E-Book with Problem Based Learning to Improve Student Critical Thinking in Science Learning at Elementary School

https://doi.org/10.3991/ijim.v16i20.32951

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Abstract—With the development of technology, especially in education, teachers must have learning media that attract students' attention, one of which is e-books. This study aims to determine whether problem-based learning-based e-books can improve students' critical thinking ability in primary school science learning. This research was conducted on elementary school students in the Jagakarsa, South Jakarta district. This research method used the Research and Development method. The researchers used a pretest and also a posttest to get the results. The results show that this e-book can improve critical thinking skills in science learning through digital media innovation, narration, video and practice questions.

Keywords—e-book, problem-based learning, critical thinking

1 Introduction

With each passing year, technology has developed very rapidly. It was found that there were many benefits from these advances, especially in the field of education. Students are provided with facilities in the form of computers, laptops and smartphones. They are allowed to access learning that is presented in an interactive format. Interaction in education is also required. Media is defined as a reference or intermediary [1]. Furthermore, it can be said that the media are tools and materials that can be poured into software or hardware. The covid-19 pandemic has spread throughout the world and in Indonesia. As a result of this pandemic, the entire community is required to maintain a distance and including students are also required to maintain a distance. At times like this, the government establishes distance learning or online via the internet. In this situation, of course, it can provide a vast discussion space for students. Furthermore, digital technology works with enormous opportunities in this period, especially in education [2]. Indonesia is implementing a 2013 curriculum system adapted to learning in the 21st century as it is today. The success of implementing the learning process cannot be separated from its components. Some components affect the course of a learning process. In teaching and learning activities,

several learning components are interrelated with each other, namely: 1) teachers, 2) students, 3) learning materials, 4) learning methods, 5) learning media, and 6) learning evaluation [3]. In these components, they will be related to each other.

In connection with the implementation of the 2013 curriculum, which in the book contains many subjects, the natural sciences incorporated in the 2013 curriculum aims to make students proficient in scientific knowledge that will be connected to life, understand the environment, be scientific and also problem-solving. Because each class has a different personality, like every course studying Science, their way of responding will be different, so the method taught will also be other for each class [4]. natural sciences are subjects that can represent implementation in learning in the 21st century. The characteristics of this natural science have content such as products, processes and procedures. Therefore, students must be able to think critically in combining these three things. Science learning is learning about natural phenomena, identifying and formulating natural phenomena based on observations, and finding solutions to problems [5]. Learning natural sciences in elementary schools has a goal that students can have the ability to learn, be responsible and also apply their knowledge in their lives. Learning science can also improve the critical thinking skills of elementary students in school because natural education sciences can stimulate students' critical thinking in their learning [6].

The role of thinking critically is considered very important in understanding reading books when faced with a problem that is felt to be solved by children [7]. Because by reading a lot, especially from books or from various other sources, students can solve these problems. It is imperative to practice critical thinking skills because these skills are not innate [8]. A person's thinking ability has been born from an early age but must be trained all the time because the ability to think will not be able to develop into a skill without training. Critical thinking includes a variety of skills, such as identifying sources, analyzing the credibility, reflecting on whether the information is consistent with prior knowledge, and drawing conclusions based on critical thinking. [9]. So critical thinking is reasoned thinking, reflection, and responsible for making reliable decisions. Thinkers have a practical and creative personality in asking the right questions, obtaining relevant information, selecting and sorting information, and providing logical reasons for information and conclusions that are credible and exciting [10]. Then improving the ability to think critically in natural sciences; it can be done by familiarizing students with questions based on Higher Order Thinking Skills (HOTS).

One of the learning models that can improve students' critical thinking skills is the Problem Based Learning model. Problem Based Learning is a student-centered learning model, so Problem Based Learning can facilitate students' systematic thinking [11]. So those students are allowed to carry out activities directly in solving a problem. Many researchers have recommended that this Problem Based Learning to be applied to various subjects. One of them is natural science. Another study said that Problem Based Learning requires a much longer time allocation for implementation [12]. Problem Based Learning emphasizes learning as a process that involves problem-solving and critical thinking, available to learn things real, develop communication, collaboration, and ideas to develop thinking skills [13]. Referring to several

opinions put forward by previous researchers, it is concluded that Problem Based Learning is a model that emphasizes student activity in finding solutions to problems or cases encountered so that they can solve these problems.

