Jurnal Ilmiah Pendidikan Guru Sekolah Dasar
April 2025, XI (1), 41-57
P-ISSN: 2085 – 4048
https://journal.unj.ac.id/unj/index.php/pgsd/

E-Book Based Problem Based Learning to Improve Student's Critical Thinking in Science Learning in Elementary School

Putri Bestari Dwiyanti
Elementary School Teacher Education Study Program, State University of Jakarta, Indonesia
Putribdy@gmail.com

Abstrak

*In the era of rapid technological development, especially in education, the use of innovative learning media is crucial for teachers to attract students' attention. This study aims to analyze the effectiveness of E-Books based on Problem Based Learning in improving students' critical thinking skills in science learning in elementary schools. The study was conducted on elementary school students in Jagakarsa District, South Jakarta, using the Research and Development (RnD) method. To measure the impact of E-Books on students' critical thinking skills, researchers used pre-tests and post-tests as evaluation instruments. The results of the study indicate that the integration of E-Books based on Problem Based Learning can improve students' critical thinking skills through digital media innovation, interactive narratives, educational videos, and practice questions that support deeper science learning.*Keyword: *smartphone addiction, elementary school students, social-emotional development, parental supervision, digital technology*.

(*) Corresponding Author: *Putribdy@gmail.com*

Received: 2025-01-13 Revised: 2025-04-29 Accepted: 2025-04-30

How to Cite: *Putri Bestari Dwiyanti. (2025). E-Book Based Problem Based Learning to Improve Student's Critical Thinking in Science Learning in Elementary School***,** *Jurnal Ilmiah Pendidikan Guru Sekolah Dasar, XI (1): 41-57*

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 given the opportunity to access learning that is presented in an interactive form. Interaction in learning is also required. Media is defined as a reference or intermediary (sukmawati, et.,al, 2020). And it can be said that the media are tools and materials that can be poured into *software* or *hardware*.

Students are provided with facilities in the form of computers, laptops and smartphones. They are given the opportunity to access learning that is presented in an interactive form. In this situation, of course, it can provide a wide discussion space for students. And, in this period digital technology works with enormous opportunities, especially in the field of education (Singh, 2021). In Indonesia, currently implementing a 2013 curriculum system that is adapted to learning in the 21st century as it is today. The success of the implementation of the learning process cannot be separated from its components. There are components that 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, 6) learning evaluation (Ananda, R. 2019). . In these components they will be related to each other.

Related to the implementation of the 2013 curriculum which in this book itself contains many subjects, then Natural Sciences (IPA) contained in the 2013 curriculum aims for students to be able to master scientific knowledge that will be connected to life, understand the environment, behave scientifically and as problem solvers. Because each class has a different personality, such as each class that is studying IPA, the way they respond will also be different, so the methods taught will also be different for each class (Suryandari, et.,al, 2021). Science learning in Elementary Schools aims for students to have the ability to learn, be responsible and apply their knowledge in their lives (Karyadi, et.,al, 2019). Science learning can also improve the critical thinking skills of elementary school students (Suryanti, et., al, 2019).

The role of critical thinking is considered very important in understanding reading books when faced with a problem that children feel needs to be solved (.Ardhian, 2020). Because by reading a lot, especially from books or from various other sources, students can solve the problem. Critical thinking includes various skills, such as identifying sources, analyzing credibility, reflecting on whether information is consistent with previous knowledge, and drawing conclusions based on critical thinking. Then improving critical thinking skills in Natural Sciences (IPA) 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. Many researchers recommend this Problem Based Learning to be applied to various subjects. Problem Based Learning emphasizes learning as a process that involves problem solving and critical thinking, available to learn real things, develop communication, collaboration, and ideas to develop thinking skills (Darling-Hammond, et.,al, 2020). Referring to several opinions that have been put forward by previous researchers, it can be concluded that Problem Based Learning is a model that emphasizes student activities in finding solutions to problems or cases faced so that they can solve these problems.

