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Development of Digital Electronics Practicum Guidance Module with Logisim Applications

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Abstract

The purpose of this study is to describe the feasibility of the results of the development of the Digital Electronics Practicum Guidance Module with Logisim Applications. Feasibility is seen from the results of the validity, practicality, and effectiveness test of the Digital Electronics Practicum Guidance Module with Logisim Applications. The research subjects were 50 Physics Education Students of Lambung Mangkurat University who took the 2019/2020 Digital Electronics course. The data collection techniques are (1) validity using a validation sheet filled in by the validator; (2) the practicality of using student response questionnaires with indicators of format, quality, clarity, and student interest; (3) effectiveness is seen from the results of student final exams. The results showed that (1) the validity was categorized as good, with a mean score of 3.33; (2) the practicality is in good category, with the mean score of student response is 4.04; (3) the effectiveness of the high category, namely the mean score of students is 79.47. Therefore, it can be concluded that the Digital Electronics Practicum Guidance Module with Logisim Applications is suitable for use in digital electronics practicum.

How to Cite

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INTRODUCTION

The era of the industrial revolution 4.0 affects all aspects of life, including education (Dewantara, Mahtari, Misbah, & Haryandi, 2019). Education must follow all the will of technology for the effectiveness of its implementation(Misbah, Pratama, Srihartini, & Dewantara, 2018; Prasetyono & Sigitta, 2019; Zainuddin, Irawati, M, Misbah, & Dewantara, 2020). Facing the increasingly rapid development of the era, learning must be designed in order to achieve the demands of the era(Huda & Faiza, 2019). To access this information technology, technology devices are needed, devices commonly used are smartphones and laptops (Nasution, 2020).

Technology is closely related to digital electronics. Digital electronics is one of the compulsory courses in the Physics Education Study Program at Lambung Mangkurat University. Digital electronics deals with various types of digital circuits(Dewantara, Wati, & Misbah, 2020). Digital circuits are often referred to as logic circuits. Digital circuit is a unit of logic elements that form a digital signal processing function. Digital system is a unit of several digital/logic circuits and logic elements/gates for the purpose of transferring energy/energy. To complete the theoretical basis and design of digital circuits, experiments must be taught about it. One of them is by using simulations which require students to practice theory through simulations(Al-Busaidi, 2014)Logisim is a delightful tool that can easily be used to reinforce a solid understanding of the theoretical concepts related to a digital logic design course. Unlike LogicWorks, one of the most attractive features of Logisim is its ability to include user built libraries. This can result in the development of a library that models the complete set of integrated circuits (ICs. One of the tools that can be used is Logisim.

Logisim is simple software that can be used to implement circuit with basic gates(Shine & Sathish, 2014). Logisim is a visual tool for designing and simulating digital logic circuits especially for educational purposes (Burch, 2002; Van Tendeloo & Vangheluwe, 2013). Students can understand how to connect basic gates to make a circuit, both simple and complex with the help of Logis (Shine & Sathish, 2014). According to the survey, the logic is simple to follow so that students are able to find experimental designs to reinforce the concept of a series (Burch, 2002).

Innovative teaching methods based on the use of educational software tools and educational hardware tools as a support system for electronic learning, so that students understand and learn theory through practical simulations. (Luković et al., 2017). Combinational Analysis in Logisim makes it very easy to construct truth tables, which is an important step in the design of combinational logic systems (Busaidi & Ahmad, 2019).

Logisim is an educational tool for designing and simulating digital logic sequences (Kurniawan & Ichsan, 2017)cheap and reliable process which is conducted by it computer system self. To fulfill that process is required how a computer works from their design and how they operate. That course is conducted by Computer Architecture and Organization (CAO. Logisim is used to construct and evaluate basic logic gates (Lum Tan & Venema, 2019). The models generated by Logisim are diagrams drawn in the construction area or drawing area (Almeida, Lima, Carvalho, & Silva, 2018). Through this simulation it helps to make students aware that technology is getting more advanced, so that learning is also based on the use of digital tools (Rolando, Carlos, Diana, & Mayra, 2009).

