Berkala Ilmiah Pendidikan Fisika
ISSN : 2337-604X (print)
ISSN : 2549-2764 (online)

Vol 10 No 3 2022
https://ppjp.ulm.ac.id/journal/index.php/bipf
page 342-351

Development of E-Module based on Flipbook Learning Model Problem Based Learning (PBL) to Improve Critical Thinking Ability

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DOI:10.20527/bipf.v10i3.13655

Received: 16 June 2022 Accepted: 2 December 2022 Published: 30 December 2022

Abstract

This paper aims to develop a flipbook-based physics e-module to determine students' critical thinking skills by applying the problem-based learning (PBL) model. The method in the 4-D model research is qualitative descriptive. The research using a non-probability sampling technique that is selected is subject class 10 MIPA MAN 4 Bantul. Techniques for collecting data with test instruments and indicators are used in critical thinking, namely analyzing facts, formulating problems, selecting, clarifying and evaluating arguments logically, and drawing conclusions. The media and material analysis results show that the category is feasible, with a percentage of 85.43 and 75.41. The E-Module shows the average response in education suitable for use on critical thinking skills. The normality value of the control class is 0.002, and the experimental class 0.156. The homogeneity of the statistical significance level is 0.304. Therefore, the data has met the requirements to be tested using an independent test; there is a significant difference between the control class with lectures and experiments using e-modules.

Keywords: 4-D Model; Critical Thinking; Qualitative Descriptive; Problem Based Learning (PBL)

How to cite: Rohmatin, I. A., Racmayani, A., & Jumadi, J. (2022). Development of e-module based on flipbook learning model problem based learning (pbl) to improve critical thinking ability. *Berkala Ilmiah Pendidikan Fisika*, *10*(3), 342-351.

INTRODUCTION

Skills to put forward a student from various aspects of life in the realm of education in the 21st century (Prabasari & Wahyuningsih, 2021) need to gain insight, explore potential and reach their goals (Tiruneh et al., 2017). A quality nation can be seen as one of them through the good and bad education and human resources owned by the state. Therefore, in human life, education is something important (Maknun, 2020), carried out in a planned and conscious manner so that students actively realize the learning process and develop their potential to achieve learning goals (Di et al., 2017; Perdana et al., 2019; Putra et al., 2019).

The transformation process of the 21st-century era of science and technology is rapidly developing, resulting in free and tight competition (Abidin et al., 2019). Students directly impact daily life, and with the application of scientific concepts in science, students can solve problems expected in real life in the 21st-century era (Budiarti & Tanta,

2021). One of the educational innovations towards changing ideas or bright ideas to solve problems and also improve mindsets in understanding lessons (Putri & Istiyono, 2017), of them is physics, which is said to be a boring and difficult subject (Kurniawati, 2019); negative perceptions indirectly affect students in thinking (Perdana et al., 2019).

Learning physics is a contextually understanding knowledge (Presley et al., 2021) which requires a scientific approach to develop knowledge and improve it (Wulansari & Admoko, 2021). Education is always changing and improving in all aspects of life (Wardani & Jatmiko, 2021). One is providing supplies for social life to find a solution (Samosa, 2021). In dealing with a problem and facing the challenges of globalization, which is advancing rapidly, students are expected to have the ability to think critically (Putra et al., 2019) for the 21st century, these skills are no longer just a desired outcome of education, but as competencies for life in the 21st century (Asysyifa et al., 2019).

Education in Indonesia regarding the national qualifications framework requires that the curriculum for physics teachers be competent in various skills (Marsa & Desnita, 2021), including technology, problem-solving, critical thinking and independent learning (Hartini et al., 2020; Jatmiko et al., 2018; Yani et al., 2021; Yuberti et al., 2019). Critical thinking skills need to be instilled as technology and science advance (Suprapto et al., 2020) so that it plays an important role in all aspects of human life; the learning process continues to be implemented with an appropriate model (Christian et al., 2021). It can affect the learning process, and the final result is determined by increasing students' critical thinking skills (Wartono et al., 2018).

Learning orientation gets used to solving problems so that it can stimulate an increase in student-centered critical thinking, a model that can accommodate one of the problem-based applications or PBL (Makkonen et al., 2021) through group discussions aimed at training to exchange ideas between individuals and groups of friends to build knowledge the material being taught (Prabasari et al., 2021). This model leads to more responsibility and freedom in learning with sources such as the internet and library books (Harefa & Gumay, 2021; Khairunnisa, Abdullah, Khairil, Hasanuddin, 2022). The application of problem-based learning activities, in addition to being able to stimulate students' critical thinking skills, is also oriented to mathematical learning skills to develop thinking skills in solving problems related to everyday life through various activities following intellectual development to produce good abilities (Aufa et al., 2021; Fathurohman et al., 2021; Zulfa et al., 2022). Simple harmonic motion (GHS) material is one of the materials contained in the physics learning curriculum, that material there is still a link between daily life events and other authentic problems (Samsudin et al., 2020), which causes students to be required to think critically so that it will affect learning outcomes (Sani & Aulia, 2018).

