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DEVELOPMENT OF INTERACTIVE ELECTRONIC MODULE WITH A PROBLEM BASED LEARNING APPROACH : STRATEGIES FOR DEVELOPING STUDENTS' CRITICAL THINGKING SKILLS

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ABSTRACT

This research aims to develop an Interactive E-Module Based on Problem Based Learning on Students' Critical Thinking Skills, with valid, practical and effective quality. The development of the Interactive E-Module follows the steps of the Plomp Model, with the stages of pleminary research, prototyping phase, and assessment phase. The assessment results showed that the Interactive E-Module was valid in terms of content, construction and language, with an average validity test result of 84.5%. The product practicality test by practitioners for the readability aspect is included in the very practical category with an average score of 92.5% which is assessed by 1 educator getting an average of 95.38% and 32 students 89.80%. Furthermore, the effectiveness test by 32 students based on critical thinking test questions was categorized as very effective with an average score of 81%. Based on the results of this development research, it was concluded that the Problem-Based Learning-Based Interactive E-Module on Students' Critical Thinking Skills has met the requirements of a good E-Module from the aspects of valid, practical and effective, so that it can be used as a teaching material by students in learning for business and energy materials in class XI of SMA/MA.

Keywords **:** *E-Module Interactive, Problem Based Learning, Critical Thingking Ability*

A. INTRODUCTION

Critical thinking skills are important skills in modern education, especially in the current era of globalization and information. Critical thinking skills are needed by students in their lives because critical thinking is part of high-level thinking skills. (Sundari, Dwi et al., 2021). Critical Thinking Skills are needed by students in the learning process because with critical thinking students have the ability to analyze and solve problems that arise, whether simple or complex (Fauziah Idris & Suhendi, 2023). The government also supports the implementation of the independent curriculum and other education policies that encourage the use of technology and the development of critical thinking skills in the Regulation of the Minister of Education and Culture (Permendikbud) Number 12 of 2024, namely having the skills to think and act creatively, productively, critically, independently, collaboratively and communicatively (Kemendikbud, 2024).

Data or facts that show that critical thinking skills among students are still low, research results show that based on the Trends in International Mathematic and Science Study (TIMSS) study, critical thinking skills of students in Indonesia tend to be lacking, where Indonesia is in the bottom 3 positions out of all 32 participating countries (Latif et al., 2022). Many factors cause low critical thinking skills. Several

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studies have shown that the cause of low critical thinking skills in students can come from educators and others such as students. This is in accordance with research (Dwi Anggreni, 2019) regarding the low level of critical thinking skills in students caused by physics educators lacking interactive and problem-based teaching materials that can be accessed by students, and this has an impact on the learning process. In addition, according to previous research (Jayanti et al., n.d.), the implementation of learning still tends to be conventional, where this learning method is less effective in developing students' critical thinking skills.

The problem solving of the lack of critical thinking skills of students addressed by previous researchers has not fully answered this problem, such as the lack of use of technology in implementing the problem-based learning model (Siburian et al., 2022). This is also in line with Dibyanti & Sulastri's research on the development of problem-based e-module teaching materials can improve critical thinking skills (Dibyantini & Sulastri, 2022). So it can be seen that e-modules can make students more active and can train students' learning independence to be better.

The development of e-modules by previous researchers has not tried to combine interactive e-modules with problem-based learning models on students' critical thinking skills in physics learning in the independent curriculum. For this reason, here the researcher emphasizes an integrative approach between electronic module technology and problem-based learning models in one physics learning package so that it can improve students' critical thinking skills. This innovation is expected to be a solution for students in increasing participation and better learning outcomes.

B. RESEARCH METHODS

The type of research used in this study is the research and development method (Research and Development). The development model in this study is the Plomp model which includes three stages of development, namely: Preliminary Research, Development or Prototype Phase and Assessment Phase (Sari, 2018).

Testing the validity of interactive e-modules based on problem based learning was carried out on the aspects of content, construction, and language. The instrument used was a questionnaire containing a table of statements and assessments as well as comments and suggestions for improvement. The product in the form of an interactive e-module based on problem based learning was validated by three experts, namely two physics experts and one language expert.

