



Efectiveness of PBL Model Assisted By 3D Animation Media on Motivation and Learning Outcomes of Science in Elementary School

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Abstract

Problem Based Learning focuses students in an active and collaborative. This study aims to; 1) analyze the effectiveness of the PBL model assisted by 3D animation media on science learning motivation; 2) analyze the effectiveness of the PBL model assisted by 3D animation media on science learning outcomes; 3) testing the effectiveness of the PBL model assisted by 3D animation media on science learning motivation and outcomes. The research used in this study is Quantitative Experiment (True Experimental Design) with Posttest-Only Control Design research. The results of the study found that 1) the PBL model assisted by 3D animation media is effective for learning motivation, with a significance value of $0.014 < 0.05$ meaning that H_0 is not accepted so H_1 is accepted. 2) the PBL model assisted by 3D animation media is effective for learning motivation. 3) The PBL model assisted by 3D animation media is effective for motivation and learning outcomes, with a significance value of X to Y_1 of 4.503 and X to Y_2 of 5.483 more than $t_{table} = 1.711$. Overall, this research is very feasible to optimize the motivation and learning outcomes of science.

Keywords: problem based learning; animation media; motivation; learning outcomes

INTRODUCTION

Education in the modern era has undergone significant modifications, leading to the creation of a learning environment that suits modern society. Education can also build a person's character and abilities so that they can compete in the global market (Sanga & Wangdra, 2023). As we enter the 21st century, education is becoming increasingly focused on digital learning, where learners and teachers utilize digital technology to meet long-term needs. A 21st century education should be understood as one that adapts to the rapid transformations in technology, economy and society. 21st century learning is commonly used to explain different types of skills required to thrive in today's advanced and related general landscape (Mthanti & Msiza, 2023). In 21st century education, the main goal is to enhance learners' potential and provide them with opportunities to build better character (Rosyid & Mubin, 2024). Previous research shows that the goals of twenty-first century education are essential to encourage innovative teaching methods (Habiyaemye et al., 2024).

Education in the 21st century focuses on activities that enhance learners' skills and direct the learning process (Marrandan & Ismail, 2024). Skills are a common part needed in everyday life therefore, learners must have learning and thinking skills (Widiana et al., 2023). In the era of 21st century education, skills refer to the abilities that learners need to have, namely logical thinking and solve the problem, interacting, cooperate, and being creative and innovative

(Alawiyah & Jovita, 2023). The 21st century goals focus on the competencies of learners to think critically, communicate well, collaborate, and be creative (Khusna et al., 2023). This era is influenced by technology which has caused changes in education, economics, politics and daily life. Technology has created opportunities for learners to learn skills such as logical thinking, cooperate, communication, and creativity (Muliana et al., 2024). In the 21st century, technological advances greatly affect education. One of the function of using technology in education and learning is as follows: technology helps education to be faster and more enjoyable, encourages active participation in class, and promotes creativity (Sandrasyifa Ully & Nugraheni, 2024).

Initial observations and conducted follow-up interviews with the IVA class teacher of SDN 03 Pagergunung was carried out on July 19, 2024. During the interview, she explained that knowledge in the classroom had not been learner-centered and the learning strategies used in science learning at the time of observation were mostly lecture-based. A common problem is that science learning is a bit boring, which makes students lazy to learn and understand the material. Another problem is that teachers are less able to use IT-based teaching media, the sense of enthusiasm and motivation when learning science is decreasing.

Based on this, steps must be taken to reduce the problems that arise during implementation so that the learning objectives of science can be carried out and the results are in line with the expectations of Merdeka Curriculum Implementation. The first step is to improve teachers' ability to use more innovative learning media (Westlund et al., 2021). We all know that the Merdeka curriculum is used to meet the needs of learners by adjusting their abilities. It focuses on essential materials so that learners can understand concepts and improve their skills (Wahyudi et al., 2023). Learners are given a variety of choices in terms of subject matter, teaching methods and assignments so that they can reach their full potential. In addition, teachers must be able to adjust the curriculum and learning activities so that learners are more capable and receive instructions that suit their needs. The Merdeka curriculum also reduces academic pressure on learners, so they have more time to study their talents and interests (Zahro et al., 2024).

