

The Influence of Problem Based Learning Models on Students' Critical Thinking Ability on Natural Disaster Mitigation Material

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Abstract

Critical thinking is an essential skill in 21st century society. The condition of students' critical thinking skills is the basis of implementation Problem Based Learning (PBL) in geography class. This study aims to determine the level of Influence of the PBL on Students' Critical Thinking Skills on Natural Disaster Mitigation material. This research used a quasi-experimental method with a non-equivalent control group design, which is a design consisting of two groups, namely the experimental and control groups. Sampling technique was purposively, consisting of 13 experimental class students and 12 control class students. The data collection technique involves written essay tests in both pretest and posttest. The data has been analyzed quantitatively. The research results indicate that, descriptively, students in the PBL group achieved higher average scores in critical thinking skills compared to those in conventional learning. Furthermore, a significant difference exists in critical thinking skills between the PBL group and conventional learning, with PBL demonstrating a significant impact on students' critical thinking skills. It is better if the PBL is given by teachers to improve students' critical thinking skills.

Keywords: Critical thinking, Natural disaster mitigation, Problem based learning.

Received: December 7, 2023

Revised: January 15, 2024

Accepted: January 17, 2024

Article Identity:

Abdullah, I., & Ningrum, E. (2024). The Influence of Problem Based Learning Models on Students' Critical Thinking Ability on Natural Disaster Mitigation Material . *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, 15(1), 159-169.

INTRODUCTION

Education is one way to improve the quality of learning resources in accordance with the needs of today's times, because education is a learning process that can be done to hold a learning process, namely teachers, students, and teaching methods (Hayati & Murdy, 2016; Abdullah, 2021a). The quality of education itself can be seen from several factors including teachers / teaching staff, school infrastructure and learning resources. Teachers also have a very important function and role for improving the quality of classroom learning, one of which is to increase the interest, intelligence, motivation and cognitive attitude of students (Abdullah, 2021b). In addition, in the quality of learning teachers can also provide innovative learning in the classroom, so that innovative learning can prioritize students as the center of learning (Anggraini, Purwanto, & Nugroho, 2020).

Success in education cannot be separated from success in a learning process (Rusman, Kurniawan, & Riyana, 2015). In order for students to understand well the material delivered by educators, educators must have knowledge, abilities, abilities, and expertise in teaching. Geography lessons that have specific material characteristics require teachers to be more critical in learning process activities. One

of them is the use of varied learning models. Critical thinking skills are students' ability to analyze arguments, make conclusions using reasoning, judge or evaluate, and make decisions or solve problems. Critical thinking skills are also important because learners who are able to think critically about a problem will produce good output in their education. One learning model that can be used to improve students' critical thinking skills is the PBL. In the application of the PBL, students will work in groups to collect information and solve problems given by the teacher. In this learning students need companions, motivators and facilitators, namely teachers. So that students are required to be active and also accustomed to critical thinking (Dewi et al., 2021). Technology and information can be utilized in learning activities, including in geography learning using PBL models using various online learning platforms (Triyanto et al., 2022).

The ability to think critically is an important aspect in creating an innovation and finding ideas to solve a problem. Thinking kirts can train learners to develop many ideas and arguments, asking some questions (Akinoğlu & Tandoğan, 2007). Students who have critical thinking skills will have a critical mindset, have more grasping power, also maximum learning outcomes, and are able to think divergently. In other words, students who have critical thinking skills will have a high mindset and comprehension when compared to students who do not have critical thinking skills. So students who have critical thinking skills will be able to find ideas and solve problems, therefore critical thinking skills are needed to have in the learning process.

However, in reality, students' critical thinking skills in Indonesia today tend to be low. This is evidenced by the results of the Trends in International Mathematic and Science Study (TIMSS) study in 2011 showing that Indonesia is in the bottom 3 of all 32 participating countries. Similar results can also be seen from the results of the Programme for International Student Assessment (PISA) study in 2012, the results of the PISA survey in 2012 showed that the literacy ability of Indonesian students was in position 64 out of 65 participating countries. In addition, the reality on the ground in the learning process in some schools also shows that students' critical thinking skills have not been developed. This is because teachers transfer their knowledge using the lecture method, thus making students less critical in solving problems, as well as teaching and learning activities less efficient and in the end students are unable to develop their critical thinking skills. Because teachers tend to still use conventional learning models, so that it has an impact on the low level of student creativity which can also affect student attitudes in learning, namely students tend to be silent and rarely ask questions related to ongoing learning, and there is still a lack of learning models that play an important role in stimulating the mindset in students.

