps that will be applied in this research. The Electrical Control Techniques Simulator-based learning media was developed using the ADDIE development model with the stages of Analysis, Design, Development, Implementation and Evaluation. Based on the research and development carried out, the research results obtained are:

1. Analysis

At this stage, it was carried out by 2 teachers from 2 schools, namely Teachers MB and BP. Basically, they stated that students felt difficulties in understanding the electrical power installation material in the Electrical Power Installation Engineering subject during learning because when explaining the electrical power installation material the teacher felt inadequate. learning media, electrical power installation material is one that is difficult for students to understand so that students find it difficult to understand the material because it explains a lot about the working principles of circuits that use electromagnetic components. For this reason, innovative learning media is really needed, teachers have tried to look for learning media on the internet and get Currently, the teaching materials used by teachers for the Electrical Power Installation Engineering subject are textbooks, the internet and modules.

In the analysis of student needs, the author concluded that students liked the electrical installation lessons, but many students did not easily understand the electrical installation lessons delivered by the teacher, while students were used to using devices such as cell phones, PCs or laptops, so this situation could be used as a learning tool because students felt Many people enjoy learning how to install electricity using gadgets, which will definitely get rid of students' boredom when reading the teaching materials given by the teacher, many students hope that the teacher will provide more varied teaching materials, and students feel happy if when studying there are pictures that can explain the material. Learning, especially in video form, will certainly make it easier for students to understand the material, according to the results of the questionnaire data collection, students feel that learning about electrical power installations uses learning media based on *Electrical Control Techniques Simulator* can improve student learning achievement.

2. Design

The material developed in the Electrical Control Techniques Simulator learning media was created based on the objectives of the learning achievement (CP) elements used by the Rejang Lebong Regency State Vocational High School Education unit. The material chosen was electrical power installations in this case about reversing the direction of motor rotation using a switch. time delay.

In making research instrument grids, the criteria created are adjusted to the expertise of each expert, such as material experts, media experts, teacher needs analysis, student needs analysis and student responses. Meanwhile, the instrument used in this research is the learning achievement test assessment sheet. The assessment sheet is used by all analytical instruments in assessing the suitability of the learning media being developed. Meanwhile, the learning achievement test is used during the pretest and post-test by providing 20 multiple choice questions. The learning achievement test aims to determine the effectiveness of the Electrical Control Techniques Simulator-based learning media product being developed.

Storyboards are used as guidelines/illustrations to simplify the process of creating learning media. Apart from that, storyboards also function to describe the contents of the flow chart into more detailed and clear data. The storyboard also contains competency columns, information, materials, evaluations/quizzes and references, the storyboard is a learning media based on the Electrical Control Techniques Simulator.

At this stage, the researcher analyzed the material included in the simulator-based learning media, namely material for designing electrical power installation circuits, then analyzed it by simulating the circuit using learning media equipped with software. The media developed contains text, images and videos so that the media display is attractive. The reference sources that researchers obtained were from available teaching material modules, internet media and other reading sources.

3. Development

At this development stage, the development model used is the ADDIE model. The development stage of Electrical Control Techniques Simulator-based learning media includes the beginning (Opening, Cover, Title, Readiness to learn/motivational video, Instructions for using the media), content (Menu, Materials, Learning Tools, simulation) and end (Summary, Evaluation, Bibliography, Conclusion).

At this stage, we will discuss the feasibility of the learning module being developed. After obtaining a feasibility assessment from media experts, material experts and students. Learning media will be revised according to the results of the validator assessment and will be changed according to what is conveyed in the comments and suggestions column from experts.

The media expert in this research is a lecturer in the FKIP UNIB Educational Technology study program, namely Prof. Dr. Johannes Sapri, M.Pd. The results of the validation of each aspect of the appearance assessment by media experts obtained an average score of 4 with very feasible criteria, then for the learning design an average score of 4 was obtained with very feasible criteria, and for content suitability an average score of 4 was obtained with very feasible criteria. So, it can be concluded that every aspect of the assessment for media expert validation results obtained a very decent score without any revisions as seen in the following graph:

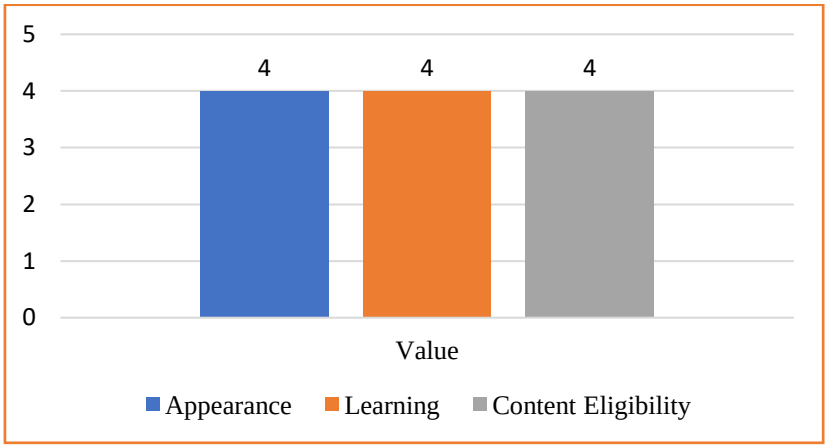

Figure 1. Graphic Image of Media Expert Validation Results

Meanwhile, the material experts from Raflesia Rejang Lebong Polytechnic lecturers are Fadhel Putra Winarta, M.Pd and senior teacher at SMK Negeri 1 Rejang Lebong Drs. Dafrizal.