Logisim simulator is suitable to be used to support learning (Dewantara, Wati, Kusuma, Rusmawati, & Melisa, 2021; Dewantara, Wati, Misbah, Mahtari, & Haryandi, 2020; Federico & Farfán, 2019). Logisim is a software tool that provides easy-to-use graphics that enable students to efficiently design and simulate digital circuits (Luković et al., 2017). The benefits of practicum through simulation are shorter timeframes and also save resources through minimizing wrong connections that can lead to damage to integrated circuits (IC) (Al-Busaidi, 2014)Logisim is a delightful tool that can easily be used to reinforce a solid understanding of the theoretical concepts related to a digital logic design course. Unlike LogicWorks, one of the most attractive features of Logisim is its ability to include user built libraries. This can result in the development of a library that models the complete set of integrated circuits (ICs. Logisim facilitates in training students' skills (Sendiawan, 2013).

Practical activities have an important role in delegating ways of thinking and activities to obtain data through the discovery process (Muslim, Syuhendri, & Saparini, 2017). The implementation of digital electronics practicum using Logisim requires a practical guide that can be used by students. In order for the implementation of practicum to be easier to understand and do, it is necessary to formulate a practicum module (Nurbaeti, Sunarsih, & Setiabudi, 2020). The practicum module can provide a visual picture, so

that students can do practicum properly (Dinatha & Kua, 2019).

Given the importance of a practicum module, researchers will develop a Digital Electronics Practicum Guidance Module with Logisim Applications. There has been no previous research that has developed this module. This module is expected to make it easier for students to carry out digital electronics practicum to understand digital electronics lecture material. The purpose of this research is to describe the feasibility of the results of the development of the Digital Electronics Practicum Guidance Module with Logisim Applications.

METHOD

This research is a development research with a 4D model developed by Thiagarajan. Development research was carried out in the Physics Education Study Program, Lambung Mangkurat University, 2019/2020 Academic Year.

The following is a description of each of the 4D stages

Define

The goal at this stage is to define and define the learning requirements starting with the objective analysis of the material limitations in the practicum module. The purpose of this practicum module is as a reference for practicum with simulations without using laboratory equipment directly due to the Covid 19 pandemic. The material limitations in the Digital Electronics Practicum Guidance Module with Logisim Applications are about logic gates, combined circuits in IC, and Sequential Circuits.

Design

This stage aims to prepare a prototype of the Digital Electronics Practicum Guidance Module with Logisim Applications. The components of the practicum guide module being developed are: (a) Title; (b) Purpose of practicum; (c) tools and materials; (d) work procedures; (e) table of observation results; (f) analysis; (g) conclusion.

Develop

This stage is carried out to produce a Digital Electronics Practicum Guidance Module with a revised Logisim Application based on input from experts. This step is the step where producing or creating or realizing the practicum module specifications that have been carried out in the previous stage, namely the design stage. In this step, the practicum module that has been developed by the researcher is then evaluated by experts related to the validity of the practicum module which consists of two academic validators. The validity of the Digital Electronics Practicum Guidance Module with Logisim Applications is measured using a validation sheet and then determined based on validation by an expert which is declared valid or invalid. If valid, it will be categorized again as very good, good, enough, poor, and very poor. The validation process is carried out by two validators.

The validity criteria of the Digital Electronics Practicum Practicum Guidance Module with the Logisim Application show the compatibility between the composer theory and the Digital Electronics Practicum Guidance Module with the compiled Logisim Application, whether it is valid or not, if it is invalid or not valid based on the theory and validator correction input, the Digital Electronics Practicum Guidance Module with the Logisim Application it needs to be repaired. Valid or not the validation results with the specified validity criteria. The data analysis technique results from the validity assessment of the Digital Electronics Practicum Guidance Module with the developed Logisim Application are as follows:

$\bar{X} = (\sum_{i=1}^{n} x_i)/n$

Where:

$\bar{X}$ = average score tota;

n= lots of questions

x_i = score on item i

The average validation value obtained is then matched with the validity assessment criteria of the Digital Electronics Practicum Guidance Module with Logisim Applications in the Table 1.