One alternative to developing students' critical thinking skills is important to teach, because students must have the capital to analyze problems about the geography learning process so that students are able to apply ideas and find solutions to solve problems that exist in everyday life (Adiwiguna, Dantes, & Gunamantha, 2019). In addition, critical thinking skills are thinking that has a purpose (proving a thing, interpreting the meaning of something, solving a problem), but critical thinking can be a collaborative and non-competitive effort. Critical thinking is reasonable, reflective thinking that is focused on deciding what to believe or do, This is in line with (Susetyo & Astina, 2017). Students' critical

thinking skills will always be active in solving various kinds of problems through knowledge and intellectual abilities in integrating learning materials and learning models. The PBL has a learning model in which learning activities only focus on activities that are prioritized in procedures to solve a problem (Yulianti & Gunawan, 2019). The statement is in line with Wijayanti and Amirudin (2016) that the PBL is a model that emphasizes contextual learning that can develop critical thinking skills in students.

Responding to these problems, there needs to be an effort by teachers in choosing learning models that can develop higher-order thinking skills, especially critical thinking skills. Furthermore, the learning model must be able to improve students' critical thinking skills in learning. According to Mabrurah and Suhandi (2017), PBL is a learning model that presents problems so as to stimulate learners to learn. In the classroom, students work together to form teams in groups to solve problems and find solutions to real-world problems (real word). The PBL was developed because it can affect students' critical thinking skills and increase interest and motivation in the teaching and learning process so that there is no longer an assumption that learning is a more active teacher than students (Amir, 2015)

This research on the influence of the PBL on students' critical thinking skills has been carried out by a number of researchers. The research was conducted by Habibah et al. (2022), the effect of the PBL based on blended learning on the critical thinking skills of class XI Students at SMAN 2 Mataram, then previous research conducted by Sulastri, Supeno, and Sulistyowati (2022) on the implementation of PBL to improve students' critical thinking skills in geography learning. Therefore, this study aims to understand the influence of the PBL on students' critical thinking skills on natural disaster mitigation material.

RESEARCH METHOD

The method used in this study is quasi-experimental. Basically, this method is done because it is given different treatment in the experimental group and the control group. This experimental research method is usually carried out to examine the extent of direct influence on a treatment. Research in experimental classes will be given a treatment on the Project Based Learning learning model, while for the control class, it uses conventional learning models such as using lecture methods, and questions and answers.

The population in this study were all students of State High School 3 Ternate City, and the sample used was 25 students consisting of 13 students as the experimental class and 12 students as the control class. The sampling technique in this research uses purposive sampling, namely sampling is adjusted to certain considerations and characteristics. This research was conducted in September 2023.

This research instrument is a written test in the form of essay questions to measure students' critical thinking skills in geography subjects. The preparation of test instruments is developed by adapting indicators of critical thinking skills. The critical thinking skills test consists of 6 description questions. The analysis of the instrument used is an expert validity test. The questions will be given during the posttest.

Data analysis techniques in this study use quantitative analysis, which is an analytical technique whose analysis is carried out by calculation, because it is

related to numbers, namely test results given to students. At the initial stage, prerequisite tests were carried out on the data obtained, namely by testing normality and homogeneity. Furthermore, it will be carried out for the *t*-test of the independent sample *t*-test technique with a significance level of 5% using the SPSS software application version 22.

RESULTS AND DISCUSSION

This study aims to determine the difference in students' critical thinking skills between the PBL and conventional groups, and the effect of the application of the PBL on students' critical thinking skills on natural disaster mitigation material. In the study, ten indicators were used to measure students' critical thinking skills. In the experimental class, the PBL learning model was applied, while in the control class, conventional learning was applied with lecture and question and answer methods. In this study, prerequisite tests were first carried out on pretest and posttest data, then hypothesis tests were carried out. This was done on both pretest and posttest data from the control class and experiments using independent sample *t*-test.

