

# Development of A Problem-Based Physics E-Module with A Flipped Classroom Approach Using Sigil Software as An Alternative Learning Media During the COVID-19 Pandemic

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## Article Info

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**Abstract:** This study aims to develop a problem-based physics e-module with a flipped-classroom approach using sigil software that is fit for use as an alternative media of learning physics simple harmonic motion material for students of class XI MIPA SMA Muhammadiyah 2 Bandar Lampung during the COVID-19 pandemic. The type of research used is research and development, with an ADDIE development model consisting of analysis, design, development, implementation, and evaluation. The data collection instruments used were interview guide sheets, observation guide sheets, and questionnaire sheets. The research data obtained were then analyzed descriptively qualitatively. Based on the results of the feasibility assessment and data analysis carried out, it was concluded that the problem-based e-module using Sigil software with a flipped-classroom approach was feasible to use.

**Keywords:** Research and development; E-Module; COVID-19

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## Introduction

Physics is a branch of science that contains a collection of knowledge and solves various problems related to science (Al-idrus, 2017). The nature of physics has three scopes, namely as a product, a process, and an attitude (Ryder & Leach, 1999). Physics as a product is a collection of knowledge consisting of facts, concepts, theories, principles, and models. Physics as a process is a skill possessed by scientists to produce products, while an attitude is a behavior based on the beliefs that scientists have in the process of producing products. Physics learning should pay attention to the nature of science as a process, product, and attitude. In line with the nature of physics, physics learning should also be able to build knowledge that is not obtained only by observing but must be through real processes and practices (Gerace & Beatty, 2005).

The emergence of the COVID-19 virus in Indonesia has become a new problem that must be faced and resolved by the government (Saeri, 2021). This COVID-

19 virus can easily spread from one person to another in a crowd. Various efforts have been made by the government to reduce the spread of the virus, one of which is by implementing large-scale social restrictions in each region in Indonesia (Suryandari & Burhendi, 2020). This of course has an impact on education in Indonesia due to the closure of schools. With the closure of schools, teaching and learning activities must be conducted online.

From the results of preliminary research that has been carried out on teachers and students from several schools in the city of Bandar Lampung, information was obtained that the COVID-19 pandemic caused new problems for them. Teaching and learning activities that are usually carried out face-to-face must be replaced with online learning. Online learning is a new thing for them, so they are required to adapt quickly. Students have never done online learning, which resulted in students having difficulty in learning physics, both in working on problems and solving problems. Teachers have used media and learning models in teaching, but they are not optimal. The selection of media and learning

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models should be able to facilitate student learning and overcome problems that occur.

Teaching and learning activities are an important part of education organized by school institutions. One of the efforts that can be made by teachers in improving the quality of learning without face-to-face online is to update the media used. The integration of media into learning resources becomes learning media that can facilitate teaching and learning activities so that teaching and learning activities become easier (Wartono et al., 2018). The learning media can be in the form of e-modules. E-module is a module in digital form, which is arranged systematically, contains animation, audio, and video so that it is interactive in its use. In addition, the use of e-modules in learning can also be done anytime and anywhere, so it can be used for independent study (Fausih & Danang, 2015).

The 2013 curriculum requires that the learning process should place more emphasis on student activity in discovering the concepts being studied. In its application, e-modules can be presented using a problem-based learning model. (Zulherman, 2018) stated that the problem-based learning model is a series of learning activities that emphasize the process of solving problems faced scientifically. This will make students able to have the ability to solve a problem. Learning with a problem-based learning model can optimize the potential possessed by students (Bahri & Bakri, 2018). This is supported by research conducted by Abeysekera & Dawson (2015) which states that problem-based learning models can help students solve a problem and make students actively work together in solving these problems.

