

# The Impact of Basic Programming Interactive E-Module Implementation on Students' Learning Outcomes in Distance Learning

Agariadne Dwinggo Samala<sup>1)\*</sup>, Ambiyar<sup>2)</sup>, Sukardi<sup>3)</sup>, Yose Indarta<sup>4)</sup>, Fadhli Ranuharja<sup>5)</sup>

<sup>1)2)3)5)</sup>Faculty of Engineering, Universitas Negeri Padang, Indonesia

<sup>4)</sup>Indonesian National Police Headquarters, Indonesia

<sup>1)</sup>[agariadne@ft.unp.ac.id](mailto:agariadne@ft.unp.ac.id), <sup>2)</sup>[ambiyar@ft.unp.ac.id](mailto:ambiyar@ft.unp.ac.id), <sup>3)</sup>[sukardiump@gmail.com](mailto:sukardiump@gmail.com), <sup>4)</sup>[yose\\_11@yahoo.co.id](mailto:yose_11@yahoo.co.id)

**Submitted:** Feb 24, 2022 | **Accepted:** Mar 21, 2022 | **Published:** Apr 1, 2022

**Abstract:** This study aims to identify the implications of implementing an interactive e-module for learning basic programming in distance learning. The subject of this research were students of Informatics Education Study Program, Department of Electronic Engineering, Universitas Negeri Padang. This research was carried out in the odd semester of 2020/2021 academic year. This research used an experimental method using a quantitative approach with a posttest-only control group design. The sampling technique used purposive sampling. In the results of the midterm exam, it is known that the learning outcomes students from the control group without treatment obtained the lowest score of 64.00; highest score 84.00; an average of 75.27; while students from the experimental group with interactive e-modules obtained the lowest score of 76.00; highest score 96.00; with an average of 84.83; Furthermore, the results of the final exam obtained student learning outcomes from the control group without treatment, the lowest score was 60,00; highest score 82,00; with an average of 72.07; while student learning outcomes from the experimental group obtained the lowest score of 72,00; highest score 90,00; with an average of 81.60. The results showed that the learning outcomes of the experimental group are much better than the learning outcomes of the control group. It means that there is a significant effect of using distance learning interactive e-module on learning outcomes of basic programming.

**Keywords:** Interactive E-Module, Basic Programming, Learning Outcomes, Distance Learning

## INTRODUCTION

The development of technology and digital transformation has changed the way of learning, the learning environment, and the learning media used (Raes et al., 2020). The recent Covid-19 pandemic has changed the way of learning that was previously face-to-face to now switch to distance learning or blended learning (Abidah et al., 2020). Technology and the internet have a very important role in supporting the implementation of the online learning process (Samala et al., 2020). As can be seen today, the world has entered the era of industrial revolution 4.0, starting to move towards society 5.0, where every aspect of human life has been integrated with technology systems and algorithms, for example, usage of computers, smartphones, the internet, cloud-based, metaverse and blockchain technology (Park & Kim, 2022). The presence of various digital-based platforms in the educational aspect will open up opportunities for the use of technology, create a more dynamic learning atmosphere, and has a high level of accessibility (Liao et al., 2022). Learning activities in this era should be done anytime and anywhere (Samala et al., 2019). The success of students in achieving a learning goal cannot be separated from the contribution of various supporting factors such as teaching styles, learning models, learning media, materials, learning environment, teacher competence, and learning facilities (Efriana, 2021). As already mentioned, learning media is one of the supporting factors in achieving learning objectives (Asrowi et al., 2019).

Along with the development of technology, learning media should be developed from various sides. Starting from digital-based media, based on augmented reality, and can also be based on interactive multimedia (Kaplan et al., 2021). A successful learning media is one that can change the behavior of students (behavior change) and improve the learning outcomes of certain students ( et al., 2019). The success of using learning media is

\*name of corresponding author



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inseparable from how well the media is planned (Perdana et al., 2021). The use of effective media requires a comprehensive analysis by taking into account various aspects, including goals, conditions of students, supporting facilities, available time, and the ability of teachers to use them appropriately (Rahayu & Sukardi, 2020). Learning media with digital technology is media that is sophisticated or meets novelty that is usually familiar to students. Our students are a generation that is accustomed to digital technology (digital native)(Samala et al., 2020). Professional educators should have the skills to use technology to improve learning processes and outcomes (McAleavy et al., 2018). The types of learning media with digital technology that can be utilized include: interactive multimedia, digital video and animation, podcasts, augmented reality (AR), virtual reality (VR), and game-based learning and gamification (Alizadeh, 2019).