Table 1. Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Dev.
Pretest PBL	25	41	39	80	60.16	13.545
Posttest PBL	25	20	70	90	79.40	6.007
Pretest Conventional	25	31	39	70	52.48	10.377
Posttest Conventional	25	25	60	85	70.20	6.371

Based on Table 1, it shows that for the Pretest in the PBL class with a minimum value of 39, and a maximum value of 80, while for the Posttest in the experimental class with a minimum value of 70, and a maximum value of 90. The average value in the experimental class Pretest score is 60.16, and the experimental class Posttest value is 79.40. While the standard deviation value in the experimental Pretest was 13.545 and the Posttest was 6.007.

In addition, the Pretest minimum value in the conventional as the control class is 39, and the maximum value is 90. As for the minimum score in the control class for Posttest is 60, while the maximum value is 85. The average value in the control class Pretest is 52.48 while the Pretest is 70.20. In addition, the standard deviation value of the control class Pretest is 10.337 while the Posttest is 6.371. The next step is to conduct a normality test, the results are presented in Table 2.

Table 2. Normality Test Results

Data	Kolmogorov-Smirnova			Shapiro-Wilk		
	Statistics	df	Sig.	Statistics	df	Sig.
Pretest PBL	.200	26	.029	.877	26	.006
Posttest PBL	.248	26	.025	.889	26	.010
Pretest Conventional	.194	26	.021	.911	26	.032
Posttest Conventional	.193	26	.020	.928	26	.077

In Table 2, Pretest and Posttest data mentioned that the normality test was carried out through the Kolmogorov-Smirnov or Shapiro-Wilk method. If the *Sig.* was more than $\alpha=0.05$, then the data sample comes from a normally distributed population. For this reason, through the results of the normality test analysis, it will be known that the Pretest data on students' critical thinking skills in the experimental class with a significance level of 0.29, while for the control class of 0.21, it can show that for the level of significance in the Pretest data for experimental and control classes of more than 0.05, the distribution of the Pretest data is stated as normal distribution. The Posttest data on students' critical thinking skills in the experimental class with a significance level of 0.025 and a control class of 0.20. It can show that for the level of significance in the Posttest experimental class and control class more than 0.05, then the distribution for the Posttest data is normally distributed.

The subsequent step involves applying a homogeneity test, and the results are presented in Table 3.

Table 3. Homogeneity Test Results

	Levene Statistic	<i>df1</i>	<i>df2</i>	<i>Sig.</i>
Based on Mean	.012	1	48	.974
Based on Median	.000	1	48	1.000
Based on Median and with adjusted <i>df</i>	.000	1	46.703	1.000
Based on trimmed mean	.012	1	48	.979

Based on Table 3, the results of the homogeneity test of Posttest data critical thinking skills, the level of significance of Posttest data on critical thinking skills was 0.12. Judging from the Based on Mean data because it looks at the equation based on the average value (mean). This means that the significance is more than 0.05, so the Posttest data of critical thinking skills of the experimental class and the control class have homogeneous variance. The results of normality and homogeneity analyses provide the statistics for hypothesis testing.

The hypothesis test was analyzed using a parametric statistical test, namely the independent sample *t*-test. The terms of the hypothesis test are if the value of *Sig.* (2-tailed) < 0.05 , then there is a significant difference between the critical thinking skills of the conventional and the PBL class. The results of the hypothesis test are presented in Table 4.

Table 4. Independent Sample *t*-test

Mean Difference	<i>t</i>	<i>df</i>	<i>Sig.</i> (2-tailed)	95% Confidence Interval	
				Lower	Upper
9.200	5.254	48	.000	5.679	12.721

Based on Table 4, the hypothesis test results on the posttest data of critical thinking skills, *Sig.*=0.000 $<0.05=\alpha$, this leads to the conclusion that there is a significant difference in the average critical thinking skills between the PBL and conventional groups.

Additionally, further analysis is to find out whether the effect of PBL is significant on students critical thinking skills. The results of the analysis for the purpose are presented in Table 5.

Table 5. Results of Simple Linear Regression Analysis

Type	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>	<i>Sig.</i>
	B	Std. Error	Beta		
1 (Constant)	68.145	6.934		9.828	.000
PBL	.047	.113	.085	.416	.681

Based on Table 5, it shows that *p*-value (*Sig.*) =0.000, and the *p*-value will be compared to $\alpha=0.05$. Because the *p*-value=0.000 $< 0.05=\alpha$, it can be concluded that there is an influence of the PBL on critical thinking skills. Meanwhile, to find the magnitude of the influence between the PBL model and critical thinking skills can be seen in the results of simple linear regression analysis, through guided by the value of *R* square or R^2 in Table 6.

