

Utilization of Outseal PLC Microcontroller Trainer Learning Media Assisted by Mobile Applications

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ABSTRACT

The use of trainer media requires a fairly high cost. this gives a burden to students if it is required to be owned. We propose a solution by using mobile learning media as a place for students to learn the outseal Programmable Logic Controller (PLC) microcontroller trainer. Therefore, the purpose of this study is to examine the practicality, and effectiveness of the learning media for the PLC outseal microcontroller trainer assisted by mobile applications. This research was conducted on Microprocessor Microcontroller learning in Industrial Electronics Engineering department of SMK Negeri 3 Batam, Indonesia. This research was conducted using a one group pretest posttest design with quantitative and primary data types. Data was obtained using questionnaires and test instruments which were then calculated using percentages for the practicality test and Gain Score for the effectiveness test. The results of this study obtained the results that the Outseal PLC Microcontroller Trainer media is very practical with a percentage of 92.27% by teachers and 90.35% by students. The effectiveness of using this media has an impact on increasing 71% for cognitive, 72% for affective, and 78% for psychomotor students. This concludes that the learning media developed is ready to be used on a wider scale. In addition, the use of this media provides effectiveness in learning at a low cost and easily.

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1. INTRODUCTION

Vocational High Schools are formal educational institutions that aim to produce graduates who are ready to work. In supporting the achievement of graduates who are ready to work, the portion of the learning process in vocational schools focuses more on practical learning, [1]. Practicums are carried out to shape students' potential into competencies that are in line with industry needs, [2].

SMK Negeri 3 Batam is one of the vocational schools located in an industrial area in Batam city, Indonesia. The industrial area within SMK Negeri 3 Batam is more focused on the electronics industry. For this reason, SMK Negeri 3 took this opportunity to open an Industrial Electronics Engineering (TEI) skills study program. Learning in the TEI study program acquires needs in industry.

For example, implementing Microprocessor Microcontroller learning in the TEI study program. The Microprocessor Microcontroller subject teaches students about electronic circuits in various complex control functions [3]. This is so that this learning can be a provision for students to become skilled experts in the field of control and automation of electronic systems [4]. However, in implementing this learning there are several obstacles.

The data that researchers obtained in the field, in the Microprocessor Microcontroller subject, was very few students who completed each semester. The assignments given by the microprocessor microcontroller subject teacher cannot be carried out by students well. They complained about the difficulty of understanding ports and programming languages in microcontrollers. This greatly influences the low learning outcomes in the Microprocessor Microcontroller subject which are presented in Table 1.

Table 1. Data on graduates of microprocessor microcontroller subjects

No	Semester/TA	Number of Students	Number of Completed Students	Completion Percentage
1	Odd/ 2019 - 2020	40	20	50
2	Even/ 2019 - 2020	39	16	41
3	Odd/ 2020 – 2021	40	18	45
4	Even/ 2020 - 2021	40	17	43

Based on table 1, information is obtained that the minimum completeness achieved by students in the Microprocessor Microcontroller subject is still very low and tends to decrease. Every semester in the Microprocessor Microcontroller subject, only around 50% of students complete it and this decreases every year. This of course requires students who have not completed remedials to be able to have a minimum passing score as a condition for being able to do an internship to the industry in the following semester [5], [6].

Examining this problem, a solution is needed. The solution is to use mobile learning media. Mobile learning media allows students to learn anywhere and at any time [7], [8].

On the other hand, the use of mobile learning media will reduce costs used for learning [9]. This is because using the Microprocessor Microcontroller trainer learning media directly will require quite expensive costs [10].

Apart from that, the use of mobile learning media has the advantage that it can be repeated at any time [11]. This repetition will enable students to prepare initial knowledge well before learning begins [12], [13]. For this reason, we developed a learning media for learning Outseal Programmable Logic Controller (PLC) Microcontrollers along with the use of this learning trainer. The description of the application being developed is in Figure 1.

