

[Research Article]

DEVELOPMENT OF INTERACTIVE *DISCOVERY LEARNING* MODULE ASSISTED BY VIR-LAB TO IMPROVE UNDERSTANDING OF PHYSICS CONCEPTS

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ABSTRACT

The aim of this research is to develop a discovery learning e-module assisted by vir-lab to increase understanding of physics concepts in the matter of vibrations, waves and light, and to test the feasibility of a discovery learning e-module assisted by vir-lab to increase understanding of physics concepts. The method used in this research is research and development using a 4D development model consisting of define, design, develop and disseminate stages. The data collection method in this research is by analyzing student response questionnaires regarding the use of e-modules in learning and giving tests before (pretests) and after (posttest) in using e-modules to determine students' understanding of physics concepts. Based on the validation results, the experts got valid results, based on the results of students' responses in using the e-module, they got an average percentage of 81%, including the "very good" criteria, and based on increasing understanding of physics concepts, they got an N-Gain value of 0.7 is included in the medium category. Based on this, it can be seen that the development of discovery learning e-modules assisted by vir-lab can increase understanding of physics concepts and can be implemented in learning.

Keywords: E-module Discovery Learning, Virlab, Concept Understanding

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1. INTRODUCTION

Physics is a science that deals with natural phenomena related to phenomena that occur today (Febrianti et al., 2023). Physics learning emphasizes more on providing direct experience in developing competencies so that students are able to understand the surrounding environment scientifically. (Asriah et al., 2022).. Physics learning can be expected to invite students to actively participate in solving problems and finding solutions. (Pamungkas, 2024). Understanding physics concepts is the main thing in learning physics material. Because his understanding in studying physics depends on his ability to understand existing concepts. One way to understand the concept of physics is with the existence of learning media (Dewi et al., 2023). Learning media is a tool or intermediary used by educators in delivering learning materials so that they can be easily understood by students. (Fitria et al., 2023)..

21st century learning is the era of the industrial revolution 4.0 to 5.0 which is characterized by the development of technological science (Hasan et al., 2024). Along with the current technological developments can provide dampak to the world of education that can improve the quality of learning. With this sophisticated technology, students can more easily access learning materials easily to support students in understanding learning materials provided by educators. (Lubis et al., 2023). So, with the current technological developments, the use of learning media in schools is not only centered on Student Worksheet (LKS) books and package books but can take advantage of current technology in digital form such as the use of E-modules. (Cahyani, Mutiara D, 2023).

E-modules are interactive media or devices in digital form that can realize the learning competencies that students want to achieve independently using applications or websites. Learners can use E-modules that can be accessed anytime and anywhere with integrated content with images, audio, and video that can help students' understanding. (Amalia & Sujatmiko, 2022). In physics learning on Vibration, Wave, and Light materials,

students find it difficult to understand the material because there are no laboratory activities that can help students learn how to describe Vibration, Wave, and Light, so to overcome these problems, observations are needed in the laboratory. (Amanda et al., 2022).

One of the technological advances in laboratory learning approaches, especially in the field of practicum, is through *virtual laboratory* media. One of the online virtual laboratory platforms that can be easily accessed by students is the *PhET Simulation (Physic Education Tecnology)* virtual lab. (Verdian et al., 2021). To maximize learning by using a virtual laboratory, the learning process uses a *discovery* learning model. The *discovery learning* model is a learning model that involves the maximum ability of students to be able to search and find something either objects, or events systematically, critically, logically, and analytically. (Turrahmah et al., 2019). Basically, the learning process using the *discovery learning* model can help students to have the ability to ask questions, observe, collect information, process information, and draw conclusions. (Winarti et al., 2021). In research (Suryanti et al., 2021) and (Solikhah & Perdana, 2023) mentioned that the *Discovery Learning* model on mastery of physics concepts will make students active in learning. This is because the *Discovery learning* model emphasizes students to build their own knowledge by providing a real problem that will provide direct experience to students in solving it.

Based on observations made in the learning process, students still use package books and LKS books as a guide in the learning process. And the existing laboratory at school is used for classrooms so that the tools needed during practicum are inadequate. So that one way that can improve the learning process in the current technological era is by applying learning media teaching materials in the form of *Discovery Learning* e-modules equipped with virtual laboratories that can encourage students to understand the concepts of students.

2. METHODS

The method used is the *Research and Development* method using the 4D model which has 4 stages of development, namely *define, design, develop, and disseminate*. (Salsabila et al., 2023).. The subjects in this study were students of SMP Negeri 2 Wagir. Data collection techniques were obtained from observation, e-module feasibility validation questionnaire, teacher response questionnaire and student response questionnaire.