Table 6. Model Summary

Type	<i>R</i>	<i>R</i> Square	Adjusted <i>R</i> Square	Std. Error of the Estimate
1	.813 ^a	.597	.534	7.47582

a. Predictors: (Constant), PBL

Based on Table 6, it shows that the *R* square is 0.597. This value means that the influence of the PBL on critical thinking skills is 59.7% and 40.3% of critical thinking skills are influenced by other variables that are not studied. Through this it can be concluded that the PBL have a stage that will support students' critical thinking skills so that students can be problem-oriented whose focus is on students so that where the teacher provides teaching material content in the form of learning objectives, describes and motivates students to always be involved and active in overcoming problems, and organizes students to work independently so that where the teacher always helps students can Encouraged to conduct independent investigations and work in groups. In addition, students are invited to carry out experiments as part of learning. Then to find a solution in the form of a teacher giving an assignment to find an explanation and solution to the problem at hand. Upon completion, students can also Develop and present the results of this Teacher can also help students through planning and preparing results that are in accordance with expectations. As well as students making reports on the results of discussions and analyzing and evaluating where the teacher can help students and reflect on investigations in the process carried out (Gultom & Adam, 2018).

To see how students have a critical way of thinking, of course, what is done is to use a learning model based on Project Based Learning. Please note that the learning model Project Based Learning that is how to encourage these students to get to know more about how to learn and work together in groups to find solutions in solving problems in the real world. Through this PBL, students are expected to be able to find a concept through problems that occur in the environment around them. The PBL can also be done in this study can be started with initial data collection with the aim of knowing how the initial picture of a critical thinking skill in students. The implementation of the learning process used through a learning model based on project based learning can be seen that in the activity of a learning will place students as a central point in learning activities carried out by the teacher. The teacher himself is a facilitator who encourages these students to be more active

in learning in the future. This is also in line with Riandi and Suryanto (2019) which states that student learning is only seen as a learning subject that needs to be actively involved in the learning process, but the teacher is only a facilitator who guides student learning activities. Through the PBL, students can be encouraged to help the spirit to build their own knowledge by going through the stages in the PBL, students are more focused on discussing with group members so that students are more independent and feel confident to understand and dominate the questions given by the teacher.

PBL is directly approach to students find problems authentically so that students are able to answer and compile their own knowledge, and can grow strong skills through inquiry and make students able to make students more independent and confident (Hosnan, 2014). In the activity of using the PBL is how the teacher can provide motivation to students because basically these students will train critical thinking, analyze problems and be able to improve the ability of critical thinking skills so that teachers can also play an important role in motivating students to solve problems will be raised as learning topics (Sianturi, Sipayung, & Simorangkir, 2018). Through this learning, teachers can also provide learning media prepared in the learning process so that these students are easily able to use the learning media. This is done because the learning media prepared is in the form of a package book on the student handbook including videos, audio visuals, and power points that will be made by the teacher and then uploaded to youtube as well as some learning videos that are very relevant to the learning material then downloaded via youtube and the link will all be shared by the teacher through student wahtsaap groups in both experimental classes and control classes. In addition, these students can also access learning materials anytime and anywhere, this makes students in the whatsaap group will be able to collect assignments as well as ask and discuss related problems that they do not understand so that it can be photographed in limited subject hours.

According to Pusparini, Feronika, and Bahriah (2018) states that PBL and students' critical thinking skills will have a significant relationship. So that in a learning model there are some physical differences, these differences are seen in student output in critical thinking skills. This is in agreement with Azizah et al. (2014) which determines that in the stages of learning activities with the PBL, the result is the process of improving students' abilities in critical thinking skills in students. In addition, according to Goddess (2020) Student response and classroom atmosphere become more conducive and support the improvement of critical thinking skills that are the result of using the PBL (Sutrisno, 2019) "Teaching in the PBL is based on a problem so that students are able to solve problems, whose problems are authentic problems with specific aims and objectives to compile and grow student knowledge, redevelop inquiry and improve high-level skills, as well as develop independence and confidence (Herliati, 2022).