Merdeka curriculum encourages learners to participate in real projects that are relevant to everyday life, to facilitate active and participatory learning (Shofia Rohmah et al., 2023). In this approach, learners not only acquire information passively, but also play an active role in seeking and applying knowledge. This is expected to increase their learning motivation and critical and creative thinking skills. The implementation of Merdeka Curriculum also faces various challenges, both in terms of teachers' understanding of the curriculum itself and school readiness in implementing the principles contained in it. Therefore, it is urgent for educators to receive adequate training and understanding so that they can implement this curriculum properly (Sarindah, 2024).

According to Lewis et al. (2024) the Merdeka curriculum requires teachers to make education more fun, interactive, and encourage learners to actively participate. In the Merdeka curriculum, learning media that can attract students' interest must be provided by teachers, such as 3D animation media. 3D animation media can increase learners' interest in lessons and help them understand difficult concepts by providing an immersive visual experience (Putra et al.,

2024). The application of 3D animation media is found in sympatographs that can support film education so as to create an interactive learning environment (Harkema & Rosendaal, 2020).

According to Halimah et al. (2023) in Problem Based Learning, the teacher functions to direct students to the problem, introduce issues that are relevant to real life, act as a facilitator in the investigation process carried out by students, facilitate discussions among students, and assist in listening to the student learning process, especially in the context of problem solving. The problem based learning model is very suitable to be applied in science learning because it allows students to learn the material studied with a real context. With this approach, students can be actively involved in the teaching and learning process, thus improving their understanding and skills in applying science (Prisilia et al., 2024). Problem-based learning can be one of the solutions to improve 21st century skills in science learning because it shows an effect size (ES) of 0.68 which is classified as high (Suhayat et al., 2022).

This research presents a significant novelty by demonstrating the effectiveness of the PBL model supported by 3D animation media. The results show that the use of such media can improve students motivation as well as learning outcomes. In addition, students become more active and engaged in the learning process, which in turn contributes to improving their understanding of scientific concepts. In other words, the application of 3D animation-assisted PBL model not only makes learning more interesting, but also effective in deepening students understanding. 3D animation media can attract students' interest and encourage them to be more actively involved in discussions and learning activities. It creates a more interactive and dynamic learning environment.

METHOD

The research was conducted in class IV SDN 03 Pagergunung as the experimental class and IV SDN 02 Pagergunung as the control class. The trial phase was conducted at SDN 03 Pagergunung. SDN 03 Pagergunung has 25 students and SDN 02 Pagergunung has 31 students. In this study, the researcher applied a quantitative experimental research type (True Experimental Design) with a Posttest-Only Control Design design. This study aims to assess the effectiveness of the PBL model supported by 3D animation media as an independent variable that affects motivation and learning outcomes as dependent variables. Two groups were randomly selected in this design (Sugiyono, 2016). Researchers gave treatment to the first group called the experimental class, while the second group was not retrieved treatment called the control class.

The research design is described as follows:

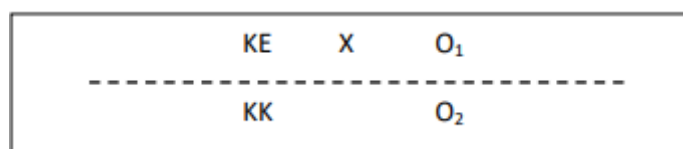


Figure 1. Posttest-Only Control Design

Source: (Sugiyono, 2016)

Description:

- KE = Experimental class (PBL model assisted by 3D animation media)
- KK = Control class (PBL model of package book media)
- X = Experimental class treatment (PBL model assisted by 3D animation media)
- O1 = Posttest of experimental class
- O2 = Posttest of control class

This research implements the Problem Based Learning (PBL) model, which consists of five strategies in its implementation: (1) focusing students on a problem; (2) organizing students to conduct research; (3) supporting them in conducting research individually or in groups; (4) elaborating and developing discussion results (5) evaluating and completing the problem solving process (Sanjaya & Ratnasari, 2021).