The results of the validation of each aspect of the assessment by media experts for the appropriateness aspect of the content were obtained from material expert 1 with an average value of 4 and material expert 2 with an average value of 4 with very appropriate criteria, for the presentation confidence aspect obtained from the material expert 1 average value 3.92 and material experts with an average score of 4 with very

decent criteria, finally the linguistic assessment obtained a score from media expert 1 with an average score of 4 and media expert 2 with an average score of 4 to get very decent criteria. So, it can be concluded that every aspect of the assessment for the material expert validation results obtained a very decent score with slight revisions in the feasibility aspect of presentation as seen in the following graph:

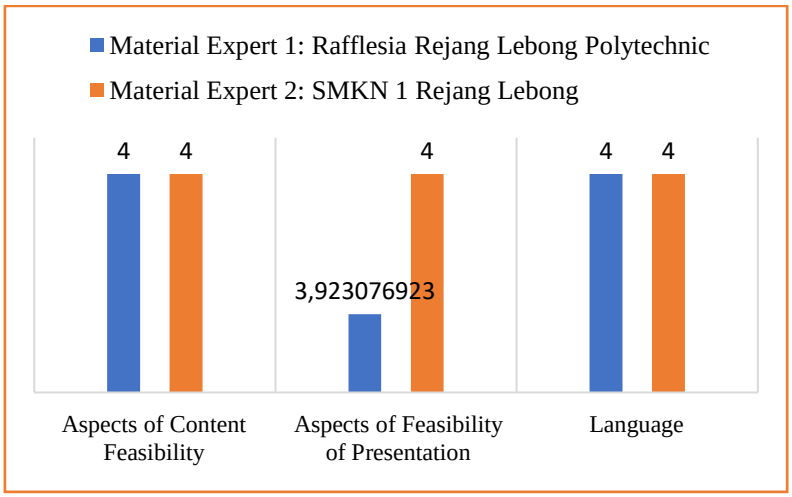

Figure 2. Graphic of Material Expert Validation Results

4. Implementation

At this stage, the results of the revised Electrical Control Techniques Simulator-based learning media which has been in limited scale field trials are implemented in wide scale field trials. Determining the experimental class for the control class in large-scale field trials is carried out by determining class TITL 1 as the experimental class and class TITL 2 as the control class.

From the results of the t test analysis, the results show sig (2-tailed) = 0.920. If the sig(2-tailed) value is greater than > 0.05, it means that there is no significant difference between the experimental class and the control class. Furthermore, it can be said that there is no difference in learning electrical power installation subjects using Electrical Control Techniques Simulator-based learning media compared to not using Electrical Control Techniques Simulator-based learning media before the treatment was carried out. The following is a table of t test results after the experimental class was given the following treatment:

Table 1. Table of Posttest t Test Analysis Results for Experimental Class and Wide Scale Control Class.

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Postest	Equal variances assumed	8.315	.006	-6.859	58	.000	-20.16667	2.94018	-26.05207	-14.28126
	Equal variances not assumed			-6.859	46.956	.000	-20.16667	2.94018	-26.08169	-14.25165

From the results of the t test analysis, the results show sig (2-tailed) = 0.000. If the sig(2-tailed) value is less than <0.05, it means that there is no significant difference between the experimental class and the control class. Furthermore, it can be said that learning electrical power installation subjects using the Electrical Control Techniques Simulator-based learning media compared to those not using the Electrical Control Techniques Simulator-based learning media after the treatment was carried out resulted in significant differences.

The Electrical Control Techniques Simulator-based learning media has been implemented in classroom learning at the wide-scale trial stage, so students are asked to fill in student response sheets regarding the quality of the Electrical Control Techniques Simulator-based learning media to determine the suitability of the media that has been developed by researchers. The results of the feasibility assessment by 30 students

in the large-scale experimental class can be seen in more detail in the attachment. The assessment sheet for the feasibility of Electrical Control Techniques Simulator based learning media by students includes 15 indicators.

Based on the results of the media suitability assessment by 30 students in table 4; Data obtained shows that the total score is 53.04 and the average score is 3.54 for the assessment of the feasibility statement for Electrical Control Techniques Simulator-based learning media which, if converted into a percentage, is 88.50 or within the range of assessment criteria that have been determined to be in the very high criteria. Good.