Practicality testing was conducted on the readability aspect. The instrument used was a questionnaire containing a table of statements and assessments as well as comments and suggestions for improvement. The questionnaire was given after the Practitioner used the interactive e-module based on problem based learning. The e-Module was tested on 1 educator and 32 students at SMAN 2 Kinali.

Effectiveness testing is seen in the critical thinking aspect of students. The instrument used is a test consisting of 5 essay questions. The questionnaire is given after students use the interactive e-module based on problem based learning. The product is given to 32 students at SMAN 2 Kinali.

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The results of the questionnaire are processed descriptively to find the percentage of criteria to process each aspect adopting data analysis by Riduwan 2009. The assessment criteria can be seen in Table 1.

Table 1. Criteria for Assessment of Questionnaire Processing Results

No	Value	Criteria
1.	81% - 100%	ry valid, practical and effective
2.	61% - 80%	lid, practical and effective
3.	41% - 60%	ıite valid, practical and effective
4.	21% - 40%	ss valid, practical and effective
5.	0% - 20%	ɔt valid, practical and effective

(Riduwan 2009)

C. RESULTS AND DISCUSSION

Based on the product development stages referring to the Plomp development model, the results at each stage can be stated as follows: preliminary research, development of prototype phase and assessment phase

1. Preliminary Research

Analysis of the needs of educators and students is carried out through literature analysis/library study, curriculum analysis and analysis of the teaching materials used. From the analysis carried out, students have difficulty understanding physics material and feel bored using printed teaching materials that are monotonous. This shows that students really need teaching materials that accommodate their desires in learning such as, electronic modules that are easy to understand and there are videos explaining the material that are easy to understand.

Furthermore, based on the analysis conducted on educators, the implementation of learning still tends to be conventional and educators are less precise in choosing learning models so that the learning process is dominated by educators. Students are not given the opportunity to explore their understanding and thinking skills and learning is only directed to memorize and accumulate in terms of its application.

This condition shows that students and educators need teaching materials that accommodate students' preferences and train critical thinking skills, so interactive e-modules based on problem-based learning are developed for students' critical thinking skills.

For the curriculum analysis stage, at SMAN 2 Kinali in class XI (phase F) has used the independent curriculum. The independent curriculum can be adjusted with this interactive e-module based on problem based learning which directs students to be more active and enjoy a fun learning process.

2. Development of Prototype Phase

In the development phase of the plomp model, this stage will consist of three stages, namely prototype, formative evaluation and revision.

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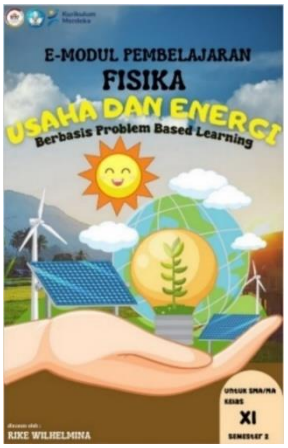
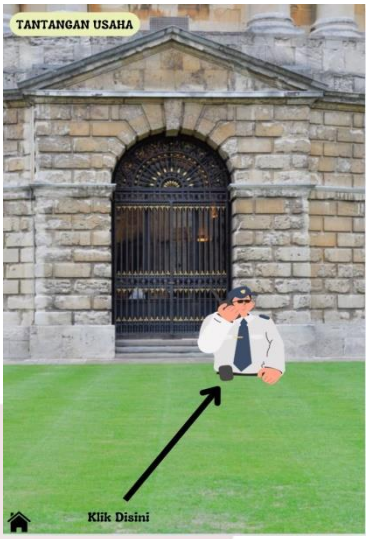
1) Prototipe

Based on the needs analysis and teaching materials analysis, it is necessary to compile a prototype of an interactive e-module based on problem based learning. The prototype stage can be seen in Table 2 as follows:

Table 2. Development of E-Module Interaktif

<table>
<tr>
<td>Cover
 

Consists of author identity, e-module identity and supporting images</td>
<td>Instructions for Using E-Module
 

In the form of an explanation regarding e-modules and their use.</td>
</tr>
<tr>
<td>Challenge
 

