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Video based e-module development by using smartphone for programmable logic controllers practical learning in vocational high school

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Abstract. The purposes of this research are: (1) Develop an interactive e-module that contain videos by using smartphone; and (2) to find out the feasibility of the results of the development of an interactive video e-module by using smartphone for PLC practical learning in Vocational High School. Type of research conducted through is research and development referring to ADDIE development model according to Robert Maribe Branch. Research steps conducted are: Analyze, Design, Develop, Implement, and Evaluate. Instruments used are questionnaire and observation sheet. Data collected is analyzed descriptively. Research result indicates: (1) An interactive video e-module by using smartphone for PLC practical learning in Vocational High School has been produced, which installed in smartphone with the name of Basic PLC Module application; and (2) Video Based Interactive E-module by using smartphone has the value of 80,75% which means it can be considered feasible to be used in PLC practical learning in Vocational High School.

1. Introduction

Today science and technology development that applied in industrial world is highly advanced. A notable example in science and technology in electrical engineering that applied in industry is Programmable Logic Controller (PLC). PLC used in industry from time to time is more advanced and sophisticated, which serve as brain to control various tool or machinery in industry. PLC application example in industry is: PLC usage as lift controller in building; conveyor belt control system; potable water bottle filling; car chassis welding and pressing; industry product sorting controller; etc.

Based on PLC usage advancement as machines control in industry as mentioned above, Vocational High School especially on Competence of Expertise in Installation of Electricity Utilization, which is an educational institution graduate producer for industry workforce, must teach the students PLC competence. PLC competency for student is very important, so after graduation student is proficient in PLC, and capable to handle works relevant to PLC technology in industry [1,2,3].

Based on study conducted in Vocational High School 1 Sedayu, Bantul, Vocational High School 2 Pengasih, Kulon Progo, and Vocational High School 2 Wonosari, Gunung Kidul, in implementing 2013 curriculum for Competence of Expertise in Installation of Electricity Utilization, obtained data PLC competency that taught for grade XII in the 5th in the form of PLC practical learning of electrical motor installation subject. In PLC practical learning of electrical motor installation subject, it is found that student PLC competency in all of 3 Vocational High School is considered low. It is indicated by student report data in all of 3 Vocational High School on academic year of 2015/2016, 2016/2017, and 2017/2018 on average student that attain PLC competency score above 70 is still under 60%.



During preliminary study obtained data on all 3 Vocational High School, PLC practical learning done by using practical tool such as industry grade trainer kit which are: Omron, Zelio, Festo and Siemens, small with average size 35 cm x 25 cm x 15 cm, approximately as big as a tote bag. The usage of small PLC trainer kit for practical learning has proven that the trainer kit is not ergonomic. All PLC practical learning conducted in a group of students summed 3-4 person each group with a PLC trainer kit, practical learning done through this method deem not effective. It is shown by the facts that (1) only 1 or 2 student in front of trainer kit and capable to perform a good practical learning, the rest seems only watch their peers; (2) between students can be seen fighting over trainer kit; (3) passive student can be seen because students do not have the chance to use trainer kit; (4) practical learning atmosphere is uncomfortable (5) often student with high ego use PLC trainer kit selfishly, etc. It seems industry grade trainer kit only feasible for individual practical learning, not suitable for group practical learning. Due to limitation of PLC trainer kit and funding of Vocational High School to procure one, so PLC practical learning must be conducted in a group.

Moreover, to use PLC trainer kit during learning process is supported by printed material in the form of job sheet. According to interview done with the teachers, the job sheet is used since a long time ago without any meaningful change. This matter of course causing student less interested, not motivated, and easily bored. Even though today and upcoming future, job sheet is very open to innovates, for example in the form of electronic module or interactive e-module which loaded with video through smartphone. Today almost every single student has a smartphone in his/her possession, because the price is getting cheaper and internet network also getting wider and better. Smartphone in student possession also can be utilized to support PLC practical learning. Moreover, a part of PLC is programming, that could have installed in computer and laptop and can be used in independent learning especially simulation menu.

