



The effectiveness of the problem-based learning model assisted by stop-motion animation videos in improving the critical thinking abilities of elementary school students

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ABSTRACT

This research aims to evaluate the effectiveness of the problem-based learning model assisted by stop-motion animation videos in enhancing the critical thinking skills of elementary school students. This research is an experimental study utilizing a nonequivalent control group design. The sample was selected using the purposive sampling technique, with the research sample consisting of 20 students from the first class of grade VI at SDN Dadapayam 01 as the experimental group and 20 students from the second class of grade VI at SDN Dadapayam 02 as the control group. Research data were collected, calculated, and analyzed using the SPSS 24 software. Data collection methods included tests, observations, and documentation. The findings indicate a significant difference in the critical thinking abilities of sixth-grade students between SDN Dadapayam 01 and SDN Dadapayam 02 after engaging in social studies lessons using the problem-based learning model assisted by graphic stop-motion animation videos compared to the problem-based learning model assisted by cut-out stop-motion animation videos. The t-test results, with $\alpha = 5\%$, reveal a calculated significance value of 0.014, less than 0.05. In conclusion, implementing the problem-based learning model assisted by graphic stop-motion animation videos is more effective than the model-assisted by cut-out stop-motion animation videos. The expected contribution is that the problem-based learning model assisted by stop-motion animation videos can be considered an alternative for educators to implement in student learning.

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INTRODUCTION

This study includes several previous research works that share similarities with the research variables and are also based on studies conducted to assess the effectiveness or influence of the PBL (Problem-Based Learning) model on students' critical thinking abilities. The aim is to provide support and references for this research from previous scholarly works. One relevant study is the research conducted by **Samadun and Dwikoranto (2022)**, titled "Improvement of students' critical thinking abilities in physics materials through the application of problem-based learning." In this study, it is explained that the application of the problem-based learning model is highly effective when applied in the student learning process because it can enhance students' critical thinking abilities. Applying the problem-based learning model has an impact on improving the critical thinking abilities of high school students.

The similarity between **Samadun and Dwikoranto's (2022)** research and the researcher's study is the research variable: both studies focus on enhancing students' critical thinking abilities

using the Problem-Based Learning (PBL) model. Use of the PBL Model: Both the researcher and Samadun and Dwikoranto's (2022) adopted the PBL model as the instructional method used. This indicates a similarity in the teaching approach used in the research. However, the difference lies in the Research Subjects: The researcher's study focuses on elementary school students, whereas Samadun and Dwikoranto's (2022) study focuses on high school students. This is a fundamental difference in the educational level of the students who are the research subjects. Additionally, the researcher utilized stop-motion animation as a supplementary medium, while Samadun and Dwikoranto did not employ any additional media assistance.

The research conducted by Prayoga and Setyaningtyas (2021) titled "The effectiveness of problem-based learning and problem solving models on the critical thinking ability of fifth-grade mathematics students" suggests that the PBL model is more effective than the problem-solving model in terms of improving students' critical thinking abilities in mathematics. The equation between Prayoga and Setyaningtyas' (2021) research and the research conducted by the researcher is that in the research variables, this research and the research conducted by Prayoga and Setyaningtyas (2021) both focus on improving students' critical thinking skills through problem-based learning models. Another similarity is in the use of the PBL model. This shows the similarity in the teaching approach used in the research.

Behind the similarities, there are differences between the two studies, namely in the subject matter and media assistance used. In this study, the researcher focused on Social Science for elementary school students, while Prayoga and Setyaningtyas's (2021) research focused on math subject matter. In the media assistance used, the researchers used stop-motion animation as an additional media, while Prayoga and Setyaningtyas (2021) did not use additional media assistance. In summary, these two studies have the same goal of improving critical thinking skills through the use of the PBL model but differ in terms of specific subject matter and the use of supplementary media.

Education is an effort made to assist the development of the abilities and potential of each student in order to have intelligence both intellectually, emotionally, and spiritually, whose results can be useful for the life of himself, society, and the country. As stated in Law Number 20 of 2003 concerning the National Education System, Article 1, paragraph 1 states that "Education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious, spiritual strength, self-control, personality, intelligence, noble character, and skills needed by themselves, society, nation, and state. High-level thinking skills have various components, including the ability to think critically. Critical thinking is a process that involves efforts to gather, interpret, analyze, and evaluate information to reach reliable and valid conclusions. Facione (1990) identified six cognitive abilities in the concept of critical thinking, namely interpretation, analysis, explanation, evaluation, self-regulation, and inference. According to him, critical thinking skills allow us to analyze and combine information to solve problems in a particular context.