A person's critical thinking ability can be seen from the way he gives opinions confidently and the way he acts by giving reasons (Mabruroh & Suhandi, 2017). In addition, students' critical thinking skills need to be developed so that students use their thinking critically to solve a given problem. According to Hasanah, Rajagukguk, & Shafa (2020), critical thinking must meet the characteristics of thinking activities which include: analysis, synthesis, problem recognition and solution, conclusion and assessment. Moreover, Maryam et al. (2019) which means

that critical thinking is very necessary for students to prepare themselves to face the future era of globalization. In addition, according to Risnawati, Nisa, and Oktaviyanti (2022) Critical thinking is essential for social and intellectual life. Critical thinking is a key competency to solve problems necessary for individuals to live successfully and responsibly and for society to face present and future challenges. Critical thinking is a way of higher-order thinking or thinking by producing the ability to identify a problem, analyze, and determine the steps of solving, making conclusions and making decisions.

Through observations for the control class in terms of activities, it can be seen that during the learning process, students only listen to the delivery of material without challenging students to think critically. This makes students feel bored, unmotivated, lazy and distracted when listening to the teacher in class. This is displayed when the teacher explains that some students are not paying attention. As Sanjaya (2012) points out, the teacher-centered learning model, where the teacher is the source of learning, is not very effective. The disadvantage of this traditional method is the presence of interaction between teachers and students, although there is no interaction between students. As a result, the teacher plays an important role in classroom learning activities, leading to passive thinking of students.

Based on the results of the description in the previous research above, it can be concluded that the PBL can be used as a reference for the learning model used by teachers in teaching. In PBL activities, it is better to designate students who are less active when in class, prepare questions in advance before carrying out teaching and learning activities, and ensure that the questions asked represent the existing ones. For other researchers, for future researchers, who are interested in carrying out research that can be used as information or reference material when conducting similar research. It is hoped that the results of this study as an evaluation and can be developed with further research to meet the shortcomings that can be seen objectively.

CONCLUSION

This research concluded that descriptively, students in the PBL group achieved higher average scores in critical thinking skills compared to those in conventional learning. Furthermore, a significant difference exists in critical thinking skills between the PBL group and conventional learning, with PBL demonstrating a significant impact on students' critical thinking skills. This is shown that the results of the hypothesis test of students' critical thinking skills with a significance level of $0.000 < 0.05$, as well as for the experimental class Pretest score with a minimum score of 39, and a maximum score of 80, while for the Posttest in the experimental class with a minimum score of 70, and a maximum score of 90, and the average score in the experimental class Pretest score is 60.16, and the experimental class Posttest score of 79.40. While the standard deviation value in the experimental Pretest was 13.545 and the Posttest was 6.007. In addition, the Pretest minimum value in the conventional as the control class is 39, and the maximum value is 90. As for the maximum score in the control class for Posttest is 60, while the maximum value is 85. The average value in the control class Pretest is 52.48 while the Pretest is 70.20. In addition, the standard deviation value of the control class Pretest is 10.337 while the Posttest is 6.371. Meanwhile, the magnitude of the influence of

the PBL on critical thinking skills is 59.7% and 40.3% of critical thinking skills are influenced by other variables that are not studied. As a follow-up research step, it is better if the PBL is given by teachers to improve students' critical thinking skills on similar subjects and variables at different times and places. In addition, for future studies, researchers are expected to take more samples so that the data can form a normal curve.

REFERENCES

Abdullah, I. (2021a). Pengaruh Penggunaan Media Pembelajaran Berbasis Macromedia Flash Terhadap Hasil Belajar Geografi Siswa di SMA Negeri 9 Kota Ternate. *JIIP-Jurnal Ilmiah Ilmu Pendidikan*, 4(3), 180-185. <https://doi.org/10.54371/jiip.v4i3.248>

Abdullah, I. (2021b). Hubungan Kecerdasan Emosional dan Motivasi Mengajar dengan Kinerja Guru IPS SMP di Provinsi Maluku Utara. *Jurnal Ilmu Pendidikan (JIP) STKIP Kusuma Negara*, 13(1), 35-43. <https://doi.org/10.37640/jip.v13i1.877>

Akinoğlu, O., & Tandoğan, R. Ö. (2007). The effects of problem-based active learning in science education on students' academic achievement, attitude and concept learning. *Eurasia journal of mathematics, science and technology education*, 3(1), 71-81. <https://doi.org/10.12973/ejmste/75375>