According to description above it is necessary to conduct a research on development of PLC trainer kit that ergonomic with the support of interactive e-module loaded with video by using smartphone in Vocational High School. The research boundary is video loaded e-module by using smartphone which is a module that created in the form of interactive e-learning especially on question based test, and loaded with trainer kit tutorial video with smartphone for android. Research product produced will be used for PLC practical learning in Vocational High School, on Competence of Expertise in Installation of Electricity Utilization.

The purpose of this research is to produce an interactive e-module loaded with video by using smartphone to support the usage of PLC trainer kit in PLC practical learning for Vocational High School. Another purpose is to find out the feasibility level of interactive e-module development loaded with video by using smartphone to support PLC trainer kit usage in PLC practical learning in Vocational High School. Interactive e-module is a teaching material in the form of electronic module or e-learning that developed interactively.

Smartphone is a type of mobile application based on software use which designed to run on mobile device. Mobile devices use in Indonesia always on the rise every year. On 2013 it is shown that 86,09% of Indonesia citizen has a phone in possession. This percentage is rising every year and there are no sign of decline. This fact is indicating that most of Indonesia citizen has already utilize mobile device. In other hand, especially in mobile application, it seems that smartphone user growth in Indonesia in 2013 has reach 70% compared to previous period. Based on that report, Android is an operating system that dominates smartphone market in Indonesia with market division as high as 59,91%.

2. Method

Research type that used in this research is research and development to produce a product in the form of an interactive e-module loaded with video by using smartphone. Development model refers to

ADDIE development model according to Robert Maribe Branch [2] Steps in this research model are: analyze, design, develop, implement and evaluate.

Technique and instrument in data collecting which used in this research: (1) on study of activity need, data collected by using questionnaire, while instrument used also used in the form of questionnaire; (2) on evaluation activity toward result of study of need, and design result, data collecting technique used is through observation, while instrument used is in the form of observation sheet; and (3) on material expert, media expert, and teacher validation toward development product, data collecting technique used is observation, while the instrument used is an observation sheet. On this research, instrument validity determined by using face validity, and content validity through expert judgement. To determine instrument reliability, especially material expert, media expert and student observation sheet Scot reliability is used. Research data collected is analyzed descriptively [3,4,5].

3. Result and Discussions

After carrying out the steps of development research that refers to ADDIE development model according to Robert Maribe Branch, then obtained development product in the form of interactive e-module loaded with video by using smartphone in PLC practical learning in Vocational High School in Competence of Electrical Installation Engineering Skills department. Development result of interactive e-module loaded with video by using smartphone on PLC practical learning in Vocational High School can be seen on smartphone with the application name of Basic PLC Module, which display can be seen on Figure 1. Testing toward work method for interactive e module loaded with video by using smartphone product in PLC practical learning in Vocational High School, done by black box testing test. Black box testing meant to test the system whether it is functional as planned. In black box testing function tests are carried out for each block of whole PLC module for smartphone application. Black box testing result is shown in full on Table 1.

To obtain feasibility level on product use of interactive e-module loaded with video by using smartphone in PLC practical learning in Vocational High School, so the product application is validated by material expert, media expert, and student. Validation activity toward product application is done by 2 material experts, 2 media experts, and 3 students which result is briefly presented in Table 2.

This developing product is in a form of interactive e-module video loaded with smartphone in PLC practical learning in Vocational High School can be seen on Smartphone with the name of Basic PLC Module. Black box testing result on interactive e-module product loaded with video by using smartphone in practical learning in vocational high school shown that 19 item of case study is perfectly successful. This means that 100% of application is functioning in PLC e-module like planned [6,7,8].