The demands of the era of globalization with the development of information technology can be used for the development of learning, one of which is a book that is presented in electronic form or known as an Electronic Book (E-Book). An e-book, also known as an electronic book, is a soft file from a printed book that is made in the form of an application that can be opened via electronic devices such as computers and cellphones, which are used as learning resources in delivering learning materials [14]. The use of e-books is hoped to increase knowledge and strengthen the students' mastery of the subject matter provided by the teacher in the classroom.

From the studies above, it is explained that the visual learning media in the form of an E-Book with a Problem Based Learning model is one of the practical learning media because it can increase students' interest and also increase students' critical thinking. Because in the author's research, many E-Books still have not used the Problem Based Learning model. In this study, an E-Book based on Problem Based Learning will be developed using the Flipbook application so that students will be more interested in reading this E-Book. The E-Book has exciting pictures and videos for students to see. In this E-Book, there are also questions related to everyday life to help students solve problems that usually occur in everyday life.

Researchers developed this E-Book-based interactive learning media to improve elementary school students critical thinking skills. The questions used in this research are: "Is the development of E-Book based on Problem Based Learning effective for improving Critical Thinking of Elementary School Students in Science Subjects?". In addition, this study seeks to answer the following problems:

1. How to develop an E-Book based on Problem Based Learning?
2. Can use of E-Book based on Problem Based Learning affect the increasing critical thinking of elementary school students in science subjects?

Researchers are interested in conducting this research with the intention that developing the E-Book media can be an effective learning media solution. The e-book media is essential to improve the critical thinking skills of elementary school students in science subjects so that elementary school students are expected to be able to understand and also be able to apply it in their daily lives.

1.1 Critical thinking

Thinking skills are complex skills that enable a person to obtain information, collect data and evaluate findings effectively[15]. Critical thinking skills are related to high reasoning levels signed by careful analysis and consideration. Developing essential thinking skills increases the quality of thinking because it involves reasoning and logic in solving it [16]. Therefore, critical thinking will be very influential in improving students' thinking. A common approach to teaching children to think critically can involve topics such as logic and judgment or opinion [17]. In addition, how to teach children to think critically can be done by reading more books by asking questions

that aim to understand what they want. Critical thinking skills are crucial for students' lifelong learning [18]. Necessary thinking skills are essential for education at all levels. Critical thinking aims to achieve deep understanding and lead to continuous learning over a long period [19].

Furthermore, if they have been trained to think critically from an early age, it will be easy for them to get a job in the world of work. The function of critical thinking itself is to solve some problems because it involves logical reasoning, then analyzing and finally evaluating information and enabling someone to make the right decisions [20]. Critical thinking skills are also essential for students because they participate in developing thinking; critical thinking skills are one of the basic skills and intellectual needs that must be met by each individual [21].

Necessary thinking skills are essential for education at all levels. In critical thinking, there are five steps, namely: 1) problem identification, 2) problem analysis, 3) research, 4) presentation, and 5) summary and evaluation [22]. These steps have an essential role and will also be interconnected. In addition, critical thinking also involves proper logical reasoning and the ability to separate facts from opinions [23]. Critical thinking will also encourage students to think more deeply and also be able to solve problems at school or in the context of daily life because critical thinking is not only needed in the classroom but also in everyday life. The critical attitude of the students shows that their thinking ability will continue to increase during the learning process [24]. The reason is students' high interest in learning when asked to convey ideas and reveal solutions to the problems that will be given.