Amir, M. T. (2013). *Inovasi Pendidikan Melalui Pembelajaran Berbasis Masalah*. Kencana Prenadamedia Group

Anggraini, W. N., Purwanto, A., & Nugroho, A. A. (2020). Peningkatan hasil belajar kognitif biologi melalui problem based learning pada siswa kelas x sma negeri 1 bulu sukoharjo. *IJIS Edu: Indonesian Journal of Integrated Science Education*, 2(1), 55-62. <https://doi.org/10.29300/ijisedu.v2i1.2864>

Azizah, N., Fatmaryanti, S. D., & Ngazizah, N. (2014). Penerapan Model Pembelajaran Konstruktivisme Berbasis Problem Based Learning (PBL) Untuk Meningkatkan Kemampuan Berpikir Kritis Pada Siswa SMA Negeri 1 Kutowinangun Kelas X Tahun Pelajaran 2013/2014. *Radiasi: Jurnal Berkala Pendidikan Fisika*, 5(2), 24-28.

Adiwiguna, S., Dantes, N., & Gunamantha, M. (2019). Pengaruh model problem based learning (PBL) berorientasi stem terhadap kemampuan berpikir kritis dan literasi sains siswa Kelas V SD di Gugus I Gusti Ketut Pudja. *PENDASI: Jurnal Pendidikan Dasar Indonesia*, 3(2), 94-103. <https://doi.org/10.23887/jpdi.v3i2.2871>

Dewi, S. M., Haerudin, H., Hasanah, S., & Kusumah, D. Pengaruh Model Pembelajaran Problem Based Learning (PBL) terhadap Kemampuan Memecahkan Masalah dalam Pembelajaran Ilmu Pengetahuan Sosial Sekolah Dasar. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 10(1), 134-143. <https://doi.org/10.33578/jpfkip.v10i1.8052>

Habibah, F. N., Setiadi, D., Bahri, S., & Jamaluddin, J. (2022). Pengaruh Model Problem Based Learning berbasis Blended Learning terhadap Keterampilan Berpikir Kritis Peserta Didik Kelas XI di SMAN 2 Mataram. *Jurnal Ilmiah Profesi Pendidikan*, 7(2b), 686-692. <https://doi.org/10.29303/jipp.v7i2b.603>

Gultom, M., & Adam, D. H. (2018). Pengaruh Pendekatan Pembelajaran Problem Based Learning Terhadap Kemampuan Berpikir Kritis Di Mts Negeri

RantauprapaT. *Jurnal Pembelajaran dan Biologi Nukleus*, 4(2), 1-5. <https://doi.org/10.36987/jpbn.v4i2.1110>

Dewi, D. T. (2020). Penerapan Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis Siswa. *Jurnal Pendidikan Ekonomi Undiksha*, 12(1), 1-14. <https://doi.org/10.23887/jjpe.v12i1.25317>

Hasanah, N., Rajagukguk, K. P., & Shafa, I. (2020). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kritis Siswa Sekolah Dasar. *Jurnal Sintaksis*, 2(2), 24-30.

Hayati, A. F., & Murdy, K. (2017). Pengaruh Metode Pembelajaran Berbasis Masalah (Problem Based Learning) terhadap Peningkatan Kemampuan Berpikir Kreatif Siswa pada Mata Pelajaran Ekonomi. *Oikos: Jurnal Ekonomi dan Pendidikan Ekonomi*, 1(2), 61-71. <https://doi.org/10.23969/oikos.v1i1.235>

Herliati, H. (2022). Meningkatkan Kemampuan Berpikir Kritis Matematika Siswa Menggunakan Model Problem Based Learning (PBL) di SDN 001 Kempas Jaya. *Jurnal Pajar (Pendidikan dan Pengajaran)*, 6(5), 1514-1519. <https://doi.org/10.33578/pjr.v6i5.8961>

Hosnan, M. (2014). *Pendekatan saintifik dan kontekstual dalam pembelajaran abad 21: Kunci sukses implementasi kurikulum 2013*. Ghalia Indonesia

Mabruroh, F., & Suhandi, A. (2017). Construction Of Critical Thinking Skills Test Instrument Related The Concept On Sound Wave. *Journal of Physics: Conference Series*, 812(1), 012056. <https://doi.org/10.1088/1742-6596/812/1/012056>

