ISSN : 2549-2764 (ONLINE)
ISSN : 2337-604X (PRINT)

BERKALA ILMIAH PENDIDIKAN FISIKA

Diterbitkan Oleh:
Program Studi Pendidikan Fisika
PMIPA FKIP UNLAM Banjarmasin

VOLUME 11 NOMOR 1 FEBRUARI 2023

VOL 11, NO 1 (2023)

DOI: http://dx.doi.org/10.20527/bipf.v11i1

TABLE OF CONTENTS

ARTICLES

ISSN : 2549-2764 (ONLINE)
ISSN : 2337-604X (PRINT)

BERKALA ILMIAH PENDIDIKAN FISIKA

https://ppjp.ulm.ac.id/journal/index.php/bipf

The Application of Problem-Based Learning Assisted by Variety of Visual Media on Student's Physics Learning Outcomes

Yulianti Yusal[1]*, Aziza Anggi Maiyanti[1] and M. Dewi Manikta Puspitasari[2]
[1]Program Studi Tadris Ilmu Pengetahuan Alam, Fakultas Tarbiyah
Institut Agama Islam Negeri Kediri, Kediri, Indonesia
[2]Teknik Elektronika, Fakultas Teknik, Universitas Nusantara PGRI Kediri
Kediri, Indonesia
*yuliantiyusal@iainkediri.ac.id

DOI:10.20527/bipf.v11i1.14388

Received: 17 September 2022 Accepted: 15 February 2023 Published: 28 February 2023

Abstract

This study aimed to find a significant difference between the learning outcomes of physics students taught through problem-based learning supported by a variety of visual media and those taught through conventional learning. This is to determine whether The method used in this study is quasi-experimental, using only a post-test control group design. The study population consisted of all 7th graders from public schools in South Sulawesi, and the sample was divided into two classes, an experimental class and a control class. The test vehicle for learning cognitive outcomes in the multiple-choice format of the extended material serves as a test vehicle. The sig values were obtained as a result of data analysis, i.e. based on the independent-samples t-test. (two-sided) is 0.000, which is less than the significance of 0.05, so H_o is rejected, and H_1 is accepted. Thus, there is a significant difference between the physics learning outcomes of students taught through problem-based learning supported by a variety of visual media and the physics learning outcomes of students taught through conventional learning.

Keywords: Physics Learning Outcomes; Problem-Based Learning; Variety Of Visual Media

How to cite: Yusal, Y, Maiyanti, A. A. & Puspitasari, M. D. M. (2022). The application of problem-based learning assisted by variety of visual media on student's physics learning outcomes. *Berkala Ilmiah Pendidikan Fisika*, 11(1), 20-27.

INTRODUCTION

Education is the main factor in improving the quality of human resources better in the face of competition in the 21st century (Stevens, 2012). Thus, the government has undertaken efforts to support almost all elements of education, such as curriculum renewal, teacher quality improvement, and learning quality improvement, including updated strategies, models, methods, and media to optimize the quality of learning.

Problem-based learning is a constructivist-influenced interactive learning model that emphasizes student-centered learning. A problem-based learning model is a learning model that uses problems as a starting point for acquiring new knowledge. Problem-based learning is a learning process to understand or solve a problem (Inel & Balim, 2010). Problem-based learning is a learning model in which student learning occurs in a true problem-solving context. This is in line with the view (Siew et al., 2015), who argue that problem-based learning requires students to work together in a group environment, understand the needs of unresolved problems, and consider multiple solutions. It can be concluded that problem-based learning models are learning in which students are given problems to solve in groups to stimulate them to build knowledge. Problem-based learning is suitable for applications because it requires solving real-world problems through stages of the scientific method so that students can acquire problem-related knowledge.

Expansion material is physics material that is much needed in solving problems in everyday life. Problems that require expansion materials to solve are why window frames fit looser than glass or why railroad tracks are faulty. In implementing problem-based learning through expansion material, students can easily remember learning material because students understand concepts based on problems, and when a substance expansion event occurs, students observe directly and then solve their problems based on observations (Imaniar et al., 2019).