Critical thinking skills are a fundamental competency that is very important to master. According to Simbolon et al. (2017), critical thinking is a process of searching, analyzing, synthesizing, and conceptualizing information to develop one's thinking, increase creativity, and take risks. Several factors can cause low critical thinking skills, one of which is the tendency of students to memorize material and formulas rather than understand existing concepts (Arif et al., 2019).

Fisher (2008) presents six indicators of critical thinking, which are (1) identifying problems, (2) gathering various relevant information, (3) generating multiple problem-solving alternatives, (4) making conclusions, (5) expressing opinions, and (6) evaluating arguments. On the other hand, according to Ennis (1991), there are twelve indicators of critical thinking skills. This is following the initial research investigation from Sianturi et al. (2018), it is known that the low response from students and their tendency to memorize rather than understand concepts causes a lack of practice in critical thinking skills. The active role of students in the learning process still needs to be improved, as seen by the few students who actively ask questions and give opinions. This shows that students are more likely to focus on the teacher without analyzing, criticizing, or evaluating what is delivered by the teacher.

Abidin (2016) states that critical thinking can be interpreted as the ability to consider various information coming from various sources and then process the information creatively and logically. In this process, individuals also evaluate the truth and validity of information, conduct analysis, and finally reach conclusions that can be defended and justified. To develop critical thinking skills, a teacher can design learning experiences by designing the learning process. Teachers can present problems that encourage students to use their thinking skills, as well as face real-world situations that require in-depth analysis. One of the learning approaches that can be applied is PBL. With PBL, students can experience and face realistic problems and are directed to focus on communication, cooperation, and utilization of existing resources to formulate ideas and develop reasoning skills.

PBL is a learning approach that uses real-world problems as a context for learners to develop critical thinking and problem-solving skills. Through PBL, students can also gain essential knowledge and concepts from the subject matter by facing relevant and practical situations (D. D. Lestari et al., 2017). Meanwhile, according to Sumantri (2015), PBL is an approach in which students learn by developing thinking and problem-solving skills, as well as learning from authentic adult experiences to become independent learners. Arends in Trianto (2010) explains that with PBL, students are allowed to solve real problems to develop their understanding, fostering inquiry and higher-order thinking skills, as well as cultivating independence and self-confidence in the learning process.

Video animation is a form of moving image formed from several objects that are assembled in such a way that it can move according to a predetermined flow at a certain time. Problem-based learning animation video is a learning media in the form of videos that contain learning materials that use problems that are relevant to everyday life as the first step in the learning process (Rahmadani et al., 2022). Stop-motion animation involves taking digital photos of objects or images after manually moving them to simulate motion, while computer-based animation involves using computer-generated images as the basis for animation (Pangestu et al., 2021). The term "Stop-motion media" refers to moving images, which consist of a sequence of pictures projected onto a screen. With a narrative storyline, it becomes an effective medium for conveying messages in the learning process (Apriana, 2016).

Stop motion animation video is a technique in which physical objects are manipulated to create the illusion of movement. These objects are recorded in many frames that are run sequentially so that when played back, the objects appear to move by themselves. Stop motion animation consists of several images arranged in sequence, and then the images are moved to form an animated video. The main difference between stop motion animation and other types of animation is that the movement could be smoother and more agile. The movement in stop-motion animation needs to be more cohesive due to limitations in the movement of objects or images used. Social studies learning at the elementary school level has been directed to be more related to the student's environment. The goal is that students can easily recognize and understand social studies concepts directly and realistically. This approach is following the social studies learning process that emphasizes direct learning experiences, which allow students to develop their potential in exploring and understanding the surrounding environment scientifically.

In order to improve understanding of social studies concepts, it is important for learning at the primary level to encourage students to be active in solving problems, discovering new things for themselves, and interacting with various ideas. However, in reality, social studies learning at the primary school level still tends to rely on the lecture method from the teacher as well as giving assignments or exercises.