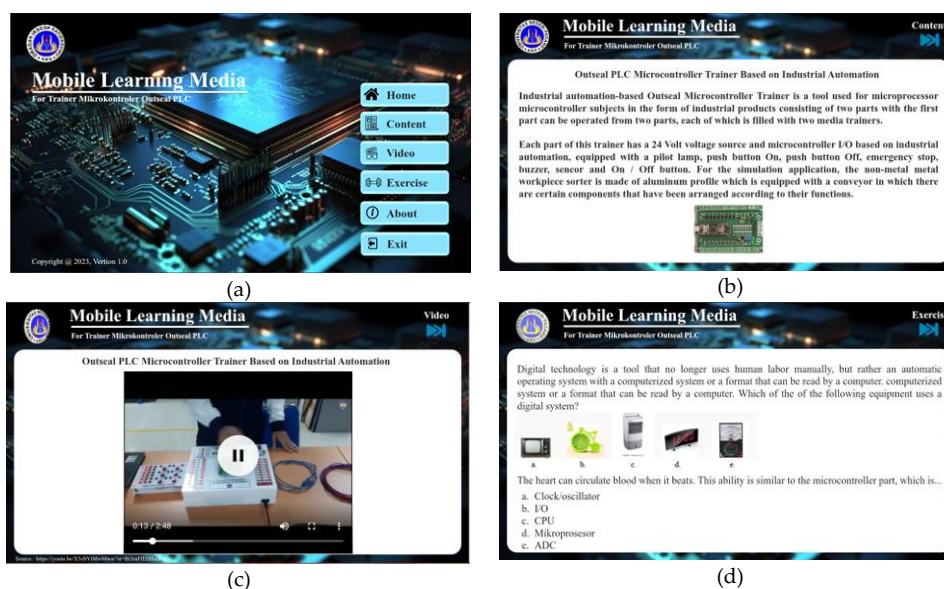


Figure 1 . Outseal PLC Microcontroller Trainer Mobile Application, (a) home page; (b) material page; (c) video page; (d) practice page

Figure 1 shows the mobile application for learning the Outseal PLC Microcontroller Trainer. This application has components in the form of teaching materials, learning videos and learning exercises. This application can be used on mobile devices such as smartphones with the Android operating system. Where this application can be downloaded at the address <https://bit.ly/MobilePLC>.

The Outseal PLC Microcontroller Trainer learning media is expected to increase students' interest, skills and competence in learning, overcome limited facilities and infrastructure during practicums, facilitate students' understanding of the material being taught and introduce practical equipment based on industrial automation, [7]. For this reason, the aim of this research is to test the practicality and effectiveness of the outseal PLC microcontroller trainer learning media assisted by mobile applications.

2. RESEARCH METHOD

This research was carried out in Microprocessor Microcontroller learning in the Industrial Electronics Engineering department of SMK Negeri 3 Batam, Indonesia. This research was conducted using a one group pretest posttest design. The one group pretest posttest design is presented in Table 2.

Table 2. One Group Pretest Posttest Design

<i>Pretest</i>	<i>Treatment</i>	<i>Posttest</i>
T1	X	T2

Source : Sugiyono [14]

T1: Initial test (pretest) before treatment is given

T2: Final test (posttest) after the treatment is carried out

X: Treatment of learning groups that use tools

Based on table 2, the pretest is given first. After the pretest was given, treatment was given in the form of using the Outseal PLC microcontroller trainer learning media with the help of a mobile application. After being given treatment, a posttest was carried out. This research data uses quantitative and primary data.

Data was obtained using questionnaires and test instruments. The data obtained will be calculated for the media practicality test. In the media practicality test, the percentage of respondents is used. The formula for this calculation is as follows.

$$NA = \frac{S}{M} \times 100\% \dots\dots\dots (1)$$

Information:

NA = Final score

S = Score obtained

SM = Highest score

Data was obtained from teacher and student respondents. The data obtained and calculated are then grouped based on the level of practicality. The level of practicality is presented in Table 3.