1.2 Problem-based learning

Problem-based learning was first implemented at the Faculty of Medicine at McMaster University in Canada in 1970 [25]. Implementing Problem-Based Learning at McMaster University is community-oriented and focused on humans through a problem-based learning and learning approach. Problem Based Learning (PBL) is a teaching and learning approach that begins with a problem scenario where students are required to identify several learning topics for further exploration and research [26]. Problem Based Learning arises because of the failure of rote teaching to stimulate the relationship between new and existing knowledge in students. Problem Based Learning is a constructivism theory-based learning model that will attract students' interest in learning and actively participate in the learning process [27]. The problem-based learning model helps stimulate students to think critically in problem-oriented situations as well as encourages students to apply critical thinking, problem-solving skills, and connecting knowledge about problems in the real world [28]. Unlike the previous teaching method, the Problem Based Learning method has various effects as a learner-centred education emphasizing problem-solving in various conditions [29].

Moreover, Problem Based Learning is considered suitable for the formation of solutions. Because it is one feature that distinguishes Problem Based Learning from traditional rote learning [30], students can get used to it if they are trained with Problem Based Learning questions at an early age. Furthermore, problem-based learning can make learning independently because it has helped students become lifelong

learners [31]. The steps of problem-based learning method include problem orientation, student organization, investigation guide as individuals or groups, developing and presenting the work, and analyzing and evaluating the problem-solving process. The role of students in Problem Based Learning is very dominant. All information related to problem-solving efforts is directed to be done independently or in groups. Implementing Problem Based Learning in schools can provide a conducive learning environment for students and parents [33]. In addition, the teacher has a role in this case as a facilitator, giving feedback and strengthening when needed. Implementing Problem Based Learning is determined by the learning experience in the classroom and other learning environments [34]. The learning experience provided is in the form of identifying problems in the surrounding environment. Problem-based learning can train sensitivity and eventually trigger student action [35-41]. However, this activity is not only to teach students sensitivity and steps but can increase students' knowledge and literacy. In implementing Problem Based Learning, students are asked to start showing their critical thinking skills [42]. By asking friends about each other, or by reading references from books.

Moreover, there are several advantages to the Problem Based Learning model, namely: 1) Increasing students' critical power in thinking skills and also solving problems; 2) Improving students' collaboration skills; 3) Teaching students to take responsibility in the learning process [43]. Problem Based Learning is considered to have advantages because Problem Based Learning teaches students to be able to think critically. Problem Based Learning is also very influential in a more positive direction toward criticism of students' thinking skills [44]. Because students can analyze from an early age, they are used to exploring and thinking critically. Learning using conventional or traditional learning models such as the lecture method is a conventional one because the model will tend to cause boredom and a lack of interest in students to understand learning [45]. Teachers must have started to implement Problem Based Learning-based learning. Therefore, students and teachers should be more motivated to implement Problem Based Learning with better concepts according to their needs [46]. With the extraordinary curiosity and enthusiasm of the students, it is hoped that students and teachers will not be immediately satisfied with what they have achieved.

2 Method

The method used in this research is R&D (Research and Development) by adapting the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation). However, this study was limited to the implementation stage, which was tested through experimental research. This study involved elementary school students in Ciganjur District, South Jakarta. This study took a random sample involving 84 students.

2.1 Design of research

The design in this study used an experimental design, as seen in Table 1. The researcher used one group as the research subject and took measurements before and after treatment. Differences in measurement results are considered as the effect of the media used.

Table 1. Experimental design

Group	Pretest	Treatment	Post-Test
Experiment	O_1	X	O_2

Notes :
O1 = Pretest of experimental group
O2 = Pretest of experimental group
X = Problem-based e-book learning

2.2 Population and sample

The population in this study were fifth-grade elementary school students in Jagakarsa District, South Jakarta. This study used a random sample of 84 fifth-grade elementary school students with the Slovin formula in Jagakarsa District, South Jakarta, as an experiment. By taking a sample, it is expected to be able to select several elements of the population and provide conclusions about the expected overall population.