Based on the identification of problems that researchers conducted, students need help with thinking critically and remembering the concepts of the subject matter, and this causes students not easily to forget the material that the teacher has given. In learning activities in the classroom, students need to be more focused on learning, and this is because learning is considered boring. Media use in the learning process is with pictures or learning books. The use of learning models is less varied, making learning activities less interesting for students. Student motivation in learning is low. The lack of varied tools or media makes children easily bored and less interested in learning. With the problems that researchers encountered at SD Negeri Dadapayam, Semarang Regency, it is necessary to take action to improve learning, namely the use of innovative learning models and media so that

learning objectives can be met optimally. In line with the Regulation of the Minister of Education and Culture of 2016 Number 22 concerning Education Process Standards for Primary and Secondary Education Units, it can be organized in an interesting, challenging, inspiring, and fun. It can motivate students to learn and develop potential according to the talents, interests, and development of students. One of the learning models following the 2013 curriculum is PBL, which leads students to think critically.

Based on research will be conducted to analyze students' critical thinking skills. So, the author is interested in conducting research titled "The effectiveness of PBL model assisted by stop motion animation video in improving critical thinking ability of elementary students."

METHOD

This research employs a quantitative approach because the data consists of numerical values, and data analysis is conducted using the statistical methods outlined by Sugiyono (2016). This research method is experimental research Sugiyono (2016). In this study, the intervention involves utilizing the PBL model with the assistance of graphic stop-motion animation videos in the experimental group and the PBL model with cut-out stop-motion animation video assistance in the control group. The research design adopts a quasi-experimental design known as the non-equivalent control group design. The selection of this design is due to the researcher's inability to control external variables that could influence the study, and both the experimental and control groups were not assigned randomly, as outlined by Sugiyono (2016).

The experimental and control groups undergo a pretest to measure their initial competencies before receiving treatment. Then, each class receives the treatment in two sessions, where the experimental group applies the PBL model with the assistance of graphic stop-motion animation videos, while the control group applies the PBL model with the assistance of cut-out stop-motion animation videos. At the end of the instruction, a posttest is conducted to measure the influence of the treatment applied to both groups. The research is conducted at SD Negeri Dadapayam, located in the Semarang Regency, Central Java Province, Indonesia.

Sugiyono (2016) explains that the population is an object with specific qualities and characteristics to be studied and concluded upon, and it is part of the generalization area. The population of this research consists of all sixth-grade classes in SD Negeri Dadapayam, Semarang Regency.

Table 1. Population in the Study

No.	School	Number of Students
1	SD Negeri Dadapayam 01 Class VI	20
	SD Negeri Dadapayam 02 Class VI	20
2	SD Negeri Dadapayam 03 Class VI	30
	Total	50

The normality test determines whether the population follows a normal distribution. The normality test is performed using the Kolmogorov-Smirnov test in SPSS 24, as explained by Priyatno (2017). Priyatno (2017) explains that the decision in the Kolmogorov-Smirnov test is based on the significance value obtained. If the significance value exceeds 0.05, the data follows a normal distribution, and vice versa. The normality test is conducted to ascertain whether the initial data follows a normal distribution. Normally distributed data is a prerequisite for parametric statistical tests (such as the t-test). The analysis conducted to test the normality of data is done using SPSS 24. The following is an analysis and the steps taken in testing the normality of data using SPSS 24.

According to Priyatno (2017), the homogeneity test is a prerequisite for hypothesis testing and aims to analyze the similarity of variances between the experimental and control groups. Meanwhile, K. E. Lestari and Yudhanegara (2018) explains that the homogeneity test is used to assess the homogeneity of data. The homogeneity test in this research is conducted using SPSS 24 with the F-test (Leven's test), where the conclusion is drawn at a significance level of 5%. If the

significance value exceeds 0.05, the variances are considered homogeneous, and vice versa **K. E. Lestari and Yudhanegara (2018)**.