Maryam, M., Kusmiyati, K., Merta, I. W., & Artayasa, I. P. (2020). Pengaruh model pembelajaran inkuiri terhadap keterampilan berpikir kritis siswa. *Jurnal Pijar MIPA*, 15(3), 206-213. <https://doi.org/10.29303/jpm.v14i3.106>

Pusparini, S. T., Feronika, T., & Bahriah, E. S. (2018). Pengaruh model pembelajaran Problem Based Learning (PBL) terhadap kemampuan berpikir kritis siswa pada materi sistem koloid. *Jurnal Riset Pendidikan Kimia (JRPK)*, 8(1), 35-42. <https://doi.org/10.21009/JRPK.081.04>

Riandi, T., & Suryanto, M. (2019). Penerapan Model Pembelajaran Problem Based Learning Terhadap Hasil Belajar Siswa Pada Mata Pelajaran Ukur Tanah di SMKN 7 Surabaya. *Jurnal Kajian Pendidikan Teknik Bangunan*, 5(1), 30-38.

Risnawati, A., Nisa, K., & Oktaviyanti, I. (2022). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Berpikir Kritis Siswa Kelas V Pada Tema Kerukunan dalam Bermasyarakat SDN Wora. *Jurnal Ilmiah Profesi Pendidikan*, 7(1), 109-115. <https://doi.org/10.29303/jipp.v7i1.426>

Rusman, R., Kurniawan, D., & Riyana, C. (2015). *Pembelajaran berbasis teknologi informasi dan komunikasi: Mengembangkan profesionalitas guru*. Rajawali Press

Sanjaya, W. (2012). *Strategi Pembelajaran Berorientasi Pada Standar Proses*. Kencana Prenada Media Group.

Sianturi, A., Sipayung, T. N., & Simorangkir, F. M. A. (2018). Pengaruh model problem based learning (PBL) terhadap kemampuan berpikir kritis matematis siswa SMPN 5 Sumbul. *UNION: Jurnal Ilmiah Pendidikan Matematika*, 6(1), 29-42. <https://doi.org/10.30738/v6i1.2082>

Sulastri, E., Supeno, S., & Sulistyowati, L. (2022). Implementasi Model Problem-Based Learning untuk Meningkatkan Keterampilan Berpikir Kreatif Siswa

Sekolah Dasar dalam Pembelajaran IPA. *Edukatif: Jurnal Ilmu Pendidikan*, 3(2), 5883-5890. <https://doi.org/10.31004/edukatif.v4i4.3400>

Susetyo, B. B., Sumarmi, S., & Astina, I. K. (2017). Pengaruh Pembelajaran Problem Based Learning Berbasis Outdoor Adventure Education terhadap Kecerdasan Spasial. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 2(12), 1669-1675. <http://dx.doi.org/10.17977/jptpp.v2i12.10326>

Sutrisno, T. (2019). Pengaruh Pembelajaran Berbasis Masalah (Problem Based Learning) Terhadap Kemampuan Berpikir Kritis Siswa pada Mata Pelajaran PKn Kelas VI di SDN Kota Sumenep. *ELSE (Elementary School Education Journal): Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*, 3(2), 98-110. <https://doi.org/10.30651/else.v3i2.3394>

Triyanto, S. A., Wahidin, W., Hartania, N., Solihat, A., & Sutrisno, S. (2022). Blended-problem based learning with integrated social media-based learning media in improving students' critical thinking skills. *Biosfer: Jurnal Pendidikan Biologi*, 15(2), 242-254. <https://doi.org/10.21009/biosferjpb.25792>

Wijayanti, A. P., Sumarmi, S., & Amirudin, A. (2016). Perbandingan Model Group Investigation Dengan Problem Based Learning Berbasis Multiple Intelligence Terhadap Kemampuan Memecahkan Masalah Siswa SMA. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, 1(5), 948-957. <http://dx.doi.org/10.17977/jp.v1i5.6326>

Yulianti, E., & Gunawan, I. (2019). Model pembelajaran problem based learning (PBL): Efeknya terhadap pemahaman konsep dan berpikir kritis. *Indonesian Journal of Science and Mathematics Education*, 2(3), 399-408. <https://doi.org/10.24042/ijjsme.v2i3.4366>