Flipped Classroom is a learning approach where the process of delivering material face-to-face is moved from classroom learning and is replaced by active and collaborative learning. The flipped classroom has become one of the most important aspects of classroom learning in recent years (Tindowen et al., 2017). Flipped classroom presents learning with a blend of technology in it to support student learning. This is an effort to provide student-centered learning solutions. Considering that learning in the COVID-19 era does not take place face-to-face, the flipped classroom can be an ideal solution for learning that is taking place now (Napitupulu, 2020; Khasanah, 2020).

Based on the description above, it is necessary to develop a problem-based physics e-module using sigil software with a flipped-classroom approach that is suitable for use as an alternative learning media during the COVID-19 pandemic.

**Method**

This study aims to develop a problem-based physics e-module using sigil software with a flipped-

classroom approach that is suitable for use as an alternative media for learning physics for simple harmonic motion material during the COVID-19 pandemic. The study uses research and development methods with the ADDIE development model consisting of 5 stages, namely analysis, design, development, implementation, and evaluation.

The research was conducted in class XI MIPA SMA Muhammadiyah 2 Bandar Lampung for the academic year 2020/2021. Data was collected using interviews, observations, and questionnaires which were distributed online to material experts, media experts, colleagues, practitioners, and students. In the analysis, the instruments used were interview guide sheets, observation guide sheets, and needs analysis questionnaire sheets. In development, the instrument used is in the form of a product feasibility assessment questionnaire by material experts, media experts, colleagues, and expert practitioners. In an implementation, the instrument used is in the form of a student response questionnaire sheet for the product being developed.

The product feasibility assessment by a material expert is addressed to 1 physicist lecturer, the instrument consists of 30 statement items relating to aspects of content feasibility, presentation feasibility, and linguistic feasibility. The product feasibility assessment by media experts is addressed to 1 lecturer who is an expert in learning media, the instrument consists of 24 statement items relating to the cover design feasibility indicators, and the content design feasibility. The assessment of product feasibility by colleagues is addressed to 1 postgraduate student of physics education, the instrument consists of 19 statements relating to aspects of the feasibility of presentation, content, and readability. The product feasibility assessment by practitioner experts is addressed to 1 physics subject teacher, the instrument consists of 24 statement items relating to the cover design feasibility indicator, and the content design feasibility. Meanwhile, student responses to the developed product were addressed to 5 class students in the limited trial, and 30 students in the expanded trial, the instrument consists of 8 statement items relating to aspects of the operation and benefits of the media.

The data obtained from material experts, media experts, colleagues, practitioner experts, and students were then analyzed qualitatively using the following equation: (Arikunto, 2014)

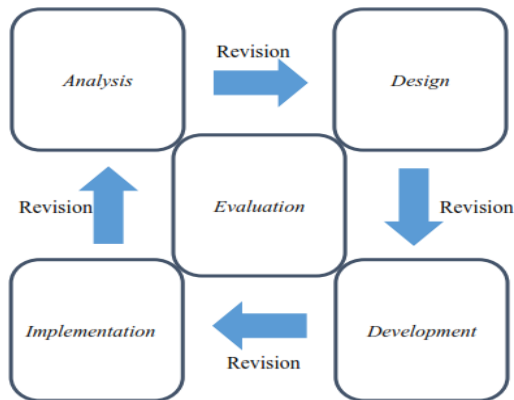
$$\%Score = \frac{Total\ score}{Maximum\ score} \times 100\% \dots\dots\dots (1)$$

To interpret the percentage of assessment results, the criteria listed in Table 1.

**Table 1:** Feasibility Assessment Criteria (Asyhari, 2017)

Achievement (%)	Criteria	Information
81 – 100	Very good	Proper to use
61 – 80	Good	Proper to use
41 – 60	Pretty good	Worth using with revision
21 – 40	Not good	Revision
0 – 20	Not very good	Revision

The following is a research flow chart of the stages of e-module development based on the ADDIE model:



**Figure 1.** Research flow chart of the stages of the ADDIE model

**Result and Discussion**

*Analysis*

1) *Preliminary analysis*

The COVID-19 pandemic has changed teaching and learning activities in schools that were originally face-to-face, into online classes. Of course, this creates new problems for both students and teachers. From the results of the analysis of the preliminary research that has been carried out, it was obtained information that students had difficulties in learning physics, both in working on problems and solving problems related to physics. Teachers have used teaching media and learning models, but they are not optimal.