Table 1. Module Validity Criteria

Interval	Category
$X > 3.4$	Very Good
$2.8 < X \leq 3.4$	Good
$2.2 < X \leq 2.8$	Enough
$1.6 < X \leq 2.2$	Poor
$X \leq 1.6$	Very Poor

(Widoyoko, 2016)

Disseminate

The objectives of this disseminate stage are as follows: (1) to find out the practicality of using the Digital Electronics Practicum Guidance Module with the Logisim Application that has been developed on a broader scale, namely in lectures; (2) testing the effectiveness of using the Digital

Electronics Practicum Guidance Module with Logisim Applications in lecture activities.

Practicality is seen from the student response questionnaire to the Digital Electronics Practicum Guidance Module with the developed Logisim Application. Student response indicators consist of (1) format, (2) quality, (3) clarity, and (4) interest. The assessment data will be analyzed into a percentage of the mean score and will be presented with the help of tables and graphs. Student responses to the Digital Electronics Practicum Guidance Module with Logisim Applications are stated very well, good, good enough, not good and not good based on the following table.

Table 2. Criteria for Module Practicality

Interval	Category
4.2 <X ≤5	Very Good
3.4 <X ≤4.2	Good
2.6 <X ≤3.4	Enough
1.8<X ≤2.6	Poor
1 <X ≤1.8	Not Good

The effectiveness is seen from the final score of the practicum. The final score will be categorized as very good, good, good enough, not good and not good based on the following table.

Table 3. Kriteria Efektivitas Modul

Interval	Category
80 <X ≤100	Very Good
60 <X ≤80	Good
40 <X ≤60	Enough
20<X ≤40	Poor
0 <X ≤20	Not Good

The practicum module will be declared fit for use if it obtains the following minimum scores: (1) the minimum validity is categorized as good enough; (2) practicability is at least in good enough category; (3) the minimal effectiveness is categorized as good enough.

RESULT AND DISCUSSION

This Digital Electronics Practicum Guidance Module with Logisim Applications is used as a reference for practicum with simulations without using laboratory equipment directly due to the Covid 19 pandemic. Logisim is very useful because of the limited use of laboratories (Luković et al., 2017). The material limitations in volume 1 of this module are about logic gates. The components of the practicum guide module being developed are: (a) Title; (b) Purpose of practicum; (c) tools and materials; (d) work procedures; (e) table of observation results; (f) analysis; (g) conclusion. Figure 1 is a display of the Digital Electronics Practicum Guide Module with the developed Logisim Application.

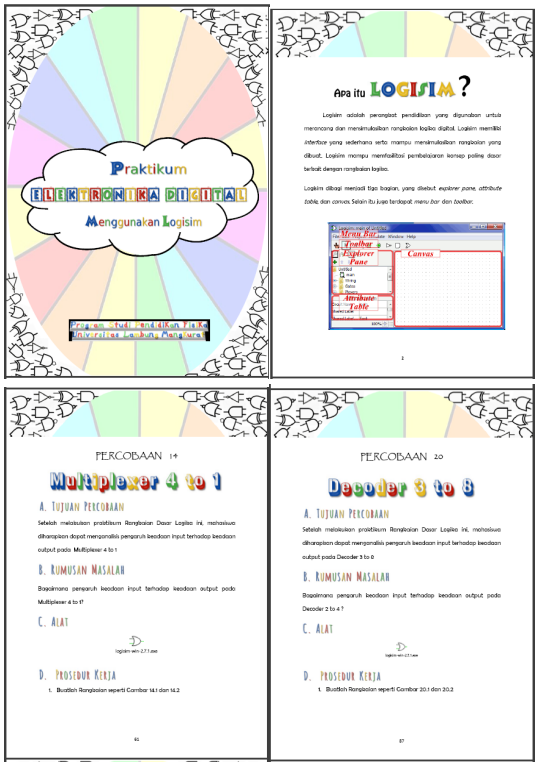

Figure 1. Display of Digital Electronics Practicum Guide Module with Logisim Applications

Validity

The Digital Electronics Practicum Guidance Module with Logisim Applications was validated by two validators. The recapitulation of the results of media validation by the validator can be seen in Table 4 below.