One of the difficulties students face in learning physics concepts is the absence of something that can be observed directly. As a result, it cannot explain abstract material. Various kinds of visual media that can help clarify abstract material include animation media (Yanti et al., 2017) and simulation media (Hidayah & Dwikoranto, 2018; Sabrina & Wasis, 2019; Sinulingga et al., 2016)

Especially on the expansion material, which contains a lot of material that is abstract (difficult to understand) so that learning media is needed to make it easier for students to clarify the abstract material, and the material being studied will be more memorable for students because there is something that can be observed in the given learning media. Visual media can clarify abstract material (Chiu & Lin, 2005a). Therefore, this study used a variety of visual media, namely animation media and simulation media.

Previous studies about problem-based learning assisted by a variety of visual media on students' physics learning outcomes have been done. These studies include the implementation of problem-based learning assisted by innovative media to improve student learning outcomes (Rosmilasari & Adoe, 2021), video-assisted problem-based learning models on learning outcomes on the concept of elasticity and Hooke's law in high school (Suo et al., 2022), using problem-based learning model assisted visual media in improving high conceptual knowledge in senior high school (Sutria et al., 2017), and problem-based learning models assisted by interactive video (Cordeanita et al., 2020). These studies examine problem-based learning assisted by visual media, video media, and/or audio-visual, which only displays videos or videos with sound but does not display animations and simulations which can clarify abstract material so that students will have difficulty understanding it. While the problem-based learning research that will be carried out in this study is research on problem-based learning that uses a variety of visual media, namely animation and simulation media, so that students will more easily understand abstract material.

Based on this background, researchers are interested in applying problem-based learning supported by various visual media to students' physics learning outcomes. This study aimed to find significant differences between students' physics learning outcomes taught through problem-based learning supported by various visual media and those taught through conventional learning. This study explores the application of problem-based learning supported by various visual media to students' physics learning outcomes. It will describe the process and results of the research that has been conducted.

METHOD

The method used in this study was a quasi-experimental method with a posttest-only control group design, and the study sample was divided into two groups, an experimental group and a control group. The two groups were processed differently, with the experimental group being processed using problem-based learning supported by a variety of visual media and the control group being processed using a typical learning process (conventional learning) in the research setting. After treatment, the two groups underwent post-tests to measure the student's learning outcomes. Differences in post-test student learning outcomes in the two groups were informative for analyzing the effectiveness of problem-based learning supported by different visual media in delivering student learning outcomes. The study design used is shown schematically in Table 1.

Table 1 Research design

Group	***Treatment***	***Posttest***
Experiment	X	O_1
Control	Y	O_2

Description:

X: a treatment in the form of problem-based learning supported by various visual media in an experimental class

O_1: a post-test of student learning outcomes in an experimental class

Y: treatment in the form of conventional learning to the control class

O_2: a post-test of the learning outcomes of students in the control class

The study population, all in her 7th grade at public schools in South Sulawesi, consisted of 5 classes with a total of 175 students. The sample for this study consisted of 62 of her students, divided into two classes: an experimental class of 32 students and a control class of 30 of her students. Samples were selected using class random sampling. With this technique, the student stays in an empty class, and a lottery selects her two classes. This will be the study sample from all open classes. In this way, one class was selected as an experimental class to undergo a problem-based learning treatment using visual media, and another class was selected as a control class to undergo a conventional learning treatment.

The learning outcome instrument used in this study was the learning outcome test instrument, which was used to identify students' learning outcomes included in the extended material after the learning treatment was administered. The learning outcome test instruments used in this study were those of the cognitive domains measured: knowledge (C1); comprehension (C2); and application (C3). The cognitive aspect learning outcome indicators used in this study were only three cognitive levels, namely C1sampai C3 or LOTS (low order thinking skills) because this research was conducted at the junior high school level so that students' thinking skills were sufficient to reach these three cognitive levels.

The learning outcome instruments used were structurally validated, followed by testing the validity and reliability of the criteria. The construct was validated by three experts: his two physics educators and one physicist. Based on his three expert analyses of construct validation, all items were valid out of the 32 items validated, with the conclusion that they could be used for validation. In addition, 35 respondents who studied the extended material were used for criterion validity. Validity test analysis determined that 15 of her 32 validated items were valid question numbers. Valid items are then checked for authenticity. Dealing with the result, the reliability of valid research instruments was moderate.

The data analysis techniques used in this study are descriptive and inferential data analysis techniques. Descriptive statistics describe learning outcomes achieved by students after being taught through problem-based learning, assisted by students taught through a variety of visual media and traditional learning. The goal is to determine the sample population, highest score (maximum), lowest score (minimum), mean score, standard deviation, and variance. Inferential statistics are used to test research hypotheses. Test the hypothesis using an independent-sample t-test. Before testing our hypotheses, we performed data normality and variance uniformity tests. Descriptive and inferential data analyzes were computed using the SPSS program.