2.3 Research instruments

This research used pretest and posttest instruments related to students' critical thinking towards studying natural sciences. Pretest measurements were carried out before giving treatment; then, the researchers gave treatment in the form of an E-Book Based on Problem Based Learning. After being given experimental treatment, the posttest was given to the experimental group. The results of the Pretest were used as a comparison with the post-test results of the experimental group after being given treatment. Comparison between the performances of the pretest and posttest groups of the effect of E-book treatment based on problem-based learning given to critical thinking. Understanding of students' data collection techniques using written tests. The composition of the questions consists of 10 questions. This research and development also use validation instruments from material and media experts to test the feasibility of the press at the pilot stage.

2.4 Data analysis

Data analysis was carried out with a normality test using the Kolmogorov Smirnov test. Levene's test is utilized to find out the data homogeneity, and the t-test to test the hypothesis. Conclusions on the basis of hypothesis are formed applying criteria with level of significance of 0.05.

3 Results

This research and development used the ADDIE model, which consists of 5 stages: analysis, design, development, implementation and evaluation.

3.1 Analysis

Before designing the e-book media, this study analyzed the level of understanding of fifth-grade elementary school students in Jagakarsa District, South Jakarta. Understand science subjects, especially in the Human and Animal Respiratory System material. Then go through the form as a pretest step by filling out ten questions. When analyzing the students' understanding of the Human and Animal Respiratory System material, students were not given any treatment. They filled out questions according to their knowledge of the material.

Then after filling in the questions in the Pretest, it turns out that some students still do not understand the concept of the Human and Animal Respiratory systems. Moreover, most students are still confused about the order of human respiration. Therefore, this analysis took Research and Development research, namely by making an E-Book based on Problem Based Learning with the ADDIE model to improve students' critical thinking about the Human and Animal Respiratory systems material and disorders obtained from air pollution.

3.2 Design

Building critical thinking through an e-book based on Problem Based Learning was designed using the Canva application and the Flipbook application as a professional application. Canva has images and animations that attract the attention of students. Flipbook also has animations to make the e-book like an actual book. Utilization of e-book such as digital Flipbooks can significantly improve memory as well as comprehension level. E-book helps explain, make subject matter understandable, and increase student motivation during teaching and learning. E-book can also foster independent understanding so that self-confidence, motivation, initiative, discipline, and responsibility will grow. Learning outcomes and critical thinking skills can be improved by implementing Flipbook as a digital medium. Moreover, this E-book collaborates with the Canva application, which has pictures and animations to attract students' attention. Overall, PBL-based e-book, especially in Natural Science material, can be used to empower critical thinking skills as one of the digital learning media innovations that are needed to support learning in this technological era. This PBL-based e-book is combined with other multimedia such as text, narration, video, and practice questions and is also integrated into the implementation of learning.

3.3 Develop

The initial display of the e-book contains the cover, book identity and introduction. The surface uses high-quality images. Furthermore, the book's identity includes the book's title, the author's name, the book's print, and the book's pages. Furthermore, there is also an introduction intended for readers and those who have helped in the process of making this book. Students only need to press the button, which will automatically move to the next page. Furthermore, there is a page that contains material in this Problem Based Learning-based e-book. We can also play a video on this page if you want to see the video. E-book has practice questions to train students' critical thinking skills. There are also research experiments in making artificial lungs and analysis of story questions. Then there is a link for the collection of students' assignments. Figure 1 presents material in an e-book based on problem-based learning.

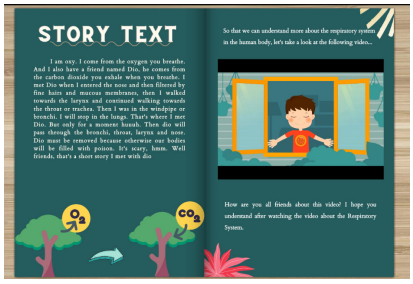

Fig. 1. Display of material in an e-book based on problem-based learning

3.4 Implementation

Before the trial was conducted on 84 students, they were given a pretest questionnaire on critical thinking, and after the media test, the students were given a posttest questionnaire on critical thinking. Table 2 presents the pretest and posttest results of students' critical reflection on the Kolmogorov-Smirnov test.