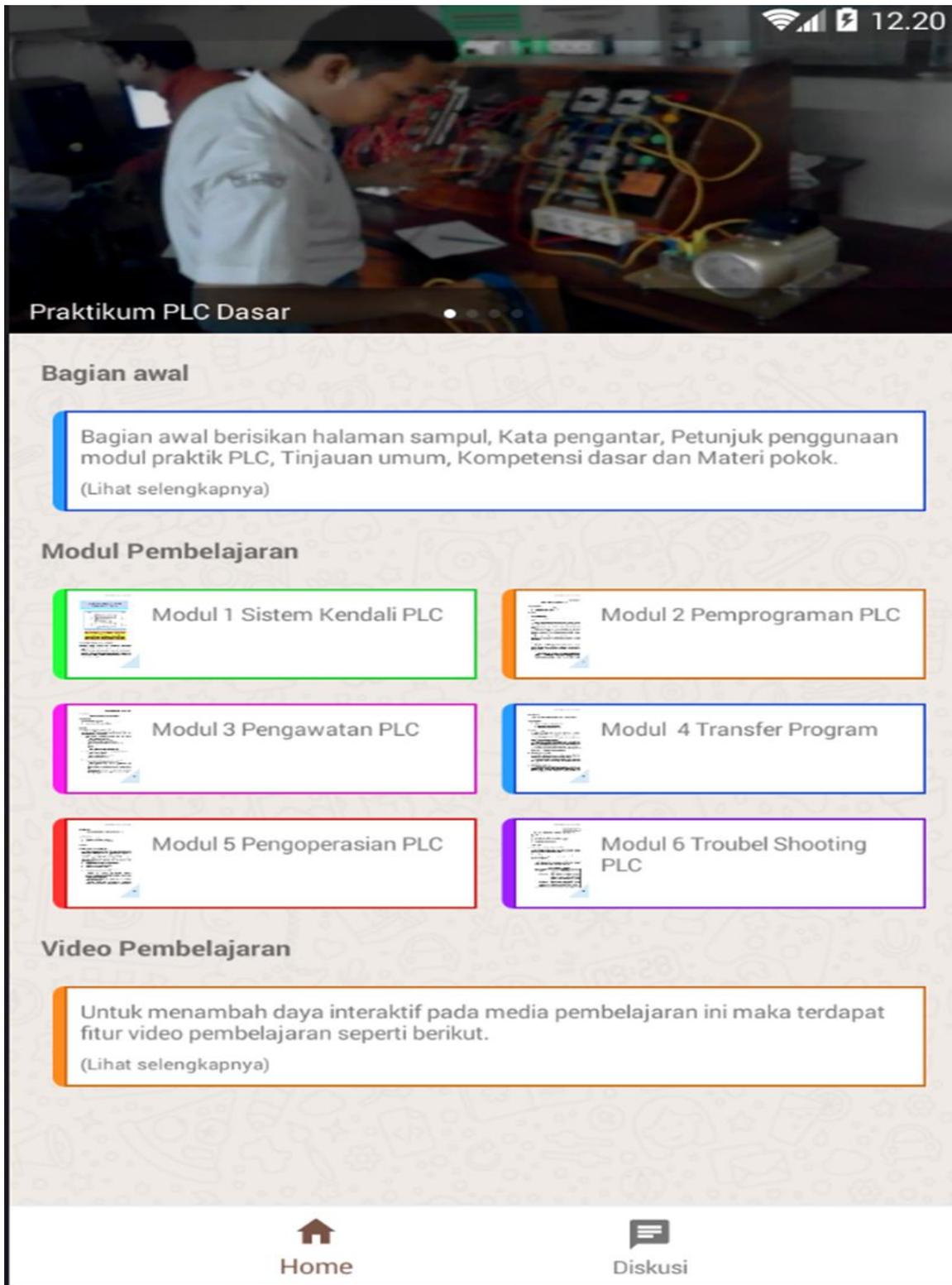


Figure 1. Display of basic e-module PLC application products on smartphones

Table 1. Black box test result on interactive e-module loaded with video by using smartphone in PLC practical learning in Vocational High School.