RESULT AND DISCUSSION

Table 2 shows the mean learning outcome scores of students in experimental classes taught through problem-based learning supported by a variety of visual media show higher mean learning outcome scores than students in control classes through traditional learning. Therefore, based on our descriptive analysis, we can conclude that problem-based learning supported by a variety of visual media provides students with better learning outcomes than traditional learning.

Table 2 General description of student learning outcomes in the experimental class and control class

	N	Minimum	Maximum	Mean	Std. Deviation	Variance
Posttest Experiment Class	32	11	27	21.00	3.877	15.032
Posttest Control Class	30	7	26	15.93	5.146	26.478
Valid N (listwise)	30					

Data from this study were analyzed descriptively as well as by inference analysis using independent-sample t-tests aimed at testing hypotheses. Normality and homogeneity tests were first performed before using the independent-samples t-test. Table 3 shows the results of the normality test analysis Table 4 shows the results of the homogeneity test analysis.

Table 3 The results of the analysis of the normality test of student learning outcomes in the experimental class and control class

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
Class	Statistic	df	Sig.	Statistic	df	Sig.
Posttest Experiment Class	.126	32	.200*	.952	32	.164
Posttest Control Class	.091	30	.200*	.967	30	.458

Table 4 The results of the homogeneity test analysis of student learning outcomes in the experimental class and control class

		Levene Statistic	df1	df2	Sig.
Learning Outcome	Based on Mean	3.803	1	60	.056
	Based on Median	3.641	1	60	.061
	Based on Median and with adjusted df	3.641	1	58.432	.061
	Based on trimmed mean	3.755	1	60	.057

Based on the results of the Kolmogorov-Smirnov normality test, the analysis in Table 3 shows that the experimental class taught using problem-based learning supported by different visual media has a significance value of 0.200, which is less than the significance value of is also large. The obtained 0.05 can therefore be concluded that the experimental classes taught using problem-based learning supported by a variety of visual media came from a normally distributed population. Similarly, the class taught by traditional learning received a significance value of 0.200, which is greater than the significance value of 0.05. It was therefore concluded that the control class taught by traditional learning came from a normally distributed population. Regarding the results of the homogeneity test analysis in Table 4, we can see that the significance value based on the mean is 0.056, greater than the significance value of 0.05. This indicates that the experimental class samples taught with mixed-media problem-based learning and the control class samples taught with conventional learning came from populations with uniform variances.

Dealing with the results of the independent-sample t-test analysis in Table 5, the value of sig (two-sided) is 0.000, less than the significance of 0.05. Based on the criteria, Ho is rejected, and H1 is accepted. This indicates a significant difference between the learning outcomes of students taught with problem-based learning using different visual media and those taught with conventional learnin

Table 5 The results of the independent sample t-test analysis in the experimental class and control class

		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 Outcome	Equal variances assumed	3.803	.056	4.396	60	.000	5.067	1.152	2.761	7.372
	Equal variances not assumed			4.357	53.822	.000	5.067	1.163	2.735	7.398

Dealing with the results of the data analysis, we found significant differences between the learning outcomes of students taught with problem-based learning and those taught with traditional learning models. In this case, students' learning outcomes in classes taught through problem-based learning outperform those of students taught through traditional learning models. The findings of this study follow the theory. This finding is in line with the findings obtained by Rerung et al. (2017) that applying problem-based learning can improve student learning outcomes. This finding is supported by Nafiah & Suyanto (2014) that student learning outcomes after the application of problem-based learning are 29 students who reached the KKM. Applying the problem-based learning model can improve students' science learning outcomes (Safitri et al., 2018; Syafriana, 2017). Furthermore Wasonowati et al. (2014) also found that student learning outcomes with problem-based learning were categorized as good.

Problem-based learning is a student-centered learning model. This is because students research to find solutions to problems presented by teachers. Students are considered scientists. Students do this activity in groups or together, exchanging ideas and opinions among students in the group until they finally reach a mutual solution to the problem. Collaborative activities are discussion activities when carrying out tasks to reach a consensus on a given task.