Table 4. Results of the validation of the practicum module

Assessment Aspects	Average	Criteria
Format	3.17	Good
Language	3.5	Good
Contents	3.33	Good
Total	3.33	Good

The results of the validation are seen from the aspects of format, language, and the contents of the Digital Electronics Practicum Guidance Module with Logisim Applications. Based on the

table, it can be seen that the Digital Electronics Practicum Guidance Module with Logisim Applications is valid in a good category.

Practicality

Practical Guidance Module for Digital Electronics with Logisim Applications is seen for its practicality based on a student response questionnaire to the practicum module. Table 5-9 shows the results of the student response questionnaire analysis.

Table 5. Student Responses to the Format indicator

Statement	Average score
Digital Electronics Practicum Guidance Module with Logisim Applications in accordance with the purpose of the lecture	4.2
The emphasis on cognitive and psychomotor skills is clear	4.08
The use of the Digital Electronics Practicum Guide Module with Logisim Applications is easy to understand	4.1
Total	4.13

Based on Table 5, student responses to the format of the Digital Electronics Practicum Guidance Module with Logisim Applications have a mean of 4.13. Thus it can be stated that the student response to the format of the Digital Electronics Practicum Guidance Module with Logisim Applications is in good category. This can also be seen from the distribution of student response questionnaire data which shows that there are no students who disagree and disagree with the statements listed in table 5.

Table 6. Student Responses on Quality indicators

Statement	Average score
The digital electronics practicum guide actually uses logistic applications	4.14
Presentation systematics, including font type, font size, language, pictures / illustrations are appropriate	3.78
Total	3.96

Based on Table 6, the student response to the quality of the Digital Electronics Practicum Guidance Module with Logisim Applications has a mean of 3.96. Thus it can be stated that the student's response to the quality of the Digital Electronics Practicum Guidance Module with Logisim Applications is in good category. This can also be seen from the distribution of data on the results of student response questionnaires which show that there are no students who disagree and disagree with the statements listed in table 6.

Table 7. Student Responses to the Clarity indicator

Statement	Average score
The aim of the Digital Electronics Practicum Guidance Module with Logisim Applications is easy to understand	4,1
The procedures in the Digital Electronics Practicum Guide Module with Logisim Applications are easy to understand	4.02
Total	4.04

Based on Table 7, student responses to the clarity of the Digital Electronics Practicum Guidance Module with Logisim Applications have a mean of 4.04. Thus it can be stated that the student's response to the clarity of the Digital Electronics Practicum Guidance Module with Logisim Applications is in good category. This can also be seen from the distribution of data on the results of student response questionnaires which show that there are no students who disagree and disagree with the statements listed in table 7.

Table 8. Student Responses on the Interest indicator

Statement	Average score
Digital Electronics Practicum becomes easier when using the Digital Electronics Practicum Guidance Module with Logisim Applications	4.16
The digital electronics practicum becomes more interesting when using the digital electronics practicum guide module with logisim applications	4,1

Digital Electronics Practicum becomes more fun when using Digital Electronics Practicum Guidance Module with Logisim Applications	4.12
The digital electronics practicum becomes more motivated when using the digital electronics practicum guide module with logisim applications	4.12
Digital electronics practicum with logistic applications can help me get to know technology better	4.14
Total	4.13

Based on Table 8, student responses to the interest of the Digital Electronics Practicum Guidance Module with Logisim Applications have a mean of 4.13. Thus it can be stated that the student response to the interest of the Digital Electronics Practicum Guidance Module with Logisim Applications is in good category. This can also be seen from the distribution of data on the results of student response questionnaires which show that there are no students who disagree and disagree with the statements listed in table 8.