2) *Analysis of learning objectives*

The analysis of learning objectives resulted in the e-module being developed containing the subject matter of simple harmonic motion, which was formulated based on an analysis of core competencies, basic competencies, and competency achievement indicators. The e-module is presented with stages of a problem-based learning model, and combined with a flipped-classroom approach, so that it can help students improve their academic abilities, as well as support learning during the COVID-19 pandemic.

3) *Concept analysis*

Concept analysis resulted in the subject matter of simple harmonic motion being presented including the restoring force on spring oscillations and pendulum swings, the energy of motion of objects on spring oscillations and pendulum swings at certain positions, characteristics of simple harmonic motion in the form of deviation, velocity, and acceleration, period and frequency of the oscillations. spring and pendulum swing, and phase and phase angle in simple harmonic motion

4) *Design*

E-modules are created and developed with the help of sigil software. E-modules can be operated via smartphones with Android and iOS operating systems with the help of an additional application, Reasily Epub Reader. The e-module consists of an opening, a body, and a closing section. The opening section of the e-module contains a cover page, identity page, introduction page, table of contents page, e-module description page, material brief description page, user guide page, core competency page, basic competency page, competency achievement indicator page, and concept map page. The content section of the e-module contains pages of learning activities 1 and 2, which contain learning objectives, prerequisites, presentation of learning, subject matter, material descriptions, sample questions, summaries, practice questions. The closing section contains an evaluation page with an answer key, a glossary page, and a bibliography page.

Each page of the e-module that is developed is made of navigation buttons that will make it easier to operate. The navigation buttons are the next page button, the previous page button, the table of contents button, the evaluation answer key button, the front cover page button, and the back cover page button. The following is the final view of the problem-based physics e-module using sigil software with a flipped-classroom approach that was developed:



**Figure 2.** Front and back cover pages

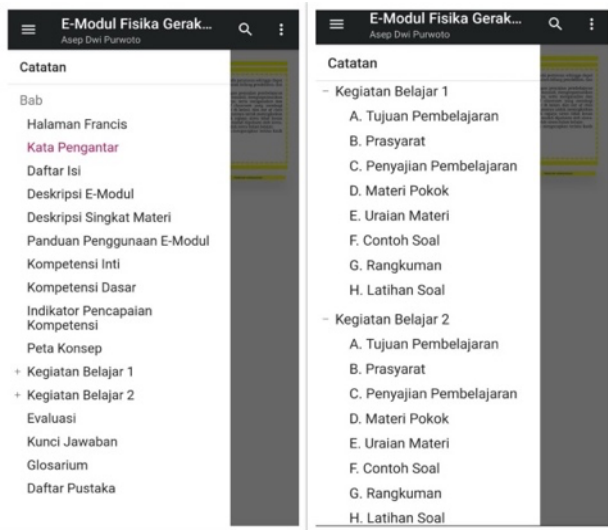


Figure 3. E-module components



Figure 4. Evaluation pages along with answer keys

Development

1) Material expert

The evaluation of the feasibility of the e-module by the material expert on the presentation feasibility aspect obtained the highest score with a percentage value of 95.83%, followed by the content feasibility aspect which obtained a percentage score of 88.64%, and the linguistic feasibility aspect obtained a percentage score of 82.14%. The average percentage value of the three assessment aspects is 88.87%, so the evaluation criteria for e-modules by material experts are very good.

Based on these results, it shows that the material that has been compiled and developed has been presented systematically, the material is by competency standards and basic competencies, has good accuracy, and is presented in a straightforward and communicative language. Assessment of the feasibility of e-modules by material experts who assess the aspects of the feasibility of content, presentation, and language is presented in table 2 and figure 5.