The types of data used in this study are qualitative and quantitative. The qualitative data used is in the form of input, suggestions, and criticisms related to the use of E-modules. And the quantitative data used is in the form of numbers obtained from the results of filling out questionnaires by validators and students which can be used as a reference to determine the quality of E-module *Discovery Learning learning* media assisted by vir-lab.

In the data analysis technique, namely to test the feasibility of using the E-module Physics with vir-lab. In the feasibility analysis of the E-module, this assessment consists of 4 categories, namely value (4) which is very suitable, value (3) which is suitable, value (2) which is less suitable, value (1) which is not suitable. In the data analysis analysis technique for testing the feasibility and practicality of using physics e-modules using *discovery learning* assisted by vir-lab, namely by using the following formula (Sinensis et al., 2022):

$$\bar{X} = \frac{\sum X}{N}$$

Description:

- \bar{X} : average assessment
- $\sum X$: sum of scores from raters
- N : number of assessors

After knowing the average score, the percentage value can be found using the formula:

$$\text{Average result} = \frac{\text{average score}}{\text{total score}} \times 100\%$$

With the assessment criteria in table 1.

Table 1. Assessment Criteria

Presentation Score Interval	Criteria
81% - 100%	Sangat Valid
61% - 80%	Valid
41% - 60%	Cukup
21% - 40%	Tidak Valid

From the results of these feasibility criteria, the E-module Physics *Learning* Media Using the *Discoery Learning* Model with Vir-lab Assisted is said to be theoretically feasible if the feasibility percentage is $\geq 61\%$.

Concept understanding test sheets were collected through before (*pretest*) and after (*posttest*) learning to determine the concept understanding of the material taught using the E-module. By using the *N-gain* equation as follows (Ariyansah et al., 2021):

$$N - gain = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}}$$

With the presentation of *N-gain* level criteria as follows:

Table 1. N-Gain Analysis

N-gain	Category
$N-gain > 0,7$	High
$0,3 < N-gain < 0,7$	Medium
$N-gain < 0,3$	Low

3. RESULTS AND DISCUSSION

The result of this research is a product in the form of learning media E-Module *Discovery Learning* Assisted by Vir-Lab on Vibration, Wave, and Light material in class VIII. The resulting learning media is used to improve understanding of physics concepts. This research is a type of *Research and Development* (R&D) research using the 4D development model which has 4 stages, namely the define stage, the design stage, the develop stage, and theD) using the 4D development model which has 4 stages, namely the *define* stage, the *design* stage, the *develop* stage, and the *disseminate* stage. The following is an explanation of each stage:

3.1. Define Stage (Defining)

The *define* stage (defining), contains information that is used as to establish and define the needs. The initial analysis of this research is to determine and determine the basic problems faced in learning physics in junior high school. At this stage, researchers conducted observations at SMP Negeri 2 Wagir and conducted interviews with science teachers. In the observations that have been made, it can be seen that the curriculum used at SMP Negeri 2 Wagir uses the independent curriculum. In the observation of students, students have used the internet to find learning resources at home. This technological development can require education to participate in the use of technology as one of the innovations in learning. Technological developments also greatly affect the learning media that will be used (Latifah et al., 2020).

The learning media used by teachers to deliver learning materials only use LKS books and package books. Whereas the use of learning media is very influential on physics learning material because many natural phenomena cannot be understood by students. Researchers also conducted a needs analysis through distributing questionnaires to students during the learning process. Based on the needs analysis questionnaire given to class students, researchers get the following results:

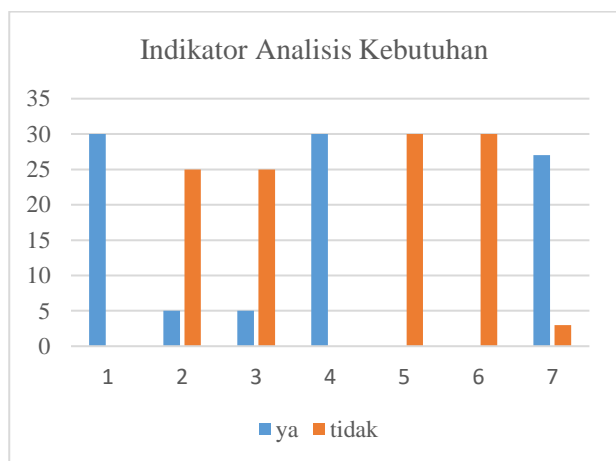


Figure 1. Needs Analysis Results

Based on the results of the needs analysis, it is found that on the indicator of the use of learning

media, it shows that 5 students answered "yes" and more answered no. Students mentioned that in the physics learning process, the teacher did not use a variety of learning media, the teacher only used LKS books and package books as learning resources. Whereas the use of physics learning media is also very necessary (Fitria et al., 2023).