The hypothesis test aims to assess the critical thinking abilities of sixth-grade social studies students in both research groups. The hypothesis test is conducted using a t-test. As explained by **K. E. Lestari and Yudhanegara (2018)**, the t-test is employed to test hypotheses in experimental research to measure the difference in students' critical thinking abilities after receiving treatment. The hypothesis test is conducted through SPSS 24 by selecting the menu "Analyze," then "Compare Means," and finally, "Independent sample t-test." The results are in the "T-test for equality of means" column. If the significance value exceeds 0.05, then the null hypothesis (H_0) is accepted. However, if the significance value is less than 0.05, then the null hypothesis (H_0) is rejected, as explained by **K. E. Lestari and Yudhanegara (2018)**. The N-gain test determines the extent of improvement between the pretest and posttest scores.

RESULTS AND DISCUSSION

The research was conducted at SD Negeri Dadapayam 01 and SD Negeri Dadapayam 02 in the Semarang Regency. The study at SD Negeri Dadapayam 01 took place from September 4th to September 16th, 2023, while at SD Negeri Dadapayam 02, it was carried out from September 18th to September 30th, 2023. The research consisted of three sessions at each school. After the researcher has completed three sessions at each school, they can conduct the posttest. Before the research was conducted, a pretest was administered to assess the student's initial abilities. Then, the learning activities were carried out following the prepared instructional materials. The teaching sessions were centered around Theme 1, Subtheme 3, with the content focusing on the political life of ASEAN and the geographical conditions of ASEAN countries. At SD Negeri Dadapayam 01, which served as the experimental group, the learning activities were facilitated using the PBL model with the assistance of graphic stop-motion animation videos. Meanwhile, at SD Negeri Dadapayam 02, the control group, the learning activities were conducted using the PBL model with the assistance of cut-out stop-motion animation videos. After implementing the treatment in each class, posttests were administered to measure the students' critical thinking abilities in the social studies subject. The results were then analyzed to test the research hypotheses' validity and served as the basis for concluding.

After implementing the treatment in the experimental class using the PBL model assisted by graphic stop-motion animation videos and the control class using the PBL model assisted by cut-out stop-motion animation videos, the next step is to conduct a posttest to measure the learning outcomes achieved by the students. The posttest results are used as the basis for conducting the final data analysis. Normality testing is conducted to determine whether the initial data follows a normal distribution. Normal data is a requirement for parametric statistical tests (such as the t-test). The analysis for testing the normality of data is carried out using SPSS 24 software. The results of the data normality test analysis can be seen in **Table 2**.

Table 2. Output of the Normality Test for Final Data

	Class	Test of Normality					
		Kolmogorov-smimov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig
Critical Thinking Ability	Posttest Eksperimen	0.107	20	0.200*	0.957	20	0.483
	Posttest Kontrol	0.144	20	0.200*	0.972	20	0.795

*. This represents the minimum level of actual significance.

a. Lilliefors Significance Correction

In the **Table 2**, based on the calculation results of the normality test, it is found that the significance value for both classes is 0.200, which is greater than 0.05. Therefore, the null hypothesis (H_0) is accepted, and the alternative hypothesis (H_a) is rejected. It is concluded that the data follows

a normal distribution. Homogeneity testing using the students' pretest scores is conducted to determine whether both classes come from the same population or not. The homogeneity test is performed using SPSS 24 software. The results of the homogeneity test can be seen in [Table 3](#).

Table 3. Output of the Initial Data Homogeneity Test

Test of Homogeneity of Variances			
Student Scores			
LeveneStatistic	df1	df2	Sig.
1,674	1	38	0.203

Based on [Table 3](#), The significance value of 0.203 is greater than 0.05, indicating that the null hypothesis (H_0) is accepted. It can be concluded that the data is homogeneous, meaning there is no significant difference in variance between the two classes. Hypothesis testing is conducted to determine the significance of the research results using the students' posttest scores. In this research, hypothesis testing is carried out to examine the critical thinking abilities in social studies after the implementation of learning in both the experimental and control classes. The analysis and calculation of hypothesis testing can be seen in [Table 4](#).