The implementation of problem-based learning includes several stages and steps. The first stage is when the teacher provides a stimulus/motivation to deliver students so that they are connected to the problem. Then the teacher gives the problem, and the students understand the problem at hand. Problem-solving instruction effectively improves student learning outcomes (Gok & Silay, 2008). At this stage, students look motivated in responding to the problems given because these problems are often experienced in life, and it is the first time for students to learn through problems. Then students are divided into several groups to do collaborative activities. The next stage is for students to determine what information they can get from the problems presented. Next, students express ideas, determine the problem's formulation, and make hypotheses. The next step is for students to identify their learning needs and find solutions to their problems. At this stage, students are seen actively giving arguments to exchange opinions or ideas with their group friends until a mutual agreement is found in a hypothesis formulation. Students actively solve problems through collaborative activities (Balta & Awedh, 2017; Yusal et al., 2021). Then the next step is for representatives from each group to make presentations to inform their solutions to problems to other friends or groups. This is done to exchange ideas or opinions if the solution differs from that of their friends or group until a mutual agreement is found. In this step, students look enthusiastic in giving arguments exchanging ideas and exchanging opinions with friends or other groups. Problem-solving builds arguments to anticipate rebuttals and rebuttals from other alternatives (Jonassen, 2011).

The application of problem-based learning is supported by a variety of visual media to ensure proper comprehension of the extended material learned. Animated and simulated media help visualize abstract concepts of augmentation to the naked eye. Simulation media often help students understand abstract scientific concepts (Chiu & Lin, 2005b). A variety of visual media plays a significant role in strengthening students' understanding of concepts significantly in science learning (Aykutlu & Sen, 2011).

CONCLUSION

Research on the Application of Problem-Based Learning Assisted by a Variety of Visual Media on Student Physics Learning Outcomes has been carried out. Based on the results of data analysis, namely the independent sample t-test, the sig. (2-tailed) is 0.000 which is smaller than the significance of 0.05, so Ho is rejected and H1 is accepted. Thus, there is a significant difference between the physics learning outcomes of students who are taught through problem-based learning assisted by various visual media and those taught through conventional learning. Therefore, problem-based learning can be an alternative learning model to optimize the quality of learning and improve student learning outcomes.

REFERENCES

Aykutlu, I., & Sen, A. I. (2011). Using analogies in determining and overcoming high school students ' misconceptions about electric current. *Necatibey Faculty of*

Education Electronic Journal of Science and Mathematics Education, *5*(2), 221–251.

Balta, N., & Awedh, M. H. (2017). The effect of student collaboration in solving physics problems using an online interactive response system. *European Journal of Educational Research*, *6*(3), 385–394. https://doi.org/10.12973/eu-jer.6.3.385

Chiu, M. H., & Lin, J. W. (2005a). Promoting fourth graders' conceptual change of their understanding of electric current via multiple analogies. *Journal of Research in Science Teaching*, *42*(4), 429–464. https://doi.org/10.1002/tea.20062

Chiu, M. H., & Lin, J. W. (2005b). Promoting fourth graders' conceptual change of their understanding of electric current via multiple analogies. *Journal of Research in Science Teaching*, *42*(4), 429–464. https://doi.org/10.1002/tea.20062

Cordeanita, Y. M., Rusdarti, & Khafid, M. (2020). Effectiveness of PBL models assisted by interactive video on problem-solving abilities of elementary school students article info. *Journal of Primary Education*, *9*(3), 260–268.

Gok, T., & Silay, I. (2008). Effects of problem-solving strategies teaching on the problem- solving attitudes of cooperative learning groups in physics education. *Journal of Theory and Practice in Education*, *4*(2), 253–266.

Hidayah, N., & Dwikoranto. (2018). Guided inquiry learning using phet simulations based worksheet to improve students' conceptual understanding on kinetic theory of gasses. *Jurnal Inovasi Pendidikan Fisika*, *07*(02), 171–175. https://doi.org/10.26740/ipf.v7n2.p%25p

Imaniar, E. N., Tandililing, E., & Hamdani. (2019). Model pembelajaran berbasis masalah terhadap hasil belajar siswa pada materi pemuaian zat di sma. *Jurnal Pendidikan Dan Pembelajaran*, *8*(5), 1–8. https://doi.org/http://dx.doi.org/10.26418/jppk.v8i5.33055

Inel, D., & Balim, A. G. (2010). The effects of using problem-based learning in science and technology teaching upon students' academic achievement and levels of structuring concepts. *Asia-Pacific Forum on Science Learning and Teaching*, *11*(2), 1–23.