E-books or also called electronic books are soft files of printed books that are made in the form of applications that can be opened via electronic devices such as computers and mobile phones that are used as learning resources in delivering learning materials (Yenzi Rafli, , 2019). From the research above, it is explained that visual learning media in the form of E-BOOK with the Problem Based Learning model is one of the effective learning media because it can increase student interest and improve students' critical thinking skills. In this study, an E-BOOK based on Problem Based Learning will be developed using the FLIPBOOK application so that students are more interested in reading this E-BOOK because in E-BOOK there are pictures and videos that are interesting for students to see.

The question used in this study is: is the development of E-BOOK based on Problem Based Learning effective in improving the critical thinking skills of elementary school students in science subjects? (1) How to develop an E-BOOK based on Problem Based Learning? (2) Can the use of E-BOOK based on Problem Based Learning influence the increasing critical thinking of elementary school students in science subjects?

Researchers are interested in conducting this research with the intention that the development of the E-BOOK media can be an effective learning media solution 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 be able to apply it in their daily lives.

Critical Thinking

Critical thinking skills are a term related to a high level of reasoning characterized by careful analysis and consideration. The development of critical thinking skills results in an increase in the quality of thinking because it involves reasoning and logic in solving it (Zubaidah, et.,al, 2019). 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. Learning critical thinking skills is very important for students and their lifelong learning (Bećirović, et.,al, 2019). Critical thinking skills are essential for education at all levels. The purpose of critical thinking is to achieve deep understanding and lead to continuous learning over a long period of time (Fahmi, 2019). The function of critical thinking itself is to solve several problems, because it involves some logical reasoning, then analyzes and finally evaluates information and allows someone to make the right decision (Arifuddin,, 2020). Critical thinking skills are also very important for students because they play a role in the development of thinking, critical thinking skills are one of the basic skills and intellectual needs that must be met by every individual (Mahanal, 2019). Critical thinking skills are very important for education at all levels. In addition, critical thinking also involves proper logical reasoning and the ability to separate facts from opinions (Basri. Et.,al, 2019).

Problem Based Learning

The implementation of Problem Based Learning at Mc Master University is community-oriented, human-focused, 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 to be explored and researched further (Orfan, et.,al, 2021). Problem Based Learning arises because of the failure of rote teaching in stimulating the relationship between new knowledge and existing knowledge in students. Problem Based Learning is a learning model based on constructivism theory that will attract students' interest in learning and actively participate in the learning process (Qomariyah, 2019). The Problem Based Learning learning model is useful for stimulating students to think critically in problem-oriented situations. Because it is one of the characteristics that distinguishes Problem Based Learning from traditional rote learning (Summons, et.,al, 2021).

Table 1. Characteristics of Problem Based Learning.

Step	Characteristics	of Student Activities
Step 1	Problem Orientation	Students understand the details of the problem to be discussed. The problem is taken from the teaching material being studied.
Step 2	Organizing Students	Students analyze and find out how to solve problems. Students can solve problems by finding problems that are similar or like the problem being analyzed. At this stage, students can classify the details of the problems discussed.
Step 3	Investigation Guide to Individuals or Groups	After students classify the details of the problem to be discussed, students can investigate the problem individually or in groups.

Step 4	Developing and Presenting the Work	Students can develop and present the results of their discussion of the problems being discussed. At this stage, students can compare the steps to solving other problems and find out which steps to solve the problem are most appropriate.
Step 5	Analyzing and Evaluating the Problem-Solving Process	Students can conduct an analysis to reflect and evaluate the results of an investigation about solving the problem being discussed. Students can conclude correctly and Solving problems accordingly.