5. Evaluation

From the results of the development of Electrical Control Techniques Simulator-based learning media using the ADDIE development model, it can be concluded that the development of the Electrical Control Techniques Simulator-based learning media that was developed is suitable as a learning medium and is effective in improving the learning achievement of class XI students at Rejang Lebong State Vocational School, Department of Power Installation Engineering. Electricity.

Electrical Control Techniques Simulator-based learning media is an alternative learning media that has unique characteristics, namely that it can be used anywhere and at any time, supported by interesting features, so that students can learn indirectly, namely actively interacting using media or learning resources. other. This can make it easier for teachers and students, where teachers can give assignments through the questions in the feature, then the answers and results will automatically appear without being assessed manually. This activity simplifies the learning process and trains students to recognize new technology and the knowledge gained to improve learning achievement.

With the developed Electrical Control Techniques Simulator-based learning media, students can learn independently, anywhere and at any time. Then in each material online questions and assignment collection are also provided, making it easier for students to take test questions and submit assignments, so teachers can see to what extent the learning has been successfully implemented.

The use of Electrical Control Techniques Simulator-based learning media at Rejang Lebong State Vocational School is used to help teachers and students learn anywhere and anytime. This Electrical Control Techniques Simulator-based learning media helps students access material, questions and even exams according to the time set by the teacher. Electrical Control Techniques Simulator-based learning media helps teachers in opening up broad communication opportunities for students so that students can more easily understand how circuits work and are able to apply them in real circuits. Apart from that, the Electrical Control Techniques Simulator-based learning media also has many interesting features and functions for students to utilize, it is also supported by various forms of media such as video, audio and images which can attract students' interest so that they can improve learning achievement, especially in power installation subjects. electricity.

Based on the research results that have been presented, it can be concluded that the Electrical Control Techniques Simulator-based learning media that was developed is effective in improving student learning achievement because the learning media makes it easier for students to understand the learning material for electrical power installations, especially at Rejang Lebong State Vocational School class XI majoring in Electrical Power Installation Engineering.

This research has limitations, namely:

1. Making video tutorials about the material displayed in the Electrical Control Techniques Simulator-based learning media is still very simple due to the limitations of researchers.
2. Internet is needed when accessing, it cannot be accessed offline, resources because media development requires sufficient resources such as time, energy and funds. These resource limitations affect the quality and completeness of the modules developed.

Although there are limitations, the results of the research can also have implications for several things, namely:

1. Learning Media based on *Electrical Control Techniques Simulator* can help students to be more interested and motivated to learn, because the media is relevant to the form of a circuit which can actually help students more easily understand how the principles of circuits work. This can increase students' interest and motivation in learning, so that they are more enthusiastic about participating in learning and studying more seriously.

2. Learning Media based on *Electrical Control Techniques Simulator* can help teachers to prepare learning materials that are more relevant to students' learning needs. This can improve the quality of learning, so that students can understand the material better. The media developed is based *Electrical Control Techniques Simulator* will help students to understand better. This will enable students to better understand the working principles of circuits according to the character of the components and instruments of equipment that will be used to operate electrical circuits.
3. Learning Electrical Power Installation using developed media based *Electrical Control Techniques Simulator* effective in improving student learning achievement, because by using media it is easier for students to understand the learning material, so it is hoped that students can use media-based learning *Electrical Control Techniques Simulator* well.

There are several suggestions for research on the development of media-based learning *Electrical Control Techniques Simulator* local, namely:

1. Teacher

a) Every teacher should always innovate in developing teaching materials to improve student achievement by using various and more accurate reference sources.
b) Teachers must be able to develop media to improve student learning achievement.
c) Teachers must be able to implement learning using media because media is considered effective in improving student learning achievement.

2. Students

a) Students can use this module to learn independently by reviewing the material presented in media-based learning *Electrical Control Techniques Simulator* so that learning achievement increases. Suggestions from research.
b) Students can use media in the teaching and learning process because effective media can improve learning achievement.
c) Students should be motivated to always be active in participating in class learning and making use of the teaching materials that have been provided.

3. Education Unit Manager

a) Managers need to propose providing learning support facilities in the form of media, because media can improve student learning achievement.
b) Managers also need to support teachers to take part in media development training, because media is considered to be able to improve learning achievement.
c) Managers should always support learning teachers to develop media, because media is effectively used to improve learning achievement.

D. Conclusion

The Electrical Control Techniques Simulator-based learning media developed is suitable for improving learning achievement based on the validation results of media experts and material experts so that it is in the very feasible/SL criteria. The effectiveness of the developed Electrical Control Techniques Simulator-based learning media can improve the learning achievement of class XI students majoring in Electrical Power Installation Engineering. This can be seen from the results of limited and wide scale field trials. It can be seen that there is a difference between the experimental class which uses Electrical Control Techniques Simulator based learning media and the control class which does not use Electrical Control Techniques Simulator based learning media. So, the conclusion from this research can be concluded that Electrical Control Techniques Simulator-based learning media can improve learning achievement.

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