The data collection method in this research goes through several stages which include: 1) Initial Stage: At this stage, the researcher determined the sample and class that would be used as the experimental class and control class. Followed with the preparation of a learning motivation compiling a questionnaire and multiple choice learning outcomes questions and before the research carried out a test of the questions then tested the validity, reliability test, difficulty test and differentiation of the questions. 2) Practice Stage; a) Researchers conducted a trial of questions. b) Conducting IPAS learning in experimental and control classes with the same material, namely Chapter 4 “Changing Forms of Energy” in the experimental class using 3D animation media while in the control class with packet book media. c) Carry out posttest questions on learning outcomes in experimental and control classes to see changes in learners learning outcomes after researchers provide treatment. d) Questionnaires regarding learning motivation were distributed in experimental and control classes to identify changes in learning motivation. 3) Final Stage; The researcher then processes the data obtained from the posttest scores and processes the learning motivation questionnaire.

In this study, the data analysis procedure was carried out through several systematic stages. First of all, the researcher determines the type of data needed to achieve the research objectives. After the type of data is determined, the next step is to collect data from various sources such as interviews, observation or documentation to increase the validity of the results. After the data is collected, the next step is to process the data including cleaning, coding and compiling the data in a format that is ready to be analyzed for accuracy. After the data is processed, the researcher then analyzes the data using statistical analysis. Furthermore, the results of the analysis need to be interpreted carefully to draw the right conclusions. Finally, data presentation is in the form of tables and clear descriptions for easy understanding.

The data collection methods used are test instruments and non-test instruments. The test type uses multiple-choice questions to see learning outcomes, while the non-test type uses observation, interviews, documentation, and questionnaires. The researcher used multiple-choice questions as a test instrument with a total of 20 questions, determining the number of easy, medium, and difficult questions on the learning outcome question grid refers to the opinion of Sudjana (2017) who stated that the ratio between easy, medium, and difficult questions is 3:5:2 which indicates that the research tool should include thirty percent easy category questions, fifty percent medium category questions, and twenty percent difficult category questions. So a total of twenty questions have been divided into three categories based

on their level of difficulty, namely six easy questions, ten medium questions, and four difficult questions. The cognitive domains used in these questions include C4, C5, and C6.

RESULTS AND DISCUSSION

Result

The detailed result of this study that demonstrate the effectiveness of the Problem-Based Learning (PBL) model assisted by 3D animation media are presented on the following tables and section presented here.

The effectiveness of the PBL model assisted by 3D animation media on science learning motivation

Table. 1. Independent Sample Test Learning Motivation

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Learning motivation	Equal variances assumed	2.618	.112	2.553	54	.014	5.790	2.268	1.243	10.337
	Equal variances not assumed			2.648	53.143	.011	5.790	2.186	1.405	10.175

The results obtained from the study in seeking the effectiveness of the PBL model assisted by 3D animation media on science learning motivation showed that the PBL model assisted by 3D animation media had high effectiveness on students' science learning motivation, namely $0.014 < 0.05$. Based on the research conducted, the results are in accordance with the theory of the PBL model assisted by 3D animation media, which shows that a value of less than 0.05 means that learning is very effective for science learning motivation (Aritonang & Zubir, 2022). So it can be conclude that the independent sample test of learning motivation there is a significant difference in the learning motivation of students who apply the pbl model, namely a significant value < 0.05 . The implications of the findings indicate that by implementing the PBL model assisted by 3D animation media, teachers can create a more interesting and interactive learning atmosphere. This will encourage students to be more active in participating in the learning process and increase their curiosity. The PBL model provides opportunities for students to solve real problems related to everyday life, which not only deepens their understanding of

concepts but also develops critical thinking and problem-solving skills. These findings also encourage educators to consider the integration model of PBL assisted by animation media in their curriculum as an effective strategy to increase science learning motivation.