Table 2: Results of the evaluation of the feasibility of e-modules by material experts

Assessment criteria	score	Rated aspect		
		Content	Language	Presentation
Very good	4	24	40	8
Good	3	15	6	15
Pretty good	2	0	0	0
Not good	1	0	0	0
Total score		39	46	23
Maximum score		44	48	28
% Score		88.64	95.83	82.14
Average % score		88.87		
Criteria		Very good		

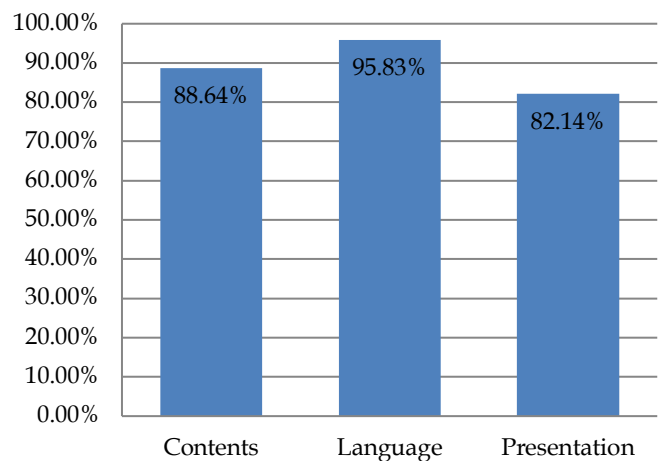


Figure 5. Results of the evaluation of the feasibility of e-modules by material experts

2) Media expert

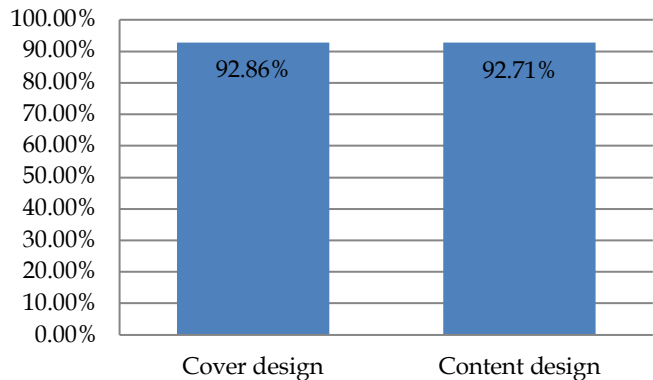
The evaluation of the feasibility of the e-module by media experts, the cover design feasibility indicator, received the highest score with a percentage value of 92.86%, followed by the content design feasibility indicator which obtained a percentage score of 92.65%. The average percentage value of the three assessment indicators is 92.71%, so the evaluation criteria for e-modules by material experts are very good.

Based on these results, it shows that the e-module cover design that was developed already has a good layout, the letters used are attractive, and the illustrations used already represent the contents of the e-module. Meanwhile, the content design of the developed e-module also has good elements and layout and makes it easier to understand. Evaluation of the feasibility of e-modules by material experts who assess aspects of the feasibility of content, presentation, and language is presented in table 3 and figure 6.



**Table 3:** Results of the evaluation of the feasibility of e-modules by media experts

Assessment criteria	Score	Rated aspect	
		Cover design	Content design
Very good	4	20	48
Good	3	6	15
Pretty good	2	0	0
Not good	1	0	0
Total score		26	63
Maximum score		28	68
% Score		92.86	92.65
Average % score		92.71	
Criteria		Very good	