Table 9. Student Responses to all indicators

Student Response Indicator	Average Score
Format	4.13
Quality	3.96
Clarity	4.04
Interest	4.03
Average	4.04 (Good)

The average result of the overall student response questionnaire from all student response indicators shows the number 4.04. Thus, the overall student response to the Digital Electronics Practicum Guidance Module with the Logisim Application is categorized as good.

Effectiveness

Effectiveness can be seen from the total score obtained by students in the digital electronics practicum using the Digital Electronics Practicum Guidance Module with Logisim Applications. The results of the accumulated calculations can be seen in Table 10.

Based on table 10, all students had the lowest score of students was 76.1 and the highest score of students was 82.9. Figure 2 is a histogram analysis of the scores obtained by students.

Table 10. Descriptive Statistics of Students' Final Grade

N	Valid	50
	Missing	0
Mean		79.4740
Median		79.6000
Mode		79.60[a]
Std. Deviation		1.42812
Variance		2.040
Minimum		76.10
Maximum		82.90

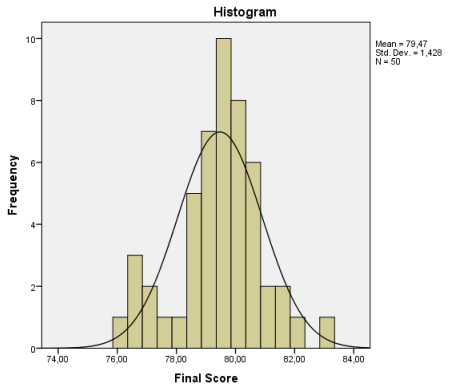

Figure 2. Histogram Analysis of Students' Final Grades

The mean score of students was 79.47 and the data were normally distributed. Based on table 3 this score is in the good category. Thus, the Digital Electronics Practicum Guidance Module with Logisim Applications is effectively used in the lecture process. This is in accordance with the results of other studies showing that through comparisons with traditional teaching methods, Logisim has better results in helping students understand learning, reducing learning difficulties, stimulating student interest and increasing teaching efficiency (Wu Ronghai, 2016).

The Digital Electronics Practicum Guidance Module with Logisim Applications is effectively used to help students complete the Digital Electronics Practicum and understand what they are getting. The results showed that there were significant differences in the increase in student understanding in the cognitive realm between students who used logistic and students who used conventional media (Pramudita, 2014). Logisim is also able to increase cooperation and openness of students during learning activities (Sendiawan, 2013).

One of the advantages of Logicim is that it has a GUI that allows you to create, view, and

modify digital logic and simulate your own circuits (Kurniawan & Ichsan, 2017). Logisim and all of its features (library of logic elements, simulation, basic logging, intuitive interface, static checking of correctness of models with visual feedback) implement syntactic editing for a Domain-Specific Language (DSL)(Van Tendeloo & Vangheluwe, 2013). Thus, students can create complete circuits with Logisim and can run simulations with any input so as to provide an experience like when they were in the lab (Shine & Sathish, 2014).

CONCLUSION

The findings from the results of this study are (1) the validity of the category is good, with a mean score of 3.33; (2) the practicality is in good category, with the mean score of student response is 4.04; (3) the effectiveness of the high category, namely the mean score of students is 79.47. Therefore, it can be concluded that the Digital Electronics Practicum Guidance Module with Logisim Applications is feasible for use in digital electronics practicum. Thus it is suggested to carry out a Digital Electronics Practicum using a Digital Electronics Practicum Guidance Module with Logisim Applications. Further research is needed to find out specific student skills after using the Digital Electronics Practicum Guidance Module with Logisim Applications.

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