The challenge here is to use the word wall as a guideline. Before students understand the material, students are asked to practice their initial skills regarding the material on work and energy.</td>
<td>Smart Menu
 

Shortcuts are designed to be attractive and simple, intended to make them easy for learners to use.</td>
</tr>
</table>

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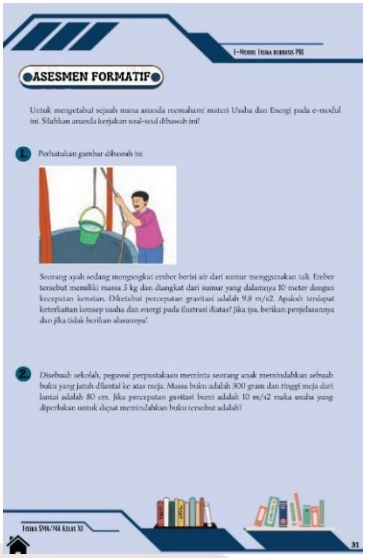
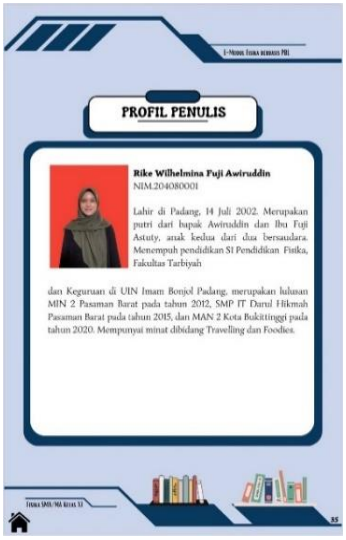
Material/Content  Using a light blue background, equipped with an explanation in the form of a video to help you find the problem	Reinforcement Video  Using the video thumbnail to strengthen students' understanding of the material on work and energy
Evaluation  Evaluation here is used to determine the extent of students' understanding of the material presented in the e-module.	Author Biodata  The author's biodata contains a brief explanation of the author's educational history and interests.

2) Formative Evaluation

After the draft module was made, a formative evaluation was carried out, to obtain a valid interactive e-module based on problem based learning, the interactive e-module was given to experts, the experts involved were Mr. Allan Asrar, M.Si (physics expert), Mrs. Pipi Deswita, M.Pd (physics expert), and Mr. Abdul Basit, M.Pd (language expert). The results of the expert assessment can be seen in table 3.

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Validity

Table 3. Validity Test Results

Validation	Average Percentage	Category
Materi	87,5%	Very Valid
Bahasa	92%	Very Valid
Konstruk	74,2%	Valid
Average	**84,5%**	**Very Valid**

3) Revision

Based on comments and suggestions by the validator, there are corrections to the product that need to be revised. Revisions to the product can be seen as follows :

Table 4. Product Revision

No	Before	After
1.	Previously there was no Shortcut Menu (Smarth Menu)	Added Shortcut Menu (Smarth Menu) 
2.	Previously there were no critical thinking indicators in the e-module 	Have added every critical thinking indicator in the e-module 

Based on the results of the final assessment and revisions that have been made, this product can proceed to the assessment phase.