In addition, problems were found the activities of the physics learning process, the teacher's more active role in delivering the material (Juan & Sulaiman, 2020), so that students only accept without being directly involved (Zarvianti & Sahida, 2020), The interview results show that problem-solving skills are not optimal (Rozal et al., 2021).

Independent and interesting learning resource facilities are needed to practice problem-solving and improve critical thinking skills (Munzil et al., 2022). lack of encouragement for the development of critical thinking skills in understanding concepts.

Thus the PBL module is very suitable, especially for physics, as it can provide more understanding of concepts than just memorizing formulas or equations (Baran et al., 2018). The opportunity to apply concepts to solve problems directly and independently is more widely used (Ngadimin et al., 2021).

One of the efforts to develop thinking skills in the active learning process requires an appropriate media or tool to teach physics material to support achieving basic competencies; based on observations at MAN 4 Bantul still using conventional teaching materials such as print media, there have not been maximized facilities. Internet and computers, especially in the digital-based learning process in schools.

Components that support 21st-century skills in the field of education are the innovation of new teaching materials or containers in the form of learning media that support the process of student learning activities in order to achieve learning goals independently and maximally digitally in the form of electronic modules (e-modules) (Prabasari et al., 2021). The advantages of e-modules are that they are equipped with interactive media so that they are innovative, increase interest in learning and can motivate and realize improvements in critical thinking and learning outcomes. While the book flipbook contains various images from one page to the next, pictures are animated by a simulated motion. When flipped quickly.

One of the e-modules developed in this innovation practicum contains simple harmonic motion material regarding the revised 2013 curriculum. This E-Module is intended for students of class X SMA/MA and contains text related to simple harmonic motion material with animation, video links, and sound recordings, along with supporting images to explain the material. Anytime use anywhere.

METHOD

The development procedure proposed by Thiagarajan et al. (1974) researches R&D (Research and Development) model is descriptive through the steps followed to produce a product with maximum and higher quality (Saniyyah et al., 2021). The research was conducted to produce useful educational products that effectively solve problems in the field with a more concise syntax but containing the overall stages (Supartini et al., 2020). The models are Define, Design, Develop, and Disseminate with the stages of defining (student analysis, concepts and curriculum), design (making flipbooks with posttest only control groups), development (validation and testing of flipbooks), and dissemination (given to students). Seen in the Figure 1.

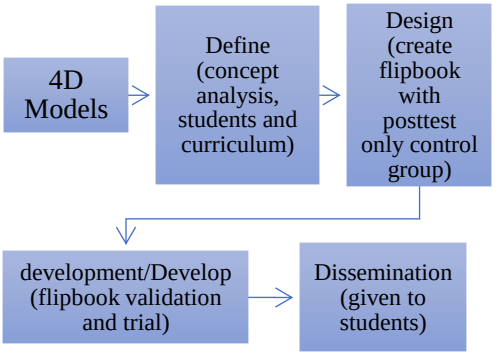

Figure 1 4D Development Model Flow

The use of the posttest-only control group is because the critical thinking ability data is only obtained from the posttest conducted, because the sample is not determined at random, but describes the academics of all classes equally, conducted at MAN 4 Bantul class X MIPA totalling 84 students. The descriptive analysis technique aims to see the data's mean, standard deviation, median and mode. The analysis was carried out using an independent t-test to determine the difference in critical thinking accompanied by the flipbook e-module in the experimental and control

classes taught with the media that is usually used. An Independent Sample t-test tested the hypothesis, if the data is normally distributed and homogeneous, also parametric statistics so that the maximum or minimum value is known. The analysis was tested first through a normality test with One-Sample Kolmogorov Smirnov and a homogeneity test with Levene Statistics after both tests were completed, then a t-test through independent sample t-test to answer the research hypothesis. The results of critical thinking skills obtained are then categorized, as shown in Table 1.

Table 1 Category of Critical Thinking Ability

Percentage (%)	Category
$81 < X \leq 100$	Very good
$61 < X \leq 80$	Well
$41 < X \leq 60$	Average
$21 < X \leq 40$	Low
$0 < X \leq 20$	Very Low

RESULTS AND DISCUSSION

The results of this paper from the control and experimental class posttest testing on critical thinking skills using flipbook-based e-modules obtained descriptive analysis. Statistical data are listed in Table 2.