Implementation of Problem Based Learning in schools can provide a conducive learning environment for students and for parents (Craig, et.,al, 2019). In addition, teachers have a role in this case, namely as a facilitator, providing feedback, and reinforcement when needed. The success of implementing Problem Based Learning-based learning is determined by the learning experience in the classroom and other learning environments (Sugiharto, et.,al, 2019). However, this activity is not only to train students' sensitivity and actions but can also increase students' knowledge and literacy. In implementing Problem Based Learning, students are asked to begin to demonstrate their critical thinking skills (Fadilla, et.,al, 2021). And there are several advantages in the Problem Based Learning learning model, namely: 1) Increasing students' critical thinking skills and problem-solving skills; 2) Increasing students' collaboration skills; 3) Teaching students to be responsible in the learning process (Ariyanto, et.,al, 2019). Problem Based Learning is considered to have advantages because Problem Based Learning teaches students to be able to think critically. Because students can analyze from an early age, they are used to analyzing and thinking critically. Therefore, both students and teachers should be more motivated in implementing Problem Based Learning with better concepts according to their needs (Husin, et.,al, 2019).

METHODS

The method used in this research is R&D (Research and Development) by adapting the ADDIE Model (Analysis, Design, Development, Implementation, Evaluation). However, in this study, it 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

Research Design

Design The design in this study used an experimental design, which can be seen in Table 2. The researcher used 1 group as the research subject and took measurements before and after treatment. Differences in measurement results are considered as the effect of the use of the media used.

Table 2. Experimental Design of Problem Based Learning-based E-BOOK Research to Improve Students' Critical Thinking

Group	Pre-test	Treatment	Post-Test
Experiment	O_1	X	O_2

Description:
O_1: Pre-test
O_2: Post-test
X: Problem Based E-BOOK Learning

Population and Sample

The population in this study were fifth grade elementary school students in Jagakarsa District, South Jakarta. This study took a random sample of 84 fifth grade elementary school students with the Slovin formula in Jagakarsa District, South Jakarta to be used 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.

Research Instruments

This research uses Pretest and Posttest instruments which are 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 in comparison with the posttest 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. The grid of pretest and posttest questions about students' critical thinking in learning science is as follows:

Table 3. Pre-test and Post-test

Indicator	Aspects Asked	No. items
Learning media used	Types of media/teaching materials used	1,2,3,4
	Contents of media/teaching materials	
	Advantages of the media used	
	Weaknesses of the media used	
21st century skills of students	Knowledge of students operating digital technology	5
	Fulfilling the need for critical thinking skills from the media used	6.7

Relationship of digital teaching materials with skills critical thinking	The need for digital media/teaching materials that empower critical thinking skills	
The process of empowering critical thinking skills	Use of PBL-based E-BOOK	8,9,10
	HOTS-based questions on digital media	
	Attitudes of students skillful 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 experts and media experts to test the feasibility of the media at the pilot stage.

Table 4. Media Validation Instrument Grid Table

Aspects	Indicator	Item number
Design	Interactive e-book based on pbl	1
	The color combination in interactive e-book based on pbl	2
	Illustration of an image on interactive E-Book	3
	Attractive interactive e-book based on pbl	4
	The used of fonts in interactive e-book-based problem-based learning video is easy to read	5
Module Content	Material in interactive e-book based on pbl is ready to understand	6
	Normal letter spacing	7
	The presentation of material fosters student learning interest.	8
	The use of letter variations is not exaggerated	9
Image and Video	Image and video quality	10
	The suitability of the content of the material on the image and video	11
	Video compatibility	12
Easy to Use	Interactive e-book based pbl is easy to use	13
	Practical interactive e-book based on pbl	14
	Can be used individually or in groups	15

Table 5. Material validation instrument grid table

Aspect	Indicator	Item number
Material Quality	The suitability of the material with the natural appearance learning indicators	1
	The suitability of the material with the learning objectives of natural appearance.	2
	Information in an interactive e-book based on pbl provides new knowledge	3
	The material is easy for students to understand	4
	Consistence of material with the subject	5
	Quiz questions and evaluations are used both to test students' abilities	6
Language	The language used is communicative, effective, and efficient	7
	The sentences used do not have a double meaning	8
	The language used is easy to understand for students	9
	Consistent in the use of terms, symbols, scientific names	10
Implementation	Image and video quality	11
	Can be used individually and in groups	12
	Interactive e-book based on pbl according to the students need	13
	The practicality of interactive e-book based on pbl	14
	Compatibility of the contents of the image and video with the material	15