In indicator number three that most students have never used online-based learning media such as the use of E-modules in the learning process. In indicator number four, students indicate that there is a science laboratory at school. But in indicator number five students have never used a science laboratory in the learning process. In indicator number six, some students have never used a *virtual laboratory* in the learning process. So that in indicator number seven students are interested in using *virtual laboratories* in the learning process to conduct alternative practicums that can be used to learn physics concepts more easily and interestingly.

3.2. Design Stage (Designing)

The *Design* Stage (Designing), aims to design the developed E-module *Discovery Learning Assisted Vir-Lab* learning media. E-module *discovery learning* assisted by vir-lab is designed using canva starting from the front cover to the back cover. The final result of the vir-lab assisted *discovery learning* E-module display design is as follows:



Figure 2. E-Modul Cover

Pada gambar 2. tersebut terdapat tampilan cover depan yang terdapat dalam e-modul. Pada cover depan tersebut dapat menjabarkan informasi yang terdapat dalam isi e-modul tersebut.



Figure 3. Introduction

In Figure 3. the introduction section contained in the e-module contains a description of the discovery learning e-module, learning outcomes, learning objectives, learning indicators, instructions for using the e-module, and learning materials.

The Vibration, Wave, and Light learning materials are prepared using the *discovery learning* model which has several stages, namely: *stimulus*, *problem statement*, *data collection*, *data procession*, *verification*, and *generalization*.



Figure 4. Material at the Stimulus Stage and Problem Statement Stage

In Figure 4. there are learning materials at the *stimulus* and *problemstatement* stages. At the

stimulus stage, students can observe the video provided by the teacher. At the *problem statement* stage, learners are asked to answer questions based on the stimulation that has been observed.



Figure 5. Learning Materials at the Data Collection Stage

In Figure 5. there is material at the *data collection* stage at this stage students are asked to conduct experiments using the *virtual laboratory PhET Simulation* by following the steps that are available in the e-module.

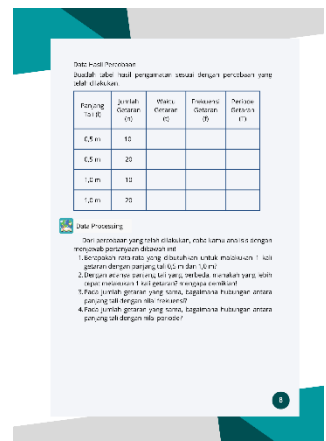


Figure 6. Learning Materials at the Data Procession Stage

In Figure 6. there is learning material at the *data procession* stage at this stage students can process the information that has been obtained by reasoning, analyzing, and calculating.



Figure 7. Learning Materials at the Verification Stage

In Figure 7. there is learning material at the verification stage, at this stage students can validate by reading the learning material information contained in the e-module.



Figure 8. Learning Materials at the Generalization Stage

In Figure 8. there is learning material at the generalization stage, at this stage students are asked to conclude in the learning process.

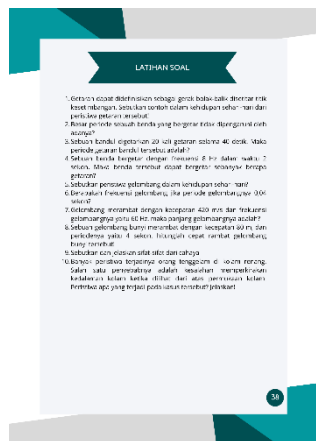


Figure 9. Practice Questions

In Figure 9. there are practice questions on Vibration, Wave, and Light material that can be done by students at the end of learning to find out how far the students' ability to understand the material that has been delivered.

3.3. Develop Stage (Development)

The develop or development stage is to produce a revised E-Module *Discovery Learning learning media* assisted by Vir-Lab based on input from material experts, media experts, and linguists, and field trials at SMP Negeri 2 Wagir in class VIII A.

