Advances in Social Science, Education and Humanities Research, volume 654
Proceedings of the 1st World Conference on Social and Humanities Research (W-SHARE 2021)

Improving Learning Outcomes Embedded System (ES) Using Learning Media Based IoT at Polytechnic

Nurhayati Nurhayati[1,*], Husain Syam[2], Muhammad Yahya[2]

[1]*Student of Graduated School of Vocational Education and Technical, Makassar State University, Makassar, Indonesia*
[2]*Faculty of Engineering, Makassar State University, Makassar, Indonesia*
[*]*Corresponding author. Email: nurhayati_tmj@pnup.ac.id*

ABSTRACT
Internet-based learning media is one of the learning resources that students can use as a substitute for textbooks. This study aimed to determine the impact of using learning media-based IoT on improving learning outcomes of the Embedded System (ES). This research uses an experimental method at the Ujung Pandang State Polytechnic. The research population is all the Electrical Engineering students who studied the Embedded System (ES). The research sample involved 35 students. Collection of learning outcomes data through learning outcomes test questions at the pre-test and post-test. Collection of learning outcomes data through learning outcomes test questions at the pre-test and post-test. Research results obtained (1) Application of learning media-based IoT in Embedded System learning in polytechnics is effectively used to improve student learning outcomes in Embedded System learning. This is based on the results of the average student score on the post-test of 83.21; (2) The tendency of Embedded System (ES) learning outcomes in the experimental class are at a high tendency with a percentage of 42.86%; and (3) Improving student learning outcomes using IoT-based learning media in Embedded System (ES) learning obtained an n-gain score of 0.54 with a medium increase in the category.

Keywords: *Learning Media, Internet of Things (IoT), Embedded System (ES)*

1. INTRODUCTION

The existence of technology provides convenience in human work. With technology, previously human work was done for a long time and required much energy, now work or activities are faster and can save energy and be completed more efficiently. One technological advance in electronics can be equipment that can help work according to our needs [1].

In the lighting sector, lighting has progressed since the invention of incandescent lamps by Thomas Alfa Edison, TL, SL lamps, and now LED and OLED lamps. Economically, the price of LED lamps is still high but has excellent prospects, considering that LED lamps have advantages over other types of lamps. LED is a semiconductor that can convert more electrical energy into light, are hardware and solid (solid-state component), so that it is superior in durability (durability). So far, LEDs are widely used in electronic devices because of their small size, practical installation method, and low electricity consumption. One of the advantages of LEDs is their relatively long life, which is more than 30,000 hours. The disadvantage is that the price per lumen (unit of light) is higher than incandescent, TL, and SL types, easily damaged if operated at an environmental temperature that is too high, for example, in the industry [2].

The internet as allowance of technological expansions that are growing fleetly in people's lives moment has been suitable to be used as a medium of communication and control of affection ever if they are quietly chained to each other. Internet of Things (IoT) is a growth of network communication of interrelated objects, connected to each different through internet messages and to change data that can also turn into facts [3].

Along with the expansion of internet structure, it is not precisely smartphones and computers that can be chained to the internet. However, colorful kinds of natural objects will be connected to the internet. For illustration, it can be an electronic outfit used by humans, including any natural objects joined to regional and global networks through embedded sensors and are continually functional [4].

With these advances, innovation has emerged where technological devices can be controlled remotely via the internet to be more efficient and save time. Learning is an information delivery activity created to facilitate specific goals. Learning media has an important position as a

component of the environment arranged for a learning activity.

Learning media is one of the essential basics in the education and knowledge process and education approaches. Overall, learning media refers to everything used to convey communications from the sender of the communication to the philanthropist of the communication that can increase or develop the midair of thinking, passion, and getting students' interest [5]. Learning media conveys information from the teacher or teacher to students or students in the teaching and learning process. In order to convey learning materials well, the learning media should have specific characteristics [6].

Based on this background, this study will describe the effectiveness of using Internet of Things (IoT)-based LED learning media for Embedded System (ES) learning at Polytechnics. The advantages of this research are: (1) the effectiveness of the learning media used; and (2) the Utilization of IoT in learning.