Universitas Negeri Padang has provided e-learning facilities to support the implementation of online learning on campus for lecturers and students (Aurora & Effendi, 2019). E-learning is electronic learning where the learning process is carried out online supported by technology and internet networks (Koutsakas et al., 2020). This of course requires adjustments by lecturers and students. For lecturers, there is a need for innovation in preparing teaching materials or learning media to fill content in e-learning. For students, learning to use technology is a common thing, because as Generation Z, they are used to living with technology (Moore et al., 2017). They just need to familiarize themselves with the use of the features of e-learning that have been provided. Some of the obstacles that occur from e-learning learning are the lack of digital-based teaching materials that attract student learning interest. However, distance learning often experiences several obstacles that make it less effective, including many lecturers who have difficulty presenting interactive learning content in e-learning.

### 1. LITERATURE REVIEW

The use of learning media is a very important factor to improve student learning outcomes and increase student motivation (Salam et al., 2020). Previous research conducted by Wilyanti, et al stated that the development of learning materials is very important in order to achieve fun, effective, and efficient learning. This research proves that digital learning materials developed in the form of e-books are able to make a positive contribution to the learning process (Wilyanti et al., 2021). Subsequent research by Maila Sari also concluded that flipbook-based digital books are creative, innovative and informative learning media so that they are easy to understand in the learning process (Sari et al., 2021). Based on the background and existing literature studies, it is deemed necessary to implement interactive e-module as digital learning media for basic programming to improve student learning outcomes in distance learning. Flipbooks as digital learning media will later contain materials presented in various media types, such as text, images, and video support regarding learning materials (Muhammad et al., 2020). In addition, several studies on the benefits of flipbooks in the learning process have been empirically proven to contribute to the achievement of learning objectives and increase student academic achievement. Other research findings also state that an interactive module can improve student learning outcomes. Therefore, in this study, researchers implemented the use of an interactive e-module for basic programming to improve student learning outcomes in distance learning. This study aims to determine whether the implications and impacts of using this learning media on student learning outcomes, whether it has a significant effect or not.

### METHOD

The research method is an experimental method. The experimental research method is a systematic method to determine the causal-effect relationship (Cash et al., 2016). The experimental method used is a true experimental design (posttest only control design)(Milun et al., 2005). The posttest-only control group design is a research design in which there are at least two groups, one of which does not receive a treatment or intervention, and data are collected on the outcome measure after the treatment or intervention (Hastjarjo, 2019). While the data analysis technique uses a descriptive quantitative approach which aims to determine and analyze the effect of the interactive e-module implementation applied in distance learning.

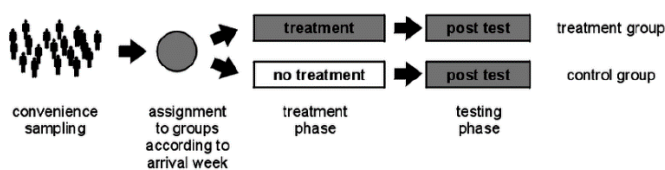


Figure 1. Posttest-Only Group Design

\*name of corresponding author



The subjects of this study were students of Informatics Education, Faculty of Engineering, Universitas Negeri Padang who were enrolled in basic programming courses. The sampling technique from the population uses purposive sampling technique. This technique includes non-probability sampling, which is a technique for determining samples with certain criteria with the aim that the data obtained are as expected. The sample criteria are 1) Students of Informatics Education, Universitas Negeri Padang who are enrolled in basic programming courses; 2) Students have a computer or smartphone.

**Table 1. Population**

Class Code	Numbers of Students
202021280278 (A)	30
202021280279 (B)	30
<b>Total</b>	<b>60</b>

Based on Table 1 above, it can be seen that the total population is 60 students. This population based on observations was declared to meet the criteria of the research sample and because the total population was less than 100, all populations were sampled in the study. This population is divided into two groups. The group that was given treatment (X) was referred to as the experimental group (Group A). The group that did not get treatment (X) was called the control group (Group B). The effect of the treatment (X) is (O1:O2) as can be seen in Table 2. The data from the mid and final test results between the two groups will be used as a reference in measuring the impact of the implementation of interactive e-module.