The assessment of the material expert validation consists of material coverage, material accuracy, and material currency. The results of the validation of the *Discovery Learning E-module* assisted by Vir-lab by the material expert are in table 3. below:

Table 2. Material Expert Validation Results

No	Assessed Aspect	Percentage	Criteria
1	Material Coverage	75%	Valid
2	Material Accuracy	92%	Very Valid
3	Up-to-date material	75%	Valid
	Average	81%	Very Valid

Assessment on media expert validation consists of appearance and programming from the appearance consists of: cover design, layout design, text, video, and images and from programming consists of: usage and navigation. The results of the validation analysis of the *Discovery Learning E-module* assisted by Vir-lab by media experts are in table 4. below:

Table 3. Media Expert Validation Results

No	Assessed Aspect	Percentage	Criteria
1	View	75%	Valid
2	Programming	63%	Valid
	Average	69%	Valid

The assessment on linguist validation consists of straightforwardness, conformity with

student development, and conformity with language rules. The results of the analysis of the validation of the *Discovery Learning* E-module assisted by Vir-lab by linguists are in table 5 below:

Table 4. Language Expert Validation Results

No	Assessed Aspect	Percentage	Criteria
1	Straightforward	63%	Valid
2	Suitability Student development	63%	Valid
3	Conformity with language rules	63%	Valid
	Average	63%	Valid

User responses to science teachers consist of aspects of material coverage, material accuracy, material currency, language feasibility, practicality, and effectiveness. The results of the user response analysis of the *Discovery Learning* E-module assisted by Vir-lab by science teachers are in table 6. below:

Table 5. Teacher User Response Results

No	Assessed Aspect	Percentage	Criteria
1	Material coverage	92%	Very Valid
2	Material accuracy	100%	Very Valid
3	Recency of material	92%	Very Valid
4	Language Feasibility	88%	Very Valid
5	Practicality	100%	Very Valid
6	Effectiveness	100%	Very Valid
	Average	95%	Very Valid

The results of the trial of the learner response questionnaire given to 30 students of class VIII A. The results of the analysis of the user response to the *Discovery Learning* E-module assisted by Vir-lab by students are in table 7. below:

Table 6. Hasil Respon Penggunaan E-modul Pada Peserta Didik

No	Assessed Aspect	Percentage	Criteria
1	Presentation of Material	80%	Very good

2	Effectiveness of E-modules	82%	Very good
	Average	81%	Very good

The results of the increase in understanding of physics concepts carried out by giving tests conducted before (*pretest*) and after (*posttest*) learning to determine the understanding of the concepts of the material taught using E-modules. With the results contained in table 8. as follows:

Table 7. N-Gain Result Analysis

No	Pretest	Posttest	N-Gain	Category
1	74,3	93,3	0,7	Medium

Based on table 8. above, it can be seen that before using learning media using E-modules, the *pretest* value obtained an average result of 74.3 and after using E-modules learning media, the *posttest* value obtained an average result of 93.3. With the results of the N-Gain equation, the average is 0.7 with a medium category. From these data it can be seen that the development of E-modules *Discovery Learning* assisted by Vir-lab to improve understanding of physics concepts on the subject of vibrations, waves, and light has increased because after the learning process using E-modules students experience improvement.

This is in line with research conducted by Wulansari Ramadhany, (2022)(2022), which states that the *discovery learning* model with the help of vir-lab can improve students' concept understanding. The *discovery learning* model is a learning model through observation or experimentation with the aim that students can find the concept of the material. (Rijaluddin & Susanti, 2022).. The *discovery learning* model also has advantages, including that it can help students improve cognitive abilities, is very effective in remembering concepts, data or information if they find it themselves, and can allow students to develop faster according to their respective learning speeds. (Khasinah, 2021). The results obtained are in line with research (Widyastuti et al., 2024)(Widyastuti et al., 2024), which states that science *learning* using the *discovery learning* model is more effective in improving students' concept understanding.

In research (Az Zahro et al., 2022)(Az Zahro et al., 2022) stated that being equipped with the use of *virtual laboratories* in learning can help students in understanding abstract concepts in physics meters. With the *virtual laboratory* media in the learning process can also make students more active and enthusiastic in the learning process that takes place. (Nuryati, 2024). The learning process using E-modules *discovery learning* with the help of *vir-lab* can make students know more about the concepts in the material taught.

3.4. Disseminate Stage (Dissemination)

The *disseminate* stage is the final stage of this development research. At this stage, researchers only spread it in SMP Negeri 2 Wagir to teachers and students.

4. CONCLUSIONS

Based on the results of research and wetting, it can be concluded that the results of the development of E-modules *Discovery Learning* assisted by *Vir-lab* from the feasibility of *design*, content feasibility, and language feasibility have been declared feasible for use in the learning process. The product of the development of E-module *Discovery Learning* assisted by *Vir-lab* is able to improve the understanding of physics concepts with N-Gain test results of 0.7 with moderate category.

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