In this study, tests were used to measure critical thinking outcomes the students. Data analysis of student learning outcomes is then calculated by the formula N – Gain.

$$N - Gain = \frac{posttest\ value - pretest}{value\ maximum\ value - pretest\ value}$$

Data Analysis

In statistical analysis, the data distribution normality test was carried out, namely the Kolmogorov-Smimov test. The basis for making normality test decisions, namely:

1) If the significance value > 0.05, then the residual value is normally distributed.
2) If the significance value is <0.05, the residual value is not normally distributed.

In this study, inferential statistics for hypothesis testing using paired sample t-test. Conclusions from the hypothesis made using criteria with a significance level of 0.05. Those are the basis for decision making in the UHI pair sample t test is:

1) If the significance value (2-tailed) < 0.05 then Ho is rejected, and Ha is accepted.
2) If the significance value (2-tailed) > 0.05 then Ho is accepted, and Ha is rejected.

Table 6. Validation Score Category Media and Material Experts

Scoring Scale	Alternative Answer
5	Very good
4	Good
3	Quite good
2	Not good
1	Bad

Table 7. Media and Material Eligibility Criteria Based on Rating Scale

Percentage of Scoring Scale	Eligibility Criteria
86% - 100%	Very Worthy
51% - 85%	Worthy
26% - 50%	Less Worthy
0% - 25%	Not Advisable

RESULTS & DISCUSSION

Result

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

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 GForm as a pretest step by filling out 10 questions. When analyzing the level of students' understanding of the Human and Animal Respiratory System material, students were not given any treatment and filled out questions according to their understanding of the material.

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

Design

Building critical thinking through an E-BOOK based on Problem Based Learning designed using the Canva application and the Flipbook application as a professional application. Canva has images and animations that really attract the attention of students. Flipbook also has animations to make the E-BOOK like a real book. Utilization of E-BOOK such as digital Flipbook can significantly improve memory as well as comprehension level. E-BOOK helps in providing explanations, making subject matter understandable and increasing student motivation during the teaching and learning process. E-BOOK can also foster independent learning 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, in this E-BOOK, it is collaborated with the Canva application which has pictures and animations to attract the attention of students. 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. In this PBL-based E-BOOK it is also combined with other multimedia such as text, narration, video, practice questions and is also integrated into the implementation of learning.

Develop

In Figure 1 this is the initial display of the E-BOOK which contains the cover, book identity and the introduction. The cover uses high quality images. Furthermore, there is the identity of the book which contains the title of the book, the name of the author, the print of the book and the pages of this book. Furthermore, there is also an introduction which is intended for readers and for those who have helped in the processof making this book

Figure 1. Initial Display of an E-BOOK based on Problem Based Learning

In the next 2 pages, students only need to press the next button, it will automatically move to the next page. Furthermore, there is a page that contains material in this Problem Based Learning-based E-BOOK. On this page there is also a video that we can play if you want to see the video.

Figure 2. Display of Material in an E-BOOK based on Problem Based Learning

In this third picture there are practice questions to train students' critical thinking skills. There are research experiments in making artificial lungs and analysis of story questions. Then there is a link for the collection of assignments that have been done by students.

Figure 3. Display of Exercises in an E-BOOK based on Problem Based Learning

Implementation

Before the trial was conducted on 84 students, they were given a pre-test questionnaire on critical thinking and after the media test, the students were then given a post-test questionnaire on students' critical thinking. Table 4 presents the results of the pre-test and post-test of students' critical thinking on the Kolmogorov-Smirnov test.