**Table 2. Posttest Only Control Group Design**

Group	Treatment	Result
Experiment	X	O1
Control	-	O2

(Source: Sugiyono, 2011)

In this study, class A was used as the experimental group and class B was used as the control group with a total of 30 students in each class. The data collection carried out in this study was by using midterm exam and final exam. This test aims to determine the achievements of students in understanding the material contained in the interactive e-module given. The exam tests given to the two groups were the same twice, consisting of a midterm exam (mid test) and a final exam (final test).

## RESULT

All samples have computers or smartphones so that this condition strongly supports the implementation process of interactive e-module in distance learning. The number of meetings in algorithmic lectures and distance learning for the January – June 2021 semester is 16 meetings. For more details, see Table 3 below:

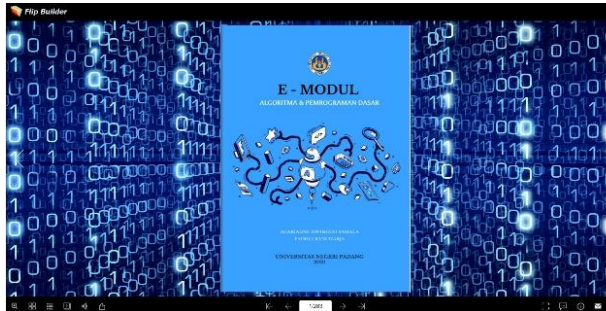
**Table 3. Meetings and Topics**

Meetings (P)	Topics
P1	Introduction to Programming
P2	Algorithm
P3	Basic C Programming
P4	Variable & Output Input
P5	Fundamental Data Types
P6	Operator
P7	Decision Making
P8	Mid Test
P9	Flow Control: Loop
P10	Flow Control: Jump
P11	Array (Array)
P12	Dynamic Pointer & Memory
P13	Function (Function)
P14	Enumeration
P15	Structure
P16	Final Test

\*name of corresponding author



This interactive flipbook for the algorithm and programming course was previously developed using a 4D development model. However, this research only focuses on the discussion to determine the impact of the implementation of the products that have been developed.



**Figure 2. Display of the Desktop Computer version**  
(Source: Researchers Document)



**Figure 3. Smartphone version display**  
(Source: Researchers Document)

The following results from the midterm exam from the control group (Group B) that were not given treatment (x) can be seen in the following table 4, and results from the midterm exam from the experimental group (Group A) who were given treatment (x) in the form of giving an interactive e-module application for basic programming courses can be seen in table 5:

**Table 4. Mid Test Results (Control Group)**

No.	Std	Score	No.	Std	Score
1	M1	74	16	M16	64
2	M2	80	17	M17	80
3	M3	76	18	M18	76
4	M4	74	19	M19	78
5	M5	82	20	M20	82
6	M6	74	21	M21	78
7	M7	80	22	M22	82
8	M8	76	23	M23	84
9	M9	72	24	M24	72
10	M10	74	25	M25	78
11	M11	70	26	M26	80
12	M12	66	27	M27	68
13	M13	78	28	M28	80
14	M14	64	29	M29	74
15	M15	70	30	M30	72

<b>Min</b>	64,00
<b>Max</b>	84,00
<b>Avg</b>	75,27

(Source: Data Processing)

**Table 5. Mid Test Results (Experimental Group)**

No.	Std	Score	No.	Std	Score
1	M1	86	16	M16	92
2	M2	84	17	M17	96
3	M3	80	18	M18	90
4	M4	76	19	M19	84
5	M5	84	20	M20	80
6	M6	90	21	M21	92
7	M7	92	22	M22	90
8	M8	90	23	M23	80
9	M9	88	24	M24	88
10	M10	81	25	M25	84
11	M11	78	26	M26	78
12	M12	78	27	M27	80
13	M13	80	28	M28	82
14	M14	82	29	M29	84
15	M15	90	30	M30	86

<b>Min</b>	76,00
<b>Max</b>	96,00
<b>Avg</b>	84,83

(Source: Data Processing)

Based on Table 4-5, it is known that the learning outcomes students from the control group without treatment obtained the lowest score of 64.00; highest score 84.00; an average of 75.27; while students from the experimental group with interactive e-modules obtained the lowest score of 76.00; highest score 96.00; with an average of 84.83; in midterm exam.