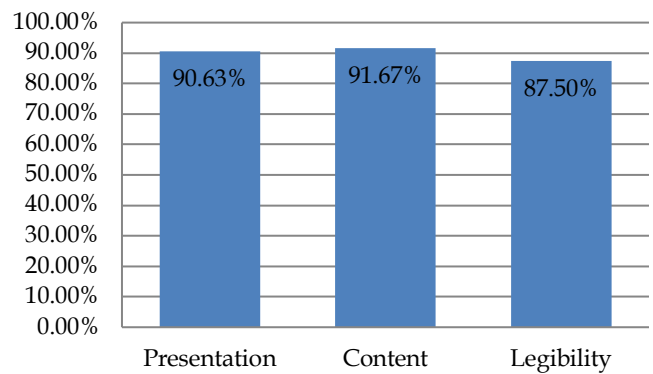
**Figure 6.** Results of the e-module feasibility assessment by media experts

3) *Peers*

The evaluation of the feasibility of the e-module by peers, the content feasibility aspect, received the highest score with a percentage score of 91.67%, followed by the presentation feasibility aspect which obtained a percentage score of 100% and the readability aspect obtained a percentage score of 87.5%. The average percentage value of the three assessment aspects is 89.93%, so the evaluation criteria for e-modules by material experts are very good. Assessment of the feasibility of e-modules by peers who assess aspects of the feasibility of presentation, content, and readability are presented in table 4 and figure 7.

**Table 4:** Results of the assessment of the feasibility of e-modules by peers

Assessment criteria	Score	Rated aspect		
		Presentati on	Conten t	Legibility
Very good	4	20	8	20
Good	3	9	3	6
Pretty good	2	0	0	2
Not good	1	0	0	0
Total score		29	11	28
Maximum score		32	12	32
% Score		90.63	91.67	87.50
Average % score		89.93		
Criteria		Very good		



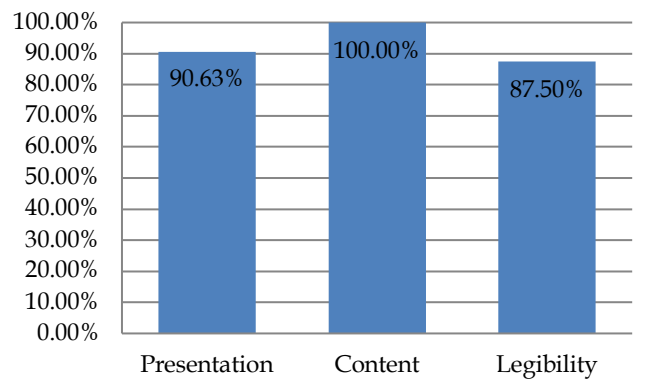
**Figure 7.** E-module feasibility assessment by peers

4) *Expert practitioner*

The evaluation of the feasibility of e-modules by practitioners of the content feasibility aspect obtained the highest score with a percentage value of 91.67%, followed by the presentation feasibility aspect which obtained a percentage score of 100% and the readability aspect obtained a percentage score of 87.5%. The average percentage value of the three assessment aspects is 89.93%, so the evaluation criteria for e-modules by material experts are very good. Evaluation of the feasibility of e-modules by expert practitioners who assess aspects of the feasibility of presentation, content, and readability are presented in table 5 and Figure 8.

**Table 5:** Results of the feasibility assessment of e-modules by expert practitioners

Assessment criteria	Score	Rated aspect		
		Presentati on	Conten t	Legibilit y
Very good	4	20	12	16
Good	3	9	0	12
Pretty good	2	0	0	0
Not good	1	0	0	0
Total score		29	12	28
Maximum score		32	12	32
% Score		90.63	100.00	87.50
Average % score		92.71		
Criteria		Very good		