Table 3. Categories of Practicality of Learning Media

No	Achievement Rate (%)	Category
1	86 – 100	Very Practical
2	76 – 85	Practical
3	60 – 75	Quite Practical
4	55 – 59	Less Practical
5	0 – 54	Impractical

Source : Purwanto [16] .

For media effectiveness, the Gain Score formula is used. The formula for this calculation is as follows.

$$N\text{ Gain} = \frac{\text{Skor Posttest} - \text{Skor Pretest}}{\text{Skor Ideal} - \text{Skor Pretest}} \dots\dots\dots (2)$$

Information :

- N Gain = Gain Value
- Post-test Score = Value after being given treatment
- Pre-test Score = Value before being given treatment
- Ideal Score = Minimum completeness value

In determining or knowing the level of effectiveness of the N-Gain calculation, Hake's N-Gain category guidelines are used. The N-Gain categories are presented in Table 4.

Table 4. N-Gain Category

N-Gain Value	Category
N-Gain > 0.7	Tall
0.3 <= N Gain <= 0.7	Medium
N Gain < 0.3	Low

Source: Hake [17] .

3. RESULTS AND DISCUSSION

3.1. Research result

The outseal PLC microcontroller trainer learning media assisted by mobile applications is used by teachers and students. Teachers and students who have used this media are asked for their responses to the practicality of using the learning media for the outseal PLC microcontroller trainer assisted by mobile applications. The results of this media practicality test are presented in Figure 2.

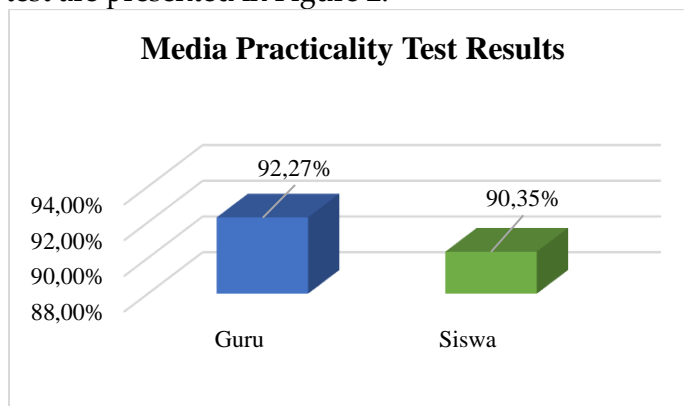


Figure 2. Media Practicality Test Results

Based on Figure 3, information is obtained that the outseal PLC microcontroller media trainer carried out practicality tests on teachers and students. Teachers rated the practicality of this media at 92.27% and students at 90.35%. The practicality value of teachers and students has an average of 91.31% using formula (1). The value of 91.31% has the interpretation that the outseal PLC microcontroller trainer media is very practical. Outseal PLC microcontroller media trainer media testing continues with the effectiveness aspect. The results of the media effectiveness test are presented in Table 5, Table 6, and Table 7.

Table 5. Cognitive Aspect Effectiveness Test Results

Mark	Pretest	Posttest	S Post - S Pre	S Max - S Pre	Gain (G%)
Mean	67.75	89.38	21.63	32.25	0.71
Stdev	10.73	8.21	6.69	10.73	0.20
Max	90.00	100.00	40.00	60.00	1.00
Min	40.00	65.00	10.00	10.00	0.36

Table 6. Affective Aspect Effectiveness Test Results

Mark	Pretest	Posttest	S Post - S Pre	S Max - S Pre	Gain (G%)
Mean	2.49	3.58	1.10	1.51	0.72
Stdev	0.50	0.49	0.61	0.50	0.36
Max	3.00	4.00	2.00	2.00	1.00
Min	2.00	3.00	0.00	1.00	0.00