2. METHOD

The type of research is experimental research which aims to know the effectiveness of the education media applied. This research was conducted by giving treatment to the problem's exploration subject.

2.1. Time and Location

This research took place for three months, from May to July 2021. This research was carried out at the Ujung Pandang State Polytechnic. The test subjects involved in this study were lecturers and students from the Department of Electrical Engineering in Embedded Systems (ES) learning.

2.2. Research Design

Design The experimental design used The Pretest Post Test Control Design Group design; namely, two classes were observed in this study, the experimental and control classes.

Table 1. Research Design

Group	Pre-test	Treatment	Posttest
Experiment	O_1	X	O_2

Description:
O_1 : Pretest Experiment Class
O_2 : Posttest Experiment Class
X: Treatment

2.3. Population and Sample

The population of this research was all students of the Department of Electrical Engineering, State Polytechnic of Ujung Pandang, who programmed the Embedded System subject. The research sample consisted of 35 students in the experimental class.

3. RESULT AND DISCUSSION

3.1. Student Learning Result

Outcomes learning outcomes in the experimental class and control class are described as follows.

3.1.1. Pretest Results of Students in the Experimental Class

The results of the pre-test of students in the experimental class can be seen in Table 2 as follows:

Table 2. Statistics of Pre-test in the Experimental Class

Description	Statistic
Sample	35.00
Means	68.65
Median	65.50
Std. Deviation	9.00
Variance	81.00
Range	36.00
Min.	53.00
Max.	89.00

Based on the results of descriptive analysis of pre-test data in the experimental class, a mean value of 83.21 existed acquired. The minimal score acquired is 68.65, and the maximum score is 89.00. While the median value acquired is 65.50. Additionally, the education issues test data are categorized into four grades to determine learning issues.

Table 3. Frequency Distribution of Pretest Result

Category	Interval	Freq.	%
Very High	77.66 – Up	4	11.43
High	68.66 – 77.65	9	25.71
Medium	59.66 – 68.65	17	48.57
Low	Down – 59.65	5	14.29

Based on Table 3, the conclusions of the pre-test students in the experimental class exposed that in the very high category, there were four students with a percentage of 11.43. In the high category, there are nine students with 25.71. In the medium category, there are 17 students with 48.57. While the low category, there are five students with a percentage of 14.29. Therefore, student learning issues in the experimental class are in the medium category.

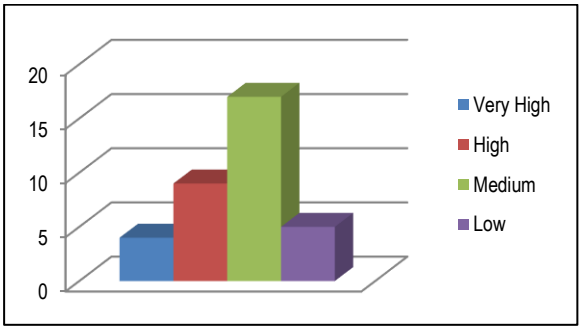

Figure 1. Pre-test Result

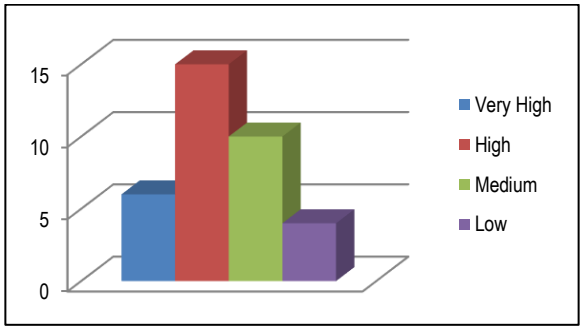

Figure 2. Post-test Result

3.1.2. Posttest Results of Students in the Experimental Class

The post-test result in the experiment class can be seen in Table 4 as follows:

Table 4. Statistics of Posttest in the Experimental Class

Description	Statistic
Sample	35.00
Means	83.21
Median	83.93
Std. Deviation	5.78
Variance	33.42
Range	25.00
Min.	67.86
Max.	92.86

Based on the descriptive analysis of knowledge test data in the experimental class, the average value was 83.21. The minimum score obtained is 67.86, and the maximum score is 92.86. While the median value obtained is 83.93. Furthermore, to determine the percentage of learning outcomes, the learning outcomes test data are grouped into four categories as follows.