**Figure 8.** Results of e-module assessment by expert practitioners

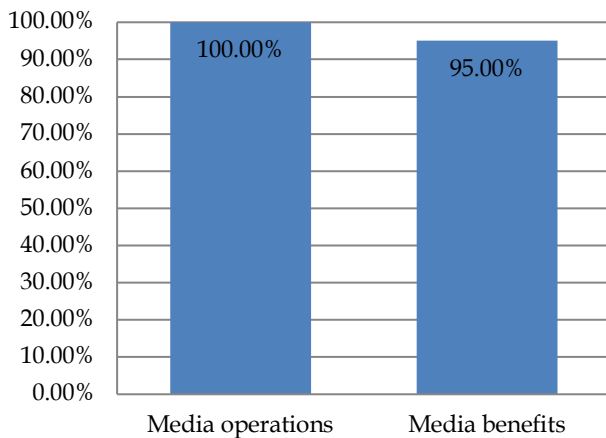
**Implementation**

**1) Limited trial**

The evaluation of the feasibility of the e-module by the students' responses to the limited trial of the media operation aspect obtained the highest score with a percentage score of 100%, and the aspect of the benefit of the media which received a percentage score of 95%. The average percentage value of the two aspects of the assessment is 97.5%, so the criteria for evaluating the feasibility of the e-module by the students' responses to the limited trial are very good. The evaluation of the feasibility of the e-module by the student responses to the limited trial of the aspects of the operation of the media and the benefits of the media are presented in table 6 and figure 9.

**Table 6:** Results of the e-module feasibility assessment by student responses from the limited trial

Assessment criteria	Score	Rated aspect	
		Media operations	Media benefits
Very good	4	60	80
good	3	0	15
Pretty good	2	0	0
Not good	1	0	0
Total score		60	95
Maximum score		60	100
% Score		100	95
Average % score		97.5	
Criteria		Very good	



**Figure 9.** Results of the e-module feasibility assessment by student responses from the limited trial

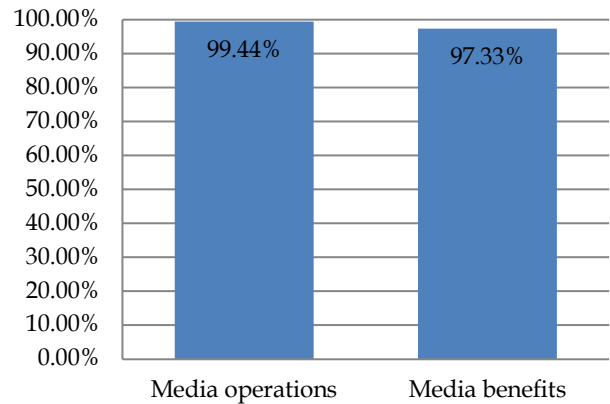
**2) Extended trial**

The evaluation of the feasibility of the e-module by the students' responses to the expanded trial of the media operation aspect obtained the highest score with a percentage value of 99.44%, and the media benefit aspect which obtained a percentage score of 97.33%. The average percentage value of the two aspects of the assessment is 98.39%, so the criteria for evaluating the feasibility of the e-module by the students' responses to

the expanded trial are very good. The evaluation of the feasibility of the e-module by the student responses to the expanded trial of the aspects of the operation of the media and the benefits of the media is presented in table 7 and figure 10.

**Table 7:** Results of the e-module feasibility assessment by student responses from the expanded trial

Assessment criteria	Score	Rated aspect	
		Media operations	Media benefits
Very good	4	352	536
good	3	6	48
Pretty good	2	0	0
Not good	1	0	0
Total score		358	584
Maximum score		360	600
% Score		99.44	97.33
Average % score		98.39	
Criteria		Very good	



**Figure 10.** Results of the e-module feasibility assessment by student responses from the expanded trial

**Evaluation**

The evaluation stage is carried out as a final improvement to the developed product. Evaluation is also carried out at each of the previous stages. Things that need to be evaluated are analyzing needs, initial product design, product development, and product implementation.

**Conclusion**

Based on the feasibility assessment of the developed product and the results of the data analysis carried out, the product feasibility assessment by material experts, media experts, colleagues, and expert practitioners obtained scores with very good criteria, and after a limited trial was carried out on 5 students, the trial was expanded to 30 students, get grades with very good criteria. Thus, the product developed in the form of a problem-based e-module using sigil software with a flipped-classroom approach is feasible to be used

as an alternative media for learning physics for simple harmonic motion material.

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