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4) Assessment Phase

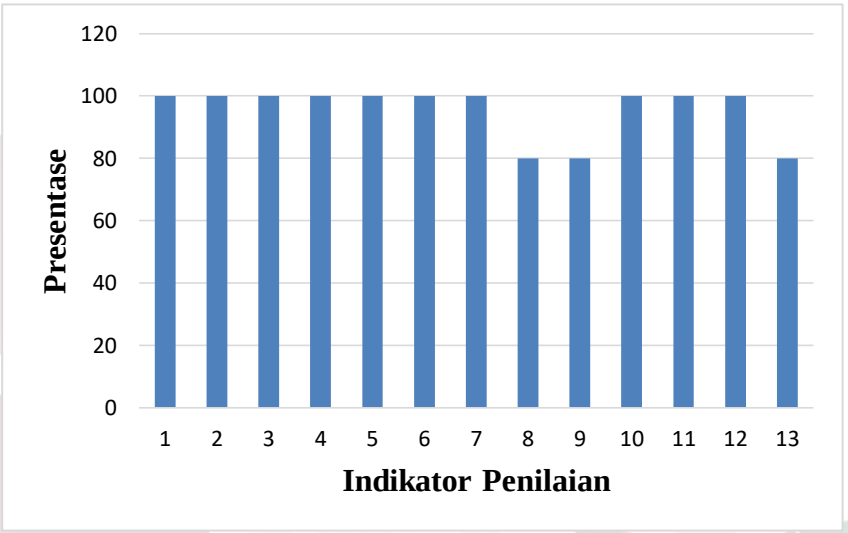
In this phase, two stages of product quality testing were carried out, namely practicality and effectiveness. The purpose of this stage is to see the practicality and effectiveness of prototype II of the interactive e-module based on the problem based learning model resulting from the development phase. The level of practicality is seen from the answers to the practicality questionnaire by 1 physics educator and the practicality questionnaire by 32 students of SMAN 2 Kinali. The effectiveness of the interactive e-module based on the problem based learning model on students' critical thinking skills is based on students' answers to critical thinking test questions.

Practicality

Practicality testing was conducted on the readability aspect. The instrument used was a questionnaire containing a table of statements and assessments as well as comments and suggestions for improvement. The questionnaire was given after practitioners used the interactive e-module based on the problem based learning model. The interactive e-module based on the problem based learning model was tested on 1 educator and 32 students at SMAN 2 Kinali. The results of the practicality test were obtained as follows:

1) Practicality Test by Educators

The practicality test of the interactive e-module based on the problem-based learning model for physics educators was carried out before being tested on students by distributing a practicality assessment questionnaire. Educators were given a product that could be viewed through a link and a practicality sheet containing 13 statements. If depicted in a graph, the level of product validity can be seen in Graph 1 below:



Graph 1. Educator Practicality Test Results

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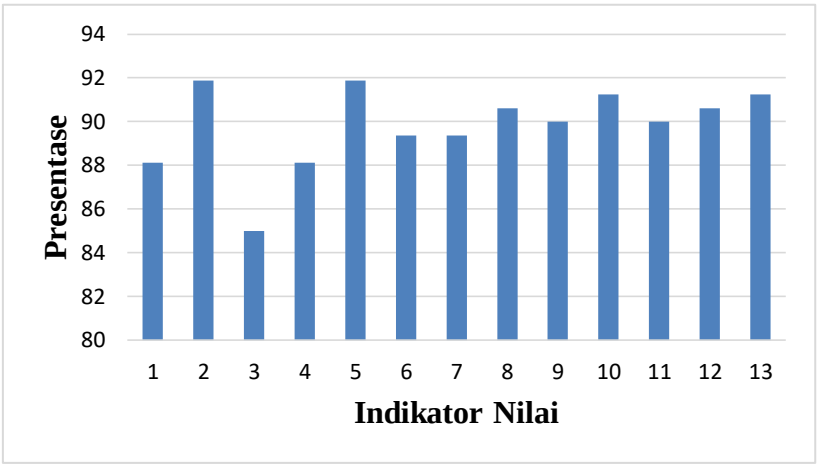
From the graph 1. above, it shows that the practicality questionnaire was filled out by 1 physics educator, namely Mrs. Moni Upita, S.Pd. The average result obtained was 95.38% with a very practical category.

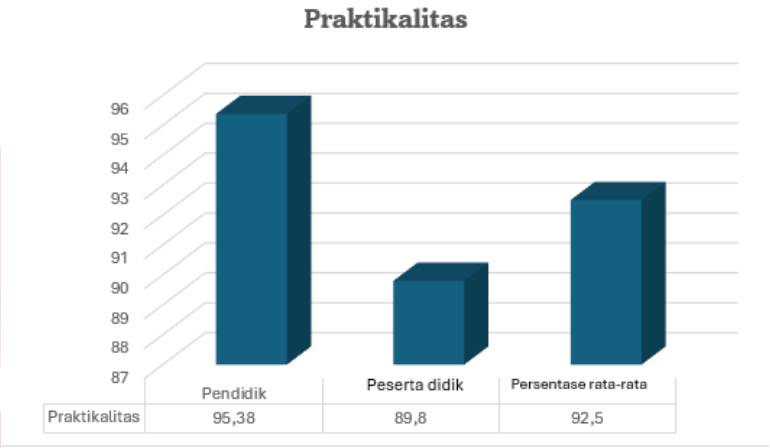
2) Practicality Test by Students

The practicality test of students was conducted after the educator. Students were given a product that could be viewed through a link and a practicality sheet containing 13 statements. The practicality sheet was filled in by 32 students of class XI F.1 at SMAN 2 Kinali. If depicted in a graph, the level of practicality of the product can be seen in Graph 2 below:



Graph 2. Student Practicality Test Results

From the graph 2 above, it shows that the practicality questionnaire was filled out by 32 students, with an average result of 89.8% in the very practical category.



Graph 3. Results of Practical Tests of Educators and Students

From graph 3. above, it can be described in the table below as follows :

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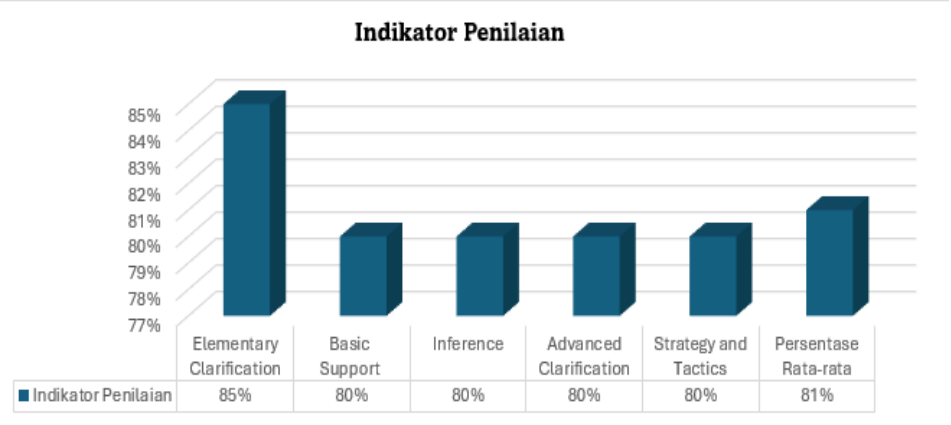
Table 5 Practicality Test Results

Practitioner	Value	Category
Educators	95,38%	Very Practical
Students	89,8%	Very Practical
Average	**92,5%**	**Very Practical**

From the data obtained, the practicality test value was 92.5%, this result is classified as very practical.

Effectiveness

Effectiveness testing is seen in the critical thinking aspect of students. The instrument used is a test question consisting of 5 essay questions. The questionnaire is given after students use the interactive e-module based on problem based learning. The product is given to 32 students at SMAN 2 Kinali. The results of the effectiveness test are as follows:



Graph 4. Effectiveness Test Results

From the 5 critical thinking indicators above, it was found that the aspect of providing elementary clarification was higher than the results of other critical thinking aspects.

Table 6. Effectiveness Test Results

No	Indicator	No Quest	Average	Category
1.	ementary Clarification	1	85%	Very Effective
2.	sic Support	2	80%	Effective
3.	erence	3	80%	Effective
4.	vanced Clarification	4	80%	Effective
5.	ategy and Tactics	5	80%	Effective
Average Percentage			**81%**	**Very Effective**

From the data obtained, the effectiveness test value was 81%, this result is classified as very effective.

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D. CONCLUSION

The interactive e-module based on problem based learning on the material of effort and energy towards students' critical thinking skills has met the valid, practical and effective quality based on the plomp development testing steps, the product has met the valid quality with an average of 84.5% with very valid criteria. The product is practical with an assessment by practitioners of 1 educator and 32 students with an average of 95.3% and 89.8% with very practical criteria. The product is effective with an assessment by 32 students based on critical thinking test questions categorized as very effective with an average score of 81%.

Based on the results of the research and development that has been carried out, it was concluded that the interactive e-module based on problem-based learning on the material on effort and energy regarding students' critical thinking skills is of good quality, namely meeting the criteria of validity, practicality, and effectiveness and can train students' critical thinking skills.

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