The effectiveness of the PBL model assisted by 3D animation media on science learning outcomes

Table. 2. Independent Sample Test Learning Outcomes

		Levene's Test for Equality of Variances		t-test for Equality of Means					95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Learning outcomes	Equal variances assumed	.088	.768	2.596	54	.012	5.374	2.070	1.223	9.525
	Equal variances not assumed			2.586	50.770	.013	5.374	2.078	1.202	9.546

The table shows that the PBL model assisted by 3D animation media is effective for learning outcomes, namely the results of the study obtained a high significance value of $0.012 < 0.05$. Based on the results obtained, it proves that this is in accordance with the theory of the PBL model, namely obtaining effective results for science learning outcomes (Nawati et al., 2023). Therefore the result of independent sample t-test shows significant difference in the learning outcomes of students who apply the PBL model, namely a significant value < 0.05 . The use of 3D animation media in learning should be considered as an important component in the curriculum to improve the effectiveness of the learning process. Teachers are expected to be able to integrate this technology into their learning plans. In addition, it is very important for teachers to receive training related to the use of animation media and the Problem Based Learning (PBL) model so that they can optimally utilize this method to improve student learning outcomes. The education curriculum also needs to be updated by including elements that support the use of interactive media such as animation, so that learning becomes more interesting and relevant for students. Thus, the application of the PBL model supported by 3D animation media is not only effective in improving learning outcomes, but can also create a more interactive and dynamic learning environment for students.

Testing the effectiveness of the PBL model assisted by 3D animation media on science learning motivation and outcomes.

Table. 3. One Sample Test of Motivation and Learning Outcomes

	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Learning Motivation	4.503	24	.000	6.080	3.29	8.87
Learning Outcomes	5.483	24	.000	8.600	5.36	11.84

The calculated t value obtained is 4.503. To make a decision, the t_{table} score is used with a level of discretion (df) of n-1, which is 24 with a significance level for a one-party test, which has a value of 1.711. In the context of learning science grade IV in Chapter 4 “Changing Forms of Energy”, the application of the PBL model assisted by 3D animation media is effective on learning motivation, so the null hypothesis (H_0) is denied ($t_{count} > t_{table}$). The calculated t value obtained is 5.483. To make a decision, the t_{table} score is used with a level of discretion (df) of n-1, which is 24 with a significance level for a one-party test, which has a value of 1.711. In the context of learning science grade IV in Chapter 4 “Changing Forms of Energy”, the application of the PBL model assisted by 3D animation media is effective on learning outcomes, so the null hypothesis (H_0) is denied ($t_{count} > t_{table}$). These results are in accordance with the theory of the PBL model on motivation and learning outcomes, indicating that this study has a significance value of < 0.05 , meaning that learning with the PBL model is effective for motivation and science learning outcomes (Dewi et al., 2022). The implementation of the PBL model assisted by 3D animation media is very effective in improving student motivation and learning outcomes. This media not only makes learning more interesting but also helps students to be more active in the learning process, encouraging them to think critically and creatively in solving problems. The implementation of this model is expected to continue to be developed to improve the quality of education at various levels of school.

Discussion

The effectiveness of the PBL model assisted by 3D animation media on science learning motivation

The results of the study with the SPSS 25 program, showed that the P-value = 0.014, so the P-value < 0.05 . Because the P value < 0.05 , H_0 is not received, so H_1 is received, which shows that there is a significant difference in learning motivation between the application of the PBL model assisted by 3D animation media (experimental class) compared to the application of conventional media (control class) in science learning. This is the same as previous research which reveals that science learning outcomes using the PBL model get a value of $0.007 < 0.05$

which means that there is an interaction between the learning model and learning motivation that affects student learning outcomes (Pakpahan et al., 2023). In conclusion there is a significant difference in the science learning motivation of students who apply the PBL model, which is a significant value < 0.05 .

According to Hamdani et al. (2021) the Problem Based Learning (PBL) learning model has been proven effective in increasing students' learning motivation, this application model encourages students to be actively involved in the learning process by solving problems that are relevant to real life. The Problem Based Learning learning model has been proven effective in increasing students' learning motivation, by integrating real problems into the learning process, students not only learn academic content but also develop important skills such as collaboration, critical analysis, and creativity (Astrianingsih, 2021). Thus, the results of this study indicate that the PBL model is a powerful learning strategy in improving students' learning motivation. Therefore, education must continue to integrate the PBL model as an effective alternative in improving the quality of student learning.