	Case study	Indicator	Result
1.	Install application on android smartphone.	User can install application on their own android smartphone	Succeed
2.	Opening Application	User can open application and get into main menu	Succeed
3.	Access illustrations.	Users can access illustration e-modules.	Succeed
4.	Access the beginning part.	Users can access the initial section consisting of module covers, preface, module usage instructions, module general review, basic competencies and subject matter of the PLC module.	Succeed
5.	Access to Module 1.	Users can access learning module 1 about PLC control systems	Succeed
6.	Work on formative tests 1.	Users can work on formative tests 1 and can find out the scores they achieved.	Succeed
7.	Access to Module 2.	Users can access learning module 2 about PLC programming techniques.	Succeed
8.	Work on formative tests 2.	Users can do formative tests 2 and can find out the scores they achieved.	Succeed
9.	Access to Module 3.	Users can access learning module 3 about PLC installation and wiring.	Succeed
10.	Work on formative tests 3.	Users can do formative tests 3 and can find out the scores they achieved.	Succeed
11.	Access to Module 4.	Users can access learning module 4 about inserting programs into the PLC.	Succeed
12.	Work on formative tests 4.	Users can do formative 4 tests and can find out the score they achieved.	Succeed
13.	Access to Module 4.	Users can access learning module 5 about operating a PLC control system.	Succeed
14.	Work on formative tests 5.	Users can do formative tests 5 and can find out the scores they have achieved.	Succeed
15.	Access to Module 6.	Users can access learning module 6 about tracking PLC control system errors.	Succeed
16.	Work on formative tests 6.	Users can do formative tests 6 and can find out the scores they achieved.	Succeed
17.	Access learning videos.	Users can access available PLC practice learning videos.	Succeed
18.	Asking question.	Users can ask questions through discussion forums. and stored in the database.	Succeed
19.	Exit the application.	Users can exit the application by clicking out of the application.	Succeed

Table 2. A summary of the results of the validation of material experts, media experts, and teachers on interactive e-module products using smartphones at the Practice of PLCs in Vocational Schools.

	Aspect	Material Expert		Media Expert		Student	
		Score (%)	Category	Score (%)	Category	Score (%)	Category
1.	Relevance	87,5	Very Feasible	85	Very Feasible	83,75	Very Feasible
2.	Benefit	82,5	Very Feasible	83,75	Very Feasible	83,13	Very Feasible
3.	Material	83,33	Very Feasible	82,5	Very Feasible	82,29	Very Feasible
4.	Technique	70,83	Feasible	71,87	Feasible	72,5	Feasible
	Overall Aspect	81,04	Feasible	80,78	Feasible	80,42	Feasible

Based on validation result of material expert toward interactive e-module loaded with video by using smartphone in PLC practical learning in Vocational High School validity, yield result of 81,04% which is in feasible category. Validation done by media expert toward feasibility of the product scored 80.78% which is in feasible category also. The same goes for validation done by student toward product validity, obtained score of 80,42% which is also in feasible category. Based on validation result of material expert, media expert and student toward interactive e-module loaded with video by using smartphone in PLC practical learning in Vocational High School above, the mean of validity scored 80,75% which is in feasible category. With that it can be said that interactive e-module product loaded with video by using smartphone in PLC practical learning in Vocational High School fulfill feasible category to be applied in PLC practical learning in Vocational High School Competence of Expertise in Installation of Electricity Utilization.

4. Conclusion

Interactive e-module loaded with video by using smartphone for PLC practical learning in Vocational High School is produced, which is installed in smartphone with the name of Basic PLC Module. Interactive e-module loaded with video by using smartphone scored 80,75% which is in feasible category to be used in PLC practical learning in Vocational High School.

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