Table 8. Kolmogorov-Smirnov Test

One-Sample Test Kolmogorov-Smirnov Test

		Unstandardized Residual
N		84
Normal Parameters[a,b]	Mean	,0000000
	Std. Deviation	6,25481733
Most Extreme Differences	Absolute	,097
	Positive	,056
	Negative	-,097
Test Statistic		,097
Asymp. Sig. (2-tailed)		0.047[c]

a. Test distribution is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

In table 8. These are the results of the Normality Test data using the Kolmogorov-Smirnov test which has the aim of knowing whether the residual value is normally distributed or not. Based on the normality test carried out in table 8. It is known that the significance value is 0.047 > 0.05, which means that the Pretest and Posttest critical thinking of fifth grade elementary school students in Jagakarksa sub-district, South Jakarta are normally distributed.

Table 9. Paired Sample Statistics

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test	80,76	84	9,807	1,070
	Post-Post	89,46	84	7,114	,776

Table 10. Paired Sample Correlations

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Pre-Test & Post-Post	tables	From	84,476,000

In table 9 and 10 we can see that the average value of Pretest = 80.76 < Posttest average value = 89.46. So, we can conclude that the average posttest value after testing E-BOOK based on Problem Based Learning is better than the average pretest value before being tested on the media.

Table 11. Paired Sample 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

Based on table 11. It is known that the significance value is 0.00 <0.05, then Ho is rejected, and Ha is accepted. Then we can conclude that there is a difference in the average critical thinking of the Pretest and Posttest. This means that the use of 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 11. It shows that the use of PBL-based E-Books has positive things. This is also reinforced by other studies which show that pbl is very useful to implement, pbl-based E-Books can be applied both to improve students' language skills and also 21st diabase skills (Suwastimi, et.,al, 2021). Because the material contained in this E-Book is presented visually and also easily understood by students. However, what must be known in using PBL is that it is necessary to improve how to present 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 problems that occur in students' lives (Aufa, et.,al, 2020). However, in this book, the questions contained in it already contain elements that meet the PBL criteria so students can start stimulating their critical minds through this E-Book.

Evaluation

The evaluation involving media experts and material experts aims to improve e-books based on the developed PBL learning media products.

1) Media Expert
   Assessment of the validity of the pbl-based e-book by a media expert from a fifth grade elementary school teacher in Jagakarsa sub-district, South Jakarta. The following are the results of media expert validation.

Table 12. Media Validation

No	Aspect	Indicator	Score	Total Score	Maximum Score	Percentage (%)	Validation Criteria
1	Design	1	4	22	25	88	Very Worthy
		2	5				
		3	4				
		4	4				
		5	5				
2	Module Content	6	5	18	20	90	Very Worhly
		7	5				
		8	4				
		9	4				
3	Image and Video	10	5	13	15	86,6	Worthly
		11	4				
		12	4				
4	Easy to Use	13	5	13	15	93,3	Very Worhly
		14	5				
		15	4				
Percentage of All Aspects						**89,4%**	
All Aspects Validation Criteria						**Very Worthy**	

Based on the results of the media expert validation research table, it is known that the average percentage of achievement obtained from 4 aspects which includes 15 questions in the questionnaire is 89.4%. Thus, it can be concluded that the Problem Based Learning-based E-Book that was developed has a very feasible interpretation.

Material Expert

Assessment of the validity of the E-Book based on Problem Based Learning by a material expert who is one of the fifth-grade elementary school teachers in Jagakarsa District, South Jakarta. The following are the results of media expert validation.