\*name of corresponding author



The following results from the final test of the control group that were not given treatment (x) can be seen in Table 6 and 7 below:

**Table 6. Final Exams Results (Control Group)**

No.	Std	Score	No.	Std	Score
1	M1	70	16	M16	74
2	M2	72	17	M17	80
3	M3	64	18	M18	70
4	M4	62	19	M19	60
5	M5	68	20	M20	66
6	M6	78	21	M21	80
7	M7	80	22	M22	70
8	M8	72	23	M23	80
9	M9	70	24	M24	72
10	M10	78	25	M25	76
11	M11	80	26	M26	78
12	M12	82	27	M27	64
13	M13	70	28	M28	78
14	M14	66	29	M29	68
15	M15	68	30	M30	66

<b>Min</b>	60,00
<b>Max</b>	82,00
<b>Avg</b>	72,07

(Source: Data Processing)

No.	Std	Score	No.	Std	Score
1	M1	82	16	M16	84
2	M2	80	17	M17	90
3	M3	82	18	M18	84
4	M4	78	19	M19	82
5	M5	84	20	M20	78
6	M6	84	21	M21	78
7	M7	90	22	M22	80
8	M8	88	23	M23	78
9	M9	90	24	M24	72
10	M10	82	25	M25	84
11	M11	80	26	M26	78
12	M12	80	27	M27	78
13	M13	78	28	M28	80
14	M14	78	29	M29	80
15	M15	82	30	M30	84

<b>Min</b>	72,00
<b>Max</b>	90,00
<b>Avg</b>	81,60

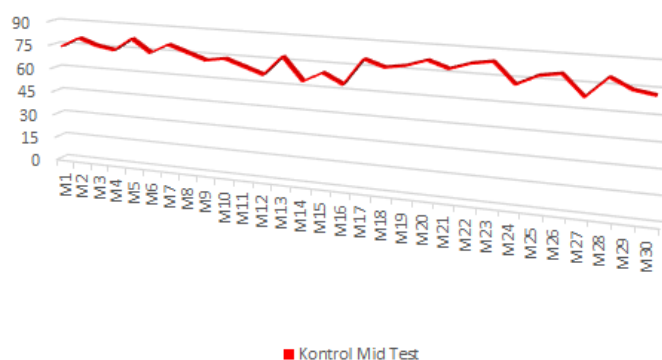
(Source: Data Processing)

**Table 7. Final Exams Results (Experimental Group)**

Based on Table 6-7, the results of the final exams of the control group can be seen that the lowest or minimum score is 60,00, with the highest score of 82,000, and the average score of 72,07. Meanwhile, the results of the final exams of the experimental group can be seen that the lowest or minimum score is 72,00, with the highest score of 90,00, and the average score of 81.60.

### DISCUSSIONS

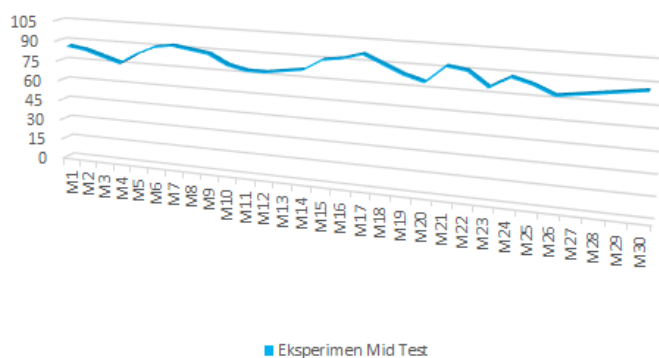
Based on the graphs in Figures 4 and 5, it is known that in the experimental group there were students who scored above 90,00, while in the control group, no one scored above 90,00 in the midterm exam.