Jonassen, D. H. (2011). *Learning to Solve Problems*. Routledge.

Nafiah, Y. N., & Suyanto, W. (2014). Penerapan model problem-based learning untuk meningkatkan keterampilan berpikir kritis dan hasil belajar siswa. *Jurnal Pendidikan Vokasi*, *4*(1), 125–143. https://doi.org/10.33369/diklabio.1.1.45-53

Rerung, N., Sinon, I. L. S., & Widyaningsih, S. W. (2017). Penerapan model pembelajaran problem based learning (PBL) untuk meningkatkan hasil belajar peserta didik sma pada materi usaha dan energi. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *6*(1), 47–55. https://doi.org/10.24042/jpifalbiruni.v6i1.597

Rosmilasari, D. M. A. R., & Adoe, D. P. (2021). Design and implementation of online problem based learning (PBL) assisted by innovative media to improve elementary school student learning outcomes. *Journal of Education Technology*, *4*(4), 456–464. https://doi.org/10.23887/jet.v5i1.29929

Sabrina, F., & Wasis. (2019). Implementation of guided discovery learning model using Phet simulations on ideal gas materials in xi mipa of state senior high school 2 nganjuk. *Inovasi Pendidikan Fisika*, *08*(02), 535–539. https://doi.org/10.26740/ipf.v8n2.p%25p

Safitri, M., Yennita, Y., & Idrus, I. (2018). Upaya meningkatkan aktivitas dan hasil belajar ipa siswa melalui penerapan model problem based learning (PBL). *Diklabio: Jurnal Pendidikan Dan Pembelajaran Biologi*, *2*(1), 103–112. https://doi.org/10.33369/diklabio.2.1.103-112

Siew, N. M., Chong, C. L., & Lee, B. N. (2015). Fostering fifth graders' scientific creativity through problem-based learning. *Journal of Baltic Science Education*, *14*(5), 655–669. https://doi.org/10.33225/jbse/15.14.655

Sinulingga, P., Hartanto, T. J., & Santoso, B. (2016). Implementasi pembelajaran fisika berbantuan media simulasi PhET untuk meningkatkan hasil belajar siswa pada materi listrik dinamis. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *2*(1), 57–64. https://doi.org/10.21009/1.02109/1

Stevens, R. (2012). Identifying 21st century capabilities. *International Journal of Learning and Change*, *6*(3/4), 123–137. https://doi.org/10.1504/IJLC.2012.050857

Suo, S. A., Odja, A. H., & Ntobuo, N. E. (2022). The influence of video-assisted problem based learning models on learning outcomes on the concept of elasticity and hooke's law in high school. *INSECTA: Integrative Science Education and Teaching Activity Journal*, *3*(1), 10–19. https://doi.org/10.21154/insecta.v3i1.3675

Sutria, Y., Sahyar. S., & Derlina, D. (2017). Using problem based learning model assisted visual media to improve high conceptual knowledge and critical thinking ability in senior high school. *American Journal of Educational Research*, *5*(6), 639–644. https://doi.org/10.12691/education-5-6-8

Syafriana, D. (2017). Penerapan model problem based learning (PBL) dalam pendekatan saintifik untuk meningkatkan hasil belajar ipa kelas v sdn 63 surabayo. *Jurnal Inovasi Pendidikan Dan Pembelajaran Sekolah Dasar*, *1*(1), 30–43. https://doi.org/10.24036/jippsd.v1i1.7932

Wasonowati, R. R. T., Redjeki, T., & Ariani, S. (2014). Penerapan model problem based learning (PBL) pada pembelajaran hukum - hukum dasar kimia ditinjau dari aktivitas dan hasil belajar siswa kelas x ipa sma negeri 2 surakarta tahun pelajaran 2013/2014. *Jurnal Pendidikan Kimia*, *3*(3), 66–75.

Yanti, M., Ihsan, N., & Subaer. (2017). Development of interactive learning media on kinetic gas theory at sman 2 takalar. *Journal of Physics: Conference Series*, *812*. https://doi.org/10.1088/1742-6596/755/1/011001

Yusal, Y., Suhandi, A., Setiawan, W., & Kaniawati, I. (2021). The Effectiveness of collaborative problem-solving using decision-making problems to improve the pre-service physics teachers' critical thinking skills. *Jurnal Pendidikan Fisika*, *9*(2), 107–116. https://doi.org/10.26618/jpf.v9i2.5059