The effectiveness of the PBL model assisted by 3D animation media on science learning outcomes

The results of the study with the SPSS 25 program, showed that the P-value = 0.012, so the P-value < 0.05 . Because the P-value < 0.05 , H_0 is not received, so H_1 is received, which shows that there is a significant difference in learning outcomes between the application of the PBL model assisted by 3D animation media (experimental class) compared to those applying conventional media (control class) in science learning. The results of previous studies that prove that learning outcomes get a value of $0.000 < 0.05$, thus it can be concluded that the problem-based learning model affects students' science learning outcomes (Nggili et al., 2023). In light of these findings, there is a significant difference in the science learning outcomes of students who apply the PBL model, namely a significant value < 0.05 .

According to Trisnawati et al. (2024) the implementation of the Problem Based Learning (PBL) model has a positive impact on student learning outcomes, by improving critical thinking skills and creating a collaborative learning environment, PBL not only helps students understand the subject matter but also prepares them to face challenges in the real world. The application of animation media in the PBL model has been proven to improve student learning outcomes. Research shows that the use of animated videos as learning media can attract students' attention and increase their involvement in the learning process, by seeing the material in an attractive visual form, students become more motivated to understand the concepts taught (Kaimudin et al., 2024). In the future, the results of this study show great potential to be applied more widely in the education system. With the increasing interest and learning outcomes of students through the PBL method assisted by animated media, it is important for educators to consider integrating technology into their curriculum. The use of animated media not only makes learning more interesting but can also increase student engagement, understanding of student learning outcomes.

Testing the effectiveness of the PBL model assisted by 3D animation media on science learning motivation and outcomes.

The results of the research shows that the PBL model assisted by 3D animation media is effective for motivation and learning outcomes, namely the significance value of $t_{\text{count}} > t_{\text{table}}$. The PBL model assisted by 3D animation media is effective for motivation $4.503 > 1.711$ and the PBL model assisted by 3D animation media is effective for learning outcomes $5.483 > 1.711$. This study is in line with previous research that the Problem Based Learning (PBL) model assisted by animation media is an innovative approach in education that integrates problem-based learning with the use of animation media to improve student motivation and learning outcomes (Yulianti & Utami, 2024). The implementation of the Problem Based Learning model not only improves students' motivation and learning outcomes but also prepares them to face future challenges with relevant skills and critical thinking abilities (Mardani et al., 2021). Overall, the implementation of the Problem Based Learning model not only provides direct benefits for student motivation and learning outcomes but also forms the foundation for future educational innovations that are more relevant and effective.

CONCLUSION**Conclusion**

Based on the research results that have been obtained, it can be concluded that the application of the PBL model assisted by 3D animation media can improve students' motivation and learning outcomes in science subjects, especially in the material of changes in energy forms. The application of the PBL model assisted by 3D animation media presents interesting and effective learning, learning by finding existing problems independently so that students can think critically and collaboratively in facing real problems. The results of the study prove that the value of $0.014 < 0.05$ means that the PBL model assisted by 3D animation media is effective for science learning motivation, while the value of $0.012 < 0.05$ means that the PBL model assisted by 3D animation media is effective for science learning outcomes, so that H_1 is accepted and the null hypothesis (H_0) is rejected. And the results of the study also state that the PBL model assisted by 3D animation media is effective with the $t_{\text{table}} > t_{\text{count}}$ (1.711) namely with a significance value of X against Y_1 of 4.503 and X against Y_2 of 5.483.

Suggestion

It is important to conduct a systematic evaluation of motivation and learning outcomes after the implementation of this model. In the study, it was seen that the average value of motivation and learning outcomes increased significantly after the implementation of the PBL model assisted by animation media. In order for the implementation of this model to be effective, teachers need to be trained in the use of 3D animation technology and the implementation of the PBL model. This training will ensure that teachers can design and implement learning that is interesting and in accordance with student needs.

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