Table 13. Material Validation

No	Aspect	Indicator	Score	Total Score	Maximum Score	Percentage (%)	Validation Criteria
1	Material Quality	1	4	27	30	90	Very Worthy
		2	5				
		3	4				
		4	4				
		5	5				
		6	5				
2	Language	7	5	18	20	90	Very Worhly
		8	5				
		9	4				
		10	4				
3	Image and Video	11	5	22	25	88	Very Worthly
		12	4				
		13	4				
		14	5				
		15	4				
Percentage of All Aspects						**89,4%**	
All Aspects Validation Criteria						**Very Worthy**	

Based on the results of the material expert validation assessment table, 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 that was developed has a very feasible interpretation

Discussion

Problem-based learning (PBL) has recently seen e-books as an effective way to improve students' critical thinking skills, especially in the context of elementary school science learning. Various studies have shown that the implementation of PBL in education has a positive impact on students' cognitive skills. Handika & Wangid (2013) research showed that PBL can significantly improve students' control over science concepts compared to traditional learning methods, with results showing main effects and P values. In addition, using e-books as PBL tools has great potential to support effective learning. However, it should be noted that the bibliography available on modules and PBL is more relevant to the context of mathematics learning. (2021). Digital media such as e-books can

be used to facilitate access to information and interactive learning materials, motivate students, and help them understand complex concepts.

Research shows that PBL has a positive impact on student learning outcomes by increasingly influencing and influencing thinking in relation to physics (Rahayu and Juliani (2016). This is consistent with the results of Islahiyah et al. This states that the PBL model can increase student customer loyalty, but PBL research does not directly discuss it in the context of Silmiati Science (2017). In this context, improving critical thinking skills is also closely related to the type of learning material. As from Mas et al. The use of PBL in history shows that students become more critical after being involved in this learning model. MAS et al. (2023). Using the same approach in science learning using e-books as a source is expected for students to think critically about ecological and scientific tasks. Based on all this knowledge, we conclude that problem-based learning that integrates the use of e-books increases tremendous potential to improve critical thinking skills among elementary school students, especially in science learning. Education should consider implementing and developing learning materials in digital formats that can support PBL so that students can not only understand the materials but also apply them in the context of everyday life.

CONCLUSION

It can be concluded that the PBL-based E-Book learning media has an impact on expanding the learning intrigued of rudimentary school understudies in Jagakarsa sub-district, South Jakarta. This inquiry can suggest that Issue Based Learning-based E-Book media can be executed as a learning medium in progressing Basic Considering in a more extensive zone, not as it were in Jagakarsa sub-district, South Jakarta but in all rudimentary school's review V Jakarta Zone to move forward Basic Considering through media E-Book learning based on Issue Based Learning.

ACKNOWLEDGEMENT

The Jakarta State University Elementary School Teacher Education Study Program supports this research to be published and accessible to the public through the Scopus website. Furthermore, the researchers would like to thank those who have helped in writing and the results of this study, especially the lecturers in charge of the Scientific Publication course as well as the population and samples, namely the fifth grade students of SD Jagakarsa District, South Jakarta, as samples for data collection in this research

REFERENCES

Ananda, R. (2019). The Effectiveness of the Implementation of the Case Methods in the Learning Evaluation Course at State Islamic University of North Sumatera. *Jurnal Ilmiah Peuradeun*, *6*(1), 103. https://doi.org/10.26811/peuradeun.v6i1.171

Ardhian, T., Ummah, I., Anafiah, S., & Rachmadtullah, R. (2020). Reading and critical thinking techniques on understanding reading skills for early grade students in elementary school. *International Journal of Instruction*, *13*(2), 107–118. https://doi.org/10.29333/iji.2020.1328a

Arifuddin, A. (2020). The Analysis of Critical Thinking Skills of Primary School Teacher Candidates in Solving Mathematical Problems. *Al Ibtida: Jurnal Pendidikan Guru MI*, *7*(1), 46. https://doi.org/10.24235/al.ibtida.snj.v7i1.6212

Ariyanto, SR, Munoto, Muslim, S., & Muhaji. (2019). *Collaborative Problem-Based Learning Models Implementation in Vocational High Schools*. *379*(Veic), 238–245. https://doi.org/10.2991/assehr.k.191217.039