Table 2. Kolmogorov-Smirnov test

One-Sample Kolmogorov-Smirnov Test		Unstandardized Residual
N		84
Normal Parameters	Mean	.000
	Std. Deviation	6.255
Most Extreme Differences	Absolute	.097
	Positive	.056
	Negative	-.097
Test Statistic		.097
Asymp. Sig. (2-tailed)		0.057
Test distribution is Normal		

Table 2 shows the results of the normality test data using the Kolmogorov-Smirnov test, which aims to know whether the residual value is usually distributed. Based on the normality test carried out in Table 2, it is known that the significance value is 0.057 > 0.05, which means that the Pretest and Posttest critical thinking of fifth-grade elementary school students in the Jagakarksa sub-district, South Jakarta, is normally distributed. Descriptively, there is a difference between the score of the pretest and posttest. Therefore, the measurement can be continued by interpreting the t-test results.

The paired sample t-test can be seen in Table 3. It is known that the significance value is 0.00 less than 0.05, then Ho is rejected, and Ha is accepted. It can be confirmed that this research concludes that there is a difference in the average critical thinking of the Pretest and Posttest. It means that using e-book based on Problem Based Learning has a positive effect on improving critical thinking for fifth-grade elementary school students. Based on the test results in Table 3. It shows that the use of PBL-based E-Books has positive things. This finding is also reinforced by other studies which show that pbl is very useful to implement. Pbl-based E-Books can be applied to improve students' language and 21st diabase skills [46] because the material in this E-Book is presented visually and quickly understood by students. However, what must be known in using PBL is that it is necessary to improve how to deliver the correct crew problem so that students easily understand what they are going to do. The initial problem presented is not a problem in the form of questions but issues that occur in students' lives [47-48]. However, in this book, the questions already have elements that meet the PBL criteria, so students can start stimulating their critical minds through this e-book.

Table 3. Paired samples test

Pretest-Posttest	Mean	Standard Deviation	Standard Error Mean	95 % Confidence interval of the difference		t	df	Sig. (2-tailed)
				Lower	*Upper*			
	-8,702	8,961	0,978	-10,647	-6,758	-8,900	83	0.000

3.5 Evaluation

The evaluation involving media and material experts aims to improve e-books based on the developed PBL learning media products. A media expert assessed the validity of the PBL-based e-book from a fifth-grade elementary school teacher in the Jagakarsa sub-district, South Jakarta. Based on the results of the media expert validation, it is known that the average percentage of achievement obtained from 4 aspects, including 15 questions in the questionnaire, is 89.4%. Thus, it can be concluded that the developed Problem Based Learning-based E-Book has a possible interpretation. A material expert, one of the fifth-grade elementary school teachers in Jagakarsa District, South Jakarta, assessed the validity of the E-Book based on Problem Based Learning. Based on the material expert validation measurement results, it is known that the average percentage of achievement obtained from 3 aspects containing 15

statements in the questionnaire is 89,4%. Thus, it can be concluded that the problem based learning-based e-book was developed as a possible interpretation.

4 Conclusion

Based on the data from the posttest results of students' critical thinking, it is known that the experimental treatment of Problem Based Learning-based E-Books is greater than the students' critical thinking pretest before being given the PBL-based E-Books. Therefore, it can be concluded that the PBL-based E-Book learning media increases elementary school students' learning interest in the Jagakarsa sub-district, South Jakarta. This media has been proven valid and practical to use so that elementary school teachers can use it as a medium in science learning. In addition, this PBL-based E-Book also affects on students' critical thinking towards science learning because the teacher can guide students to access the Human and Animal Respiratory System materials through pictures, videos, experiments, and exercises contained in this PBL-based E-Book. Consequently, it can become a unique attraction for students accessing this E-Book. This research can recommend that Problem Based Learning-based E-Book media be implemented as a learning medium in improving fifth grade elementary school Critical Thinking in a broader area, not only in Jagakarsa sub-district, South Jakarta but also all elementary schools in Jakarta Area.

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Article submitted 2022-06-02. Resubmitted 2022-08-26. Final acceptance 2022-08-30. Final version published as submitted by the authors.