Table 5. Frequency Distribution of Posttest Result

Category	Interval	Freq.	%
Very High	88.99 - Up	6	17.14
High	83.21 – 88.99	15	42.86
Medium	77.43 – 83.20	10	28.57
Low	Down – 77.42	4	11.43

Based on Table 5, the post-test results of students in the experimental class displayed six students in the very high category with a percentage of 17.14. In the high category, there are 15 students with a percentage of 42.86. In the medium category, there are ten students with a percentage of 28.57. While the low category, there are four students with a percentage of 11.43. Therefore, the tendency of the post-test conclusions of students in the experimental class is in the high category.

3.2. Test of Normality

The normality test used in this study is the Kolmogorov Smirnov calculation method with the criteria if the significance value (sig. > 0.05), then the data is declared normally distributed. However, if the significance value (sig. < 0.05), then the data is declared not generally distributed with the hypothesis:

- H0: the data comes from a normally distributed population;
- H1: the data do not come from a normally distributed population.

Table 6. Test of Normality

Data	Kolmogorov-Smirnov Z	Sig.
Pre-test	1.69	0.18
Post-test	1.55	0.12

Based on the results of the analysis of the normality test using the SPSS Version 22 program in Table 6, the significance value for the pre-test is sig = 0.18 > 0.05 while the results of the Posttest normality test obtained the value of sig = 0.12 > 0.05. These two values were tested using the Kolmogorov-Smirnov Z test. Based on the results of these tests, it can be concluded that the data in the experimental class are normally distributed.

3.3. Test of Homogeneity

The homogeneity test data analysis results can be seen in Table 7.

Table 7. Test of Normality

Levene Statistic	df1	df2	Sig.
3.781	3	136	.412

Based on the homogeneity test results in Table 4.47, it is known that the significance value (Sig. 2-tailed) is 0.412 > 0.05. From the homogeneity test results, it is known that the significance value is more significant than 0.05, so it can be concluded that the variance of student learning outcomes test scores in 4 cells is the same or homogenous.

3.4. Analysis of Improved Learning Outcomes

Analysis of improving learning outcomes using n-gain score analysis was carried out to prove the effectiveness of IoT-based learning media products more effectively than products used so far—analysis of n-gain score based on learning outcomes in the experimental class. Furthermore, the acquisition of the n-gain score was analyzed and interpreted into the n-gain score categorization table as follows.

Table 8. N-Gain Score Category

***N-Gain* Value**			**Description**
0.70 ≤	g	≤ 1.00	High
0.30 ≤	g	≤ 0.70	Medium
0.00 <	g	≤ 0.30	Low
	g	= 0	Does not Happen Improved
-1 ≤	g	< 0	The decrease occurred

Analysis result *N-gain score* can be seen in Table 9 below.

Table 9. The results of the analysis for the *N-Gain Score*

Class	**Mean Pre-test**	**Mean Post-test**	**N-Gain**
Experiment	68.65	83.21	0.54

The analysis *n-gain score* in the experimental class 1 obtained the value *pre-test mean* of 63.41, the value *post-mean* test of 83.21 and an *N-gain score* of 0.54. Based on the acquisition of the *N-gain score* in the experimental class, it can be concluded that there was an increase in learning outcomes in the medium category.