Aufa, MN, Iriani, R., Saadi, P., Hasbie, M., Fitri, MA, & Yunita, A. (2020). Module Development with Problem Based Learning (PBL) Model Based on Environmental Wetland to Increase Students Learning Outcomes. *Jkpk (Jurnal Kimia Dan Pendidikan Kimia)*, *5*(2), 201–210. https://doi.org/10.20961/jkpk.v5i2.40451

Basri, H., Purwanto, As'ari, AR, & Sisworo. (2019). Investigating critical thinking skill of junior high school in solving mathematical problem. *International Journal of Instruction*, *12*(3), 745–758. https://doi.org/10.29333/iji.2019.12345a

Bećirović, S., Hodžić, F., & Brdarević-Čeljo, A. (2019). The problems of contemporary education: Critical thinking development in the Milieu of high school education. *European Journal of Contemporary Education*, *8*(3), 469–482. https://doi.org/10.13187/ejced.2019.3.469

Craig, TT, & Marshall, J. (2019). Effect of project- based learning on high school students' state- mandated, standardized math and science exam performance. *Journal of Research in Science Teaching*, 56(10), 1461-1488. https://doi.org/10.1002/tea.21582

Darling-Hammond, L., Flook, L., Cook-Harvey, C., Barron, B., & Osher, D. (2020). Implications for educational practice of the science of learning and development. *Applied Developmental Science*, *24*(2), 97–140. https://doi.org/10.1080/10888691.2018.1537791

Fadilla, N., Nurlaela, L., Rijanto, T., Ariyanto, SR, Rahmah, L., & Huda, S. (2021). Effect of problem-based learning on critical thinking skills. *Journal of Physics: Conference Series*, *1810*(1). https://doi.org/10.1088/1742-6596/1810/1/012060

Fahmi, Setiadi, I., Elmawati, D., & Sunardi. (2019). Discovery Learning Method for Training Critical Thinking Skills of Students. *European Journal of Education Studies*, *6*(3), 342–351. https://doi.org/10.5281/zenodo.3345924

Handika, I. and Wangid, M. N. (2013). Pengaruh pembelajaran berbasis masalah terhadap penguasaan konsep dan keterampilan proses sains siswa kelas v. Jurnal Prima Edukasia, 1(1), 85. https://doi.org/10.21831/jpe.v1i1.2320

Hussin, WNTW, Harun, J., & Shukor, NA (2019). Problem Based Learning to Enhance Students Critical Thinking Skill via Online Tools. *Asian Social Science*, *15*(1), 14. https://doi.org/10.5539/ass.v15n1p14

Islahiyah, I., Pujiastuti, H., & Mutaqin, A. (2021). Pengembangan e-modul dengan model pembelajaran berbasis masalah untuk meningkatkan kemampuan pemecahan masalah matematis siswa. AKSIOMA: Jurnal Program Studi Pendidikan Matematika, 10(4), 2107. https://doi.org/10.24127/ajpm.v10i4.3908

Karyadi, B., Susanta, A., Winari, EW, Ekaputri, RZ, & Enersi, D. (2019). The development of learning model for natural science based on environmental in conservation area of Bengkulu University. *Journal of Physics: Conference Series*, *1013*(1). https://doi.org/10.1088/1742-6596/1013/1/012074

Mahanal, S., Zubaidah, S., Sumiati, ID, Sari, TM, & Ismirawati, N. (2019). RICOSRE: A learning model to develop critical thinking skills for students with different academic abilities. *International Journal of Instruction*, *12*(2), 417–434. https://doi.org/10.29333/iji.2019.12227a

Mas, R. B., Nasution, N., & Familawati, Z. S. (2023). Upaya meningkatkan kemampuan berpikir kritis peserta didik kelas x sman 1 rengel kabupaten tuban pada materi proses masuknya hindu-buddha ke nusantara melalui model pembelajaran problem-based learning (pbl). Jurnal Pendidikan Dan Kewirausahaan, 11(3), 912-931. https://doi.org/10.47668/pkwu.v11i3.907