Table 7. Results of Psychomotor Aspect Effectiveness Test

Mark	Pretest	Posttest	S Post - S Pre	S Max - S Pre	Gain (G%)
Mean	60.75	90.13	29.38	39.25	0.78
Stdev	14.52	8.23	11.37	14.52	0.19
Max	85.00	100.00	45.00	60.00	1.00
Min	40.00	75.00	10.00	15.00	0.40

Based on Table 5, Table 6, and Table 7, information is obtained from each media effectiveness test developed from cognitive, affective and psychomotor aspects. There is a significant increase between the results of the pretest test and the posttest test. These differences produce a significant impact on every aspect of learning. In the cognitive aspect based on the Gain value, the impact of media use reaches 71%, in the affective aspect the impact is 72% and in the psychomotor aspect the impact is 78% using formula (2). These three values provide an interpretation that the use of Outseal PLC microcontroller trainer learning media has a high impact with an average value of 73.67%.

3.2. Research Discussion

Based on the research results obtained, the learning media for the outseal PLC microcontroller trainer assisted by mobile applications is highly accepted by teachers and students. This media is supported by mobility, completeness, and ease of acquisition. The mobile application-assisted PLC outseal microcontroller trainer learning media has good mobility. This is because this media can be used on smartphone devices [18].

The completeness of the outseal PLC microcontroller media trainer is the second aspect that is favored. This media has complete components, starting with chipsets, ICs, resistors, capacitors, LEDs, and of course with the help of mobile applications. This equipment allows students to learn with simulations for all Microprocessor Microcontroller learning material. Simulated learning can represent reality with a complexity of events that can be controlled and can be transferred to the real world, [19, p. 357] .

The use of a microcontroller trainer as a simulator gives students learning tasks to which they can respond, but these responses do not have the same consequences as in real life situations [19] . Furthermore, simulations can also increase students' level of confidence when learning in the laboratory takes place [20] .

Simulation has been proven to improve skills from complex attributes such as problem solving, emotional intelligence, and situational sensitivity through carried out exercises [21] . This is also in line with reality, where the more often you practice, the more skilled and dexterous a person will be. Just like athletes, they will be able to run fast, lift heavy, play fast, and other things that come from intense and consistent training [12].

The ease of obtaining this media is the third priority. This media is very cheap when compared to Programmable Logic Controller (PLC) learning media. Affordable prices enable schools to complete their learning materials and for students to study this trainer using mobile applications outside the laboratory, [22]. This superiority can be seen from the responses of teachers and students who gave the practicality level of this media at 91.31%. The use of outseal PLC microcontroller trainer learning media assisted by mobile applications also has a positive impact on student learning outcomes.

In the cognitive aspect, the use of this media contributes to the achievement of increasing students' knowledge by 71%. This shows that another 29% is influenced by factors outside the application of this media. Likewise with affective which received a score of 72%, which means that the other 28% was influenced by factors other than the application of the outseal PLC microcontroller trainer learning media assisted by mobile applications. Finally, the application of this media had a good impact on the psychomotor aspect with a value of 78%. This means that only 22% of factors outside the application of Outseal PLC microcontroller trainer learning media assisted by mobile applications influence student learning outcomes [23] . For the use of outseal PLC microcontroller trainer learning media assisted by mobile applications, it is recommended in learning Microprocessor Microcontrollers.

4. CONCLUSION

Outseal PLC microcontroller trainer learning media assisted by mobile applications was successfully applied and used well by teachers and students. The use of this media obtained a practicality level of 91.31% with an effectiveness of 73.67%. The learning media for the outseal PLC microcontroller trainer assisted by mobile applications is able to

facilitate student learning with good mobility, completeness of media materials, and easy to obtain. For this reason, this media is recommended to be used in Microprocessor Microcontroller learning to increase the effectiveness of the learning process.

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