Table 4. Output of the Equality of Means Test

		Independent Samples Test								
		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Critical Thinking Ability	Equal variances assumed	1.674	0.203	2.577	38	0.014	7.00	2.72	1.501	12.498
	Equal variances not assumed			2.577	35.099	0.024	7.00	2.72	1.486	12.513

Based on [Table 4](#), it is evident that the significance value is 0.014, which is less than 0.05. This means that the null hypothesis (H_0) is rejected, and the alternative hypothesis (H_a) is accepted. Therefore, it can be concluded that the PBL model assisted by graphic stop-motion animation media is more effective compared to the PBL model assisted by cut-out stop-motion animation media in enhancing the critical thinking abilities of sixth-grade students in social studies at SD Negeri Dadapayam. The N-Gain test measures the extent of improvement in students' learning outcomes after receiving treatment. The improvement in pretest and posttest scores for students in the social studies subject can be observed in the following table. The N-Gain test was conducted to measure the extent of improvement in students' learning outcomes after receiving treatment. The increase in students' pretest and posttest scores in social studies can be observed in [Table 5](#).

Table 5. Output of the Equality of Means Test

Class	Average		Number of Student	G	Criteria
	Pretest	Posttest			
Eksperimen	56.40	80.60	20	0.56	Moderate
Kontrol	51.22	73.60	20	0.47	Moderate

Based on [Table 5](#), it can be observed that the increase in scores from the pretest to the posttest in the experimental class is 0.56, which falls into the "moderate" category. In the control class, the increase is 0.47, also falling into the "moderate" category. The diagram below illustrates the improvement from pretest to posttest.

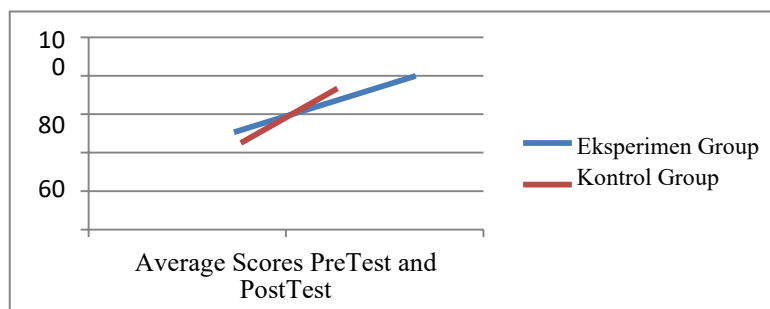


Figure 1. Pretest and Posttest Score Improvement Diagram

Based on Figure 1, both classes initially had relatively similar abilities. However, after receiving treatment, the experimental class that implemented PBL aided by graphic stop-motion animation showed a more significant improvement in scores than the control class that used PBL aided by cut-out stop-motion animation. This indicates that applying PBL with graphic stop-motion animation is effective when applied to the subject of IPS with ASEAN material for sixth-grade students at SDN Dadapayam, Semarang Regency.

Ibrahim and Nur (2000), as cited in Riduwan (2008), explained that the objectives of PBL are: (1) the development of critical thinking skills, (2) students can learn through real experiences, (3) learners can engage in solving problems independently. Meanwhile, Shoimin (2014) described that the PBL model has several advantages, such as (1) encouraging learners to solve real-world problems, (2) motivating learners to acquire knowledge through active learning, (3) focusing learning more effectively, and (4) conducting learning through group work to build active learning activities.

These advantages support the higher post-test scores obtained in the experimental class compared to the control class. From the calculation and t-test analysis, a significance value of 0.014 was obtained. The significance value is less than 0.05, which means that H_0 (null hypothesis) is rejected, and H_a (alternative hypothesis) is accepted. Therefore, it can be concluded that the PBL model assisted by graphic stop-motion video animation is effective compared to the PBL model assisted by cut-out stop-motion video animation in improving the critical thinking abilities of IPS subject students.

The effectiveness of the PBL model assisted by graphic stop-motion video animation is related to the research findings and the practical benefits expected. This approach can significantly improve the critical thinking abilities of elementary school students in the IPS subject. By presenting real-world problems, it stimulates students to think critically in order to solve these problems. This, in turn, enhances students' motivation to learn, as the presented problems are real and solvable, making learning meaningful and enabling students to master the material effectively.

The effectiveness of the PBL model assisted by graphic stop-motion video animation is more favorable compared to the PBL model assisted by cut-out stop-motion video animation. Various factors, both internal and external, influence this difference. Internal factors include students' intelligence, interests, talents, motivation, and health. Meanwhile, external factors encompass the family environment, school environment, and the community where students live. Implementing the PBL model can facilitate educators in creating more meaningful learning experiences, encouraging students to think critically and construct their knowledge through problem-solving activities. Ultimately, it can improve educational quality and learning outcomes in schools.