**Figure 4. Graph of Control Group MidTerm Score**  
(Source: Data Processing)

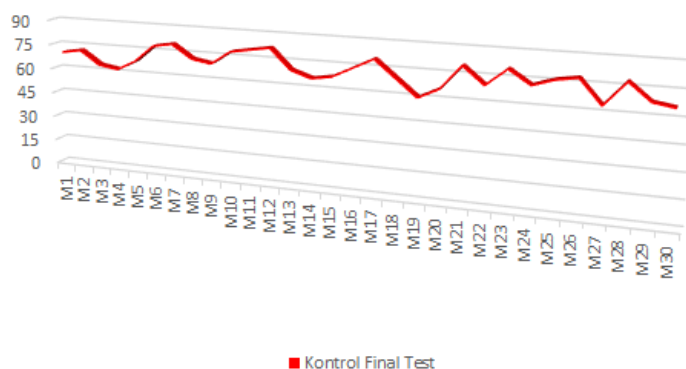
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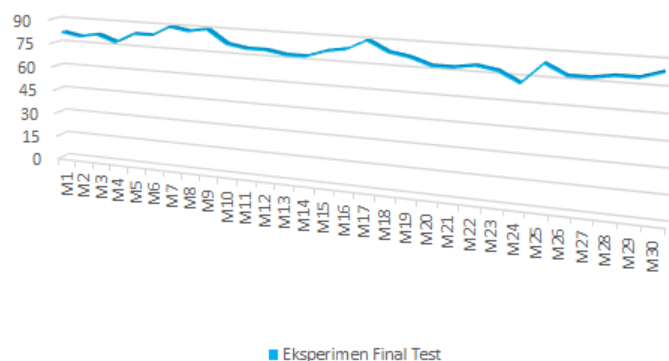


**Figure 5. Graph of Experimental Group MidTerm Score**  
(Source: Data Processing)

Based on the graphs in Figures 6-7, it is known that in the experimental group there were students who scored 90,00, while in the control group, no one scored above 90 in the final exams. The results showed that the learning outcomes of the experimental group are much better than the learning outcomes of the control group. It means that there is a significant effect of using distance learning interactive e-module on learning outcomes of basic programming.



**Figure 6. Graph of Control Group Final Exam Score**  
(Source: Data Processing)



**Figure 7. Graph of Experimental Final Exam Score**  
(Source: Data Processing)

\*name of corresponding author



This learning model makes students more active because, during learning, students are the subject of education. Students who seek information, process information, and convey information obtained through presentations from representatives of each group's members and encourage communication between students and student achievement can increase.

### CONCLUSION

The following comparison of the results of the midterm and final exams between the control group and the experimental group can be seen in the two graphs in Figure 8:

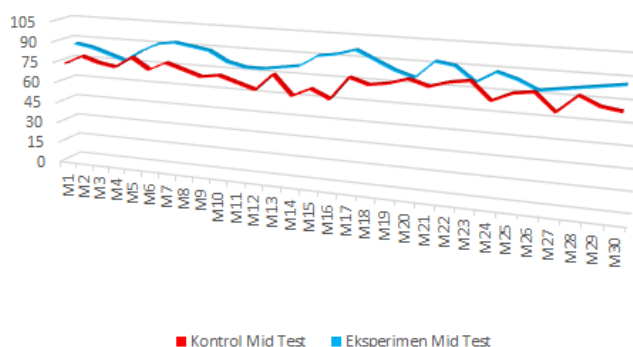


Figure 8. Comparison Chart of Experimental group and Control group learning outcomes

(Source: Data Processing)

From the results of the discussion that has been explained, it can be stated that the implementation of the interactive e-module makes it easy for students to understand the material because it is equipped with pictures, learning videos, reference links as additional reading material. So that the existence of interactive digital learning media is proven to make a positive contribution in efforts to increase the effectiveness of distance learning in basic programming courses, it can be seen from the student learning outcomes of the control group which is better than the experimental group, it can be concluded that the interactive e-module developed can support the achievement more effective and enjoyable online learning process, and about learning loss is not only focused on elements of information technology but also requires a curriculum reorganization that is in line with current conditions. Schools or universities should also make students more ready to face the freedom of seeking knowledge instead of just pursuing assignments and grades.

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\*name of corresponding author



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