Orfan, SN, Akramy, SA, Noori, AQ, & Hashemi, A. (2021). Afghan Lecturers' Perception of Problem-Based Learning: A Case Study of Takhar University. *Journal of Problem-Based Learning*, *8*(2), 62–68. https://doi.org/10.24313/jpbl.2021.00059

Qomariyah, SN (2019). Effect of Problem Based Learning Learning Model to Improve Student Learning Outcomes. *International Journal of Educational Research Review*, *2009*, 217–222. https://doi.org/10.24331/ijere.518056

Rahayu, S. and Juliani, R. (2016). Pengaruh model pembelajaran berbasis masalah terhadap hasil belajar dan aktivitas siswa pada materi pokok listrik dinamis kelas x semester ii di sma muhammadiyah 8 kisaran t.a 2014/2015. INPAFI (Inovasi Pembelajaran Fisika), 4(1). https://doi.org/10.24114/inpafi.v4i1.5441

Silmiati, N. Y. (2017). Perbandingan retensi siswa smp pada pembelajaran ipa terpadu konsep cahaya antara model pembelajaran berbasis masalah dan metode pembelajaran inkuiri. Jurnal Penelitian Pendidikan, 17(1). https://doi.org/10.17509/jpp.v17i1.6637

Singh, MN (2021). Introduction of Digital Technology in Education: Age of Digital Classroom. *Higher Education for the Future*, *8*(1), 20–30. https://doi.org/10.1177/2347631120980272

Sugiharto, B., Corebima, AD, Susilo, H., & Ibrohim. (2019). The pre-service biology teacher readiness in Blended Collaborative Problem Based Learning (BCPBL). *International Journal of Instruction*, *12*(4), 113–130. https://doi.org/10.29333/iji.2019.1248a

Sukmawati, RA, Pramita, M., Purba, HS, & Utami, B (2020). The Use of Blended Cooperative Learning Model in Introduction to Digital Systems Learning. *Indonesian*

Journal on Learning and Advanced Education (IJOLAE), *2*(2), 75–81. https://doi.org/10.23917/ijolae.v2i2.9263

Summons, P., Harmon, J., Park, M., Colloc, J., Yeom, S., Pitt, V., & Inder, K. (2021). Development of a Framework for Problem Domain Transference in Health-Related Problem Based Learning and Assessment. *Journal of Problem-Based Learning*, *8*(2), 75–86. https://doi.org/10.24313/jpbl.2021.00066

Suryandari, KCS, Rokhmaniyah, & Wahyudi. (2021). The Effect of Scientific

Suryanti, Arifin, ISZ, & Baginda, U. (2019). The Application of Inquiry Learning to Train Critical Thinking Skills on Light Material of Primary School Students. *Journal of Physics: Conference Series*, *1108*(1). https://doi.org/10.1088/1742-6596/1108/1/012128

Suwastini, NKA, Puspawati, NWN, Adnyani, NLPS, Dantes, GR, & Rusnalasari, ZD (2021). Problem-based learning and 21st-century skills: Are they compatible? *EduLite: Journal of English Education, Literature and Culture*, *6*(2), 326. https://doi.org/10.30659/e.6.2.326-340

Yenzi Rafli, MA (2019). Jurnal Vokasional T eknik Elektronik a dan Informatika http://ejournal.unp.ac.id/index.php/voteknika/index Vol. 7, No. 1, Maret2019 E - ISSN: 2302-3295. *Yenzi Rafli, MA (nd). Jurnal Vokasional T Eknik Elektronik a Dan Informatika*, *7*(1). https://doi.org/10.24036/voteteknika.v7i1.103787

Zubaidah, S., Corebima, AD, Mahanal, S., & Mistianah. (2019). Revealing the relationship between reading interest and critical thinking skills through remap GI and remap jigsaw. *International Journal of Instruction*, *11*(2), 41–56. https://doi.org/10.12973/iji.2018.1124a