The effectiveness of the PBL model assisted by cut-out stop-motion video animation is related to the research findings and the theories under study. Based on the research conducted, the use of the PBL model aided by cut-out stop-motion video animation in the subject of IPS for sixth-grade students in SD is less effective compared to the application of the PBL model aided by graphic stop-motion animation at SDN Dadapayam.

The effectiveness of using the PBL model assisted by cut-out stop-motion animation videos in elementary school (SD) learning aligns with the theories of Paul and Elder as cited in Syakur (2009). They explain that critical thinking is a way for an individual to enhance the quality and results

of their thinking using systematic techniques and generating intellectual thinking power in the ideas they propose. According to Piaget's theory (as cited in Syakur (2009)), which states that during the elementary school years, children are in the concrete operational stage. Children can learn by applying logical thinking skills to solve real-world problems. This is further supported by David Ausubel's theory of meaningful learning (as cited in Syakur (2009)), which explains that children acquire knowledge when the learning process is meaningful.

The research by Mahfudah et al. (2019) titled "The Effectiveness of the Problem-Based Learning Model on Critical Thinking Abilities in the Topic of Heat and Its Transfer" indicates that critical thinking abilities improved after using the PBL model compared to before its implementation. The similarities between the research by Samadun and Dwikoranto (2022) and the researcher's study are as follows: Research Variables: Both studies focus on enhancing students' critical thinking abilities through the use of the PBL model. Use of the PBL Model: Both the researcher and Salis Mahfudah and Ary Susatyo adopted the PBL model as the instructional method used. This indicates a similarity in the teaching approach used in the research.

There are differences between the two studies: Research Subject Matter: The researcher focuses on the social studies (IPS) subject matter for elementary school students, while Mahfudah's et al. (2019) study focuses on the science (IPA) topic of heat and its transfer. Media Assistance: The researcher utilized stop-motion animation as a supplementary medium, whereas Salis Mahfudah and Ary Susatyo did not use any additional media assistance. Overall, both studies share a common focus on the effectiveness of the PBL model in enhancing critical thinking abilities. However, they differ in terms of the specific subject matter and the use of supplementary media.

Implementing the PBL model in elementary schools (SD) still faces several challenges. One of the challenges is the difficulty that students need help understanding the problems presented. As a result, educators need to guide students through the process patiently. Additionally, during group work, educators must effectively manage and guide the problem-solving process. With proper guidance, students may become more reliant on each other.

On the other hand, the control group also improved their critical thinking abilities, although less significant than the experimental group. This is because the control group used the video animation medium with cut-out stop-motion, which is less modern than graphic stop-motion animation. In the control group, students were required to listen to the teacher's explanation, pay attention to the cut-out stop-motion video animation, take notes on the presented material, and complete related exercises. However, not all students were fully engaged in these activities. Some students were seen talking to their peers or being inactive when the teacher asked questions about the material.

CONCLUSION

The PBL model assisted by graphic stop-motion animation is effective compared to the PBL model assisted by cut-out stop-motion animation in Social Studies for sixth-grade students at SD Negeri Dadapayam, Semarang Regency. Based on the average posttest scores, the experimental group achieved an average score of 0.56, while the control group had an average score of 0.47. The t-test results, with a significance level of 5%, showed a significance value of 0.014, which is less than 0.05, thus leading to the rejection of the null hypothesis and the acceptance of the research hypothesis. In conclusion, implementing the PBL model assisted by graphic stop-motion animation is effective compared to the model-assisted by cut-out stop-motion animation in improving the learning outcomes in Social Studies for sixth-grade students at SDN Dadapayam, Semarang Regency.

The PBL model can be an alternative for educators to implement in student learning. Additionally, it is expected that stop-motion animation videos can be an alternative media for educators to use in facilitating learning activities, making it easier for students to grasp lesson content. In applying the PBL model, teachers need to provide adequate guidance so that students can understand and effectively address the problems presented. Furthermore, apart from the social studies curriculum, the Problem-Based Learning model is expected to apply to other subjects by adapting it to the specific content, serving as an innovative alternative in selecting teaching models.

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