



Effectiveness of Problem Based Learning Models Assisted by Worksheets on Students' Critical Thinking Ability

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Article Info	Abstract
Received January 7, 2023	This study aims to describe the effectiveness of the Problem Based Learning (PBL) model assisted by worksheet on the critical thinking ability of students. This quasi-experimental study employs the nonequivalent posttest-only control group design with the cluster random sampling technique. The study sample consists of students from classes VII B and VII C in one of the Public Junior High Schools in Magelang, Central Java, Indonesia. The research instruments used are learning tools in the form of worksheet and critical