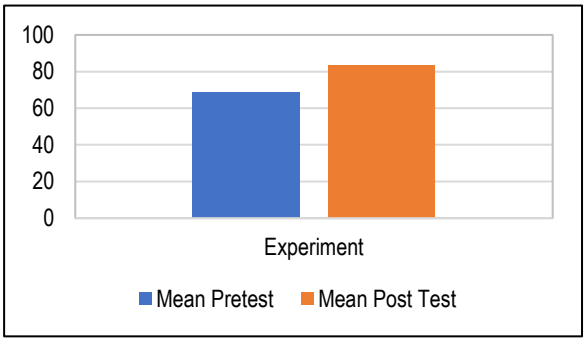

Figure 3. Comparison of Student Learning Outcomes

4. CONCLUSION

The internet application allows the operation of independence, acceleration, enrichment, addition, conclusiveness, and productivity in accomplishing the education process and can positively influence [7]. Learning that utilizes media internet-based learning as a source of learning can create learning activities that become interesting with the interaction between students and teachers and interactions between students. As is interaction in learning, student activities will make group discussions, and group cooperation goes well because each student has teaching materials that can be used as a learning resource [8].

Based on the results of research and discussion, here are some conclusions regarding the research results, including (1) Application of learning media-based IoT in Embedded System learning in polytechnics is effectively used because it can improve student outcomes in Embedded System learning. This is based on the results of the average student score on the post-test of 83.21; (2) The tendency of Embedded System (ES) learning outcomes in the experimental class are at a high tendency with a percentage of 42.86%; and (3) Improving student learning outcomes using IoT-based learning media in Embedded System (ES) learning obtained an n-gain score of 0.54 with a medium increase in the category.

REFERENCES

[1] A. Faroqi, M. S. WS, and R. Nugraha, "Perancangan Sistem Kontrol Otomatis Lampu Menggunakan Metode Pengenalan Suara Berbasis Arduino," *TELKA - Telekomun. Elektron. Komputasi dan Kontrol*, vol. 2, no. 2, pp. 106–117, 2016, doi: 10.15575/telka.v2i2.31.

[2] D. Suhardi, "Prototipe Controller Lampu Penerangan LED (Light Emitting Diode) Independent Bertenaga Surya Prototype Lamp Lighting Controller LED (Light Emitting Diode) Independent Solar Jika kita Perhatikan Cadangan Energi Dari Bahan Minyak Bumi di Indonesia," *Jurna GAMMA*, vol. 10, no. September, pp. 116–122, 2014.

[3] B. Artono and R. G. Putra, "Penerapan Internet Of Things (IoT) Untuk Kontrol Lampu Menggunakan Arduino Berbasis Web," *J. Teknol. Inf. dan Terap.*, vol. 5, no. 1, pp. 9–16, 2019, doi: 10.25047/jtit.v5i1.73.

[4] A. Kusumaningrum, A. Pujiastuti, and M. Zeny, "Pemanfaatan Internet of Things Pada Kendali Lampu," *Compiler*, vol. 6, no. 1, pp. 53–59, 2017, doi: 10.28989/compiler.v6i1.201.

[5] N. Hasanah, "Pengembangan Trainer Internet Of Things Sebagai Media Pembelajaran Pada Mata Kuliah Internet Of Things," *Elinvo*, vol. 3, no. 2, pp. 19–29, 2018.

[6] Dwiyono, "Pengembangan Game Edukasi Sebagai Media Pembelajaran Interaktif Pada Kompetensi Dasar Mendeskripsikan Penggunaan Peralatan Tangan (Hand Tools) Dan Peralatan Bertenaga (Power Tools),"

Progr. Stud. Pendidik. Tek. MEKATRONIKA, vol. 7, no. 4, pp. 343–351, 2017.

[7] M. Wijaya, "Pengembangan Model Pembelajaran E-Learning Berbasis Web dengan Prinsip E-Pedagogy dalam Meningkatkan Hasil Belajar," *J. Pendidik. Penabur*, vol. 19, no. 2, pp. 20–37, 2012.

[8] T. Hidayat, H. Rahmatan, and K. Khairil, "Pemanfaatan Media Pembelajaran Berbasis Internet pada Konsep Sistem Peredaran Darah Terhadap Hasil Belajar Kognitif Siswa pada SMA Negeri 1 Woyla," *Biot. J. Ilm. Biol. Teknol. dan Kependidikan*, vol. 4, no. 1, p. 1, 2017, doi: 10.22373/biotik.v4i1.1065.