Table 2 Group Statistics

	Class	N	Mean	Std. Deviation	Std. Error Mean
Critical Thinking	Experimental Class	24	83.83	3.547	0.724
	Control class	24	63.00	3.270	0.668

It is known from Table 1 that the experimental class, through the e-module learning media, the flipbook-PBL model obtained a higher mean than the control class. It is effectively applied when compared to conventional use. The research was conducted by Aufa et al. (2021) using a quasi-experimental method.

There is a difference in critical thinking skills using the PBL e-module model, which is to train students in analyzing a concept so that they get solutions to solve problems that are different from textbooks that are widely used in schools. In addition to descriptive analysis, further parametric testing is carried out to test the hypothesis with the conditions being normally distributed and homogeneous so that the Normality test and Homogeneous Test are needed, seen from Levene Statistics and the Kolomogorov-Smirnov test. Table 3 shows the results of the homogeneous test and the normality test.

Table 3 Tests of Normality

		Kolmogorov-Smirnov			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Critical Thinking	Experimental Class	0.152	24	0.160	0.939	24	0.156
	Control class	0.237	24	0.001	0.843	24	0.002

Based on Figure (2), it can be concluded that the data is not normally distributed. Normality occurs only in the experimental class because the significance value is more than 0.05. As for the control, the significance of which is less than 0.05, it is stated that the data is not normal. Furthermore, the homogeneity test was carried out, as shown in Table 4.

Table 4 Test of Homogeneity of Variance

		Levene Statistic	df1	df2	Sig.
Critical Thinking	Based on Mean	0.304	1	46	0.584
	Based on Median	0.195	1	46	0.661
	Based on Median with adjusted df	0.195	1	45.694	0.661
	Based on trimmed mean	0.301	1	46	0.586

It shows that the significance is 0.523, so it is stated that it is 0.523 > 0.05 with the homogeneity of Levene Statistics data. While the One-Sample Kolmogorov-Smirnov used in table 6 functions as a normality test, the normal distribution is proven to be sig > 0.05; in the experiment sig 0.200 and control 0.142, it is concluded that both are normally distributed, the Independent Sample t-test was carried out to know the results of the hypothesis with the data that had been obtained previously, the conditions were met. The Independent Sample t-test was carried out. The results of the independent sample t-test are listed in Table 5.

Table 5 Independent Sample T-Test

		Equal Variances Assumed	Equal Variances not Assumed
Levene's Test for Equality of Variance	f	0.304	
	Sig.	0.584	
T-Test for Equality of Means	t	21.155	
	df	46	
	Sig. (2-tailed)	0.000	
	Mean Difference	20.833	
	Std. Error Difference	0.985	
	Lower	18.851	
	Upper	22.816	

Based on the table above, it can be concluded that the data is homogeneous. The significance value indicates this in the Levene statistic column based on the mean of 0.304, which means more than 0.05. The data has met the requirements to be tested using an independent test.

The data from the independent test can be seen in the table in sig (2-tailed), where the value is 0.000; there is a significant difference between the two because the value is less than 0.05. This is also reinforced in the statistical group table from the experimental class; the mean is greater than the control.

Based on the results of the post-test, it was concluded that the distribution of critical thinking skills in the experimental and control classes. Seen in the following Table 6.

Table 6 Obtaining Critical Thinking Ability Score

	Value Critical Thinking Skills					
Class type	Very low	Low	Average	Well	Very good	Category
Experiment	-	3 L	2 L	7 L	10 L	Well
Control	-	6 L	9 L	5 L	2 L	Average

Information: L= Learners

Based on Table 6, the average experimental value is higher than the control on all indicators of critical thinking ability. The average improvement test results obtained in the learning process, seen from students' ability to master the material and to apply their responses, tend to be more active in

the experimental class than in the control class. Electronic media is interesting, varied and interactive, so it can help develop material and physics concepts (Sari et al., 2022). The results of the response questionnaire for selecting e-module components make it easier to understand the learning material (Asrizal et al., 2022). One of the learning resources is independent, so critical thinking skills are created because the material aspects in the e-module include problems that provoke critical thinking in finding a solution in problem-solving (Divayana et al., 2019). This is supported by the research of Putri & Aznam (2019) with the quasi-experimental method. The result of the research is that there is a difference in thinking skills between the experimental class using a module based on local batik potential, so it has more influence on critical thinking skills because it is adjusted to the indicators. It can provide insight to science teachers to create innovative learning materials, make students more interested in learning science and practice thinking skills, and research conducted by Aufa et al. (2021), research with a quasi-experimental method. Research results. There is a difference in critical thinking skills used by the PBL e-module model, namely training students in analyzing a concept to get solutions to solve problems that are different from textbooks used in schools.

CONCLUSION

Research on the use of e-module learning media based on flipbook critical thinking skills with a PBL learning model has been carried out so that an increase in the modeling class results, it is seen that the value that is proven through the independent t-test test increases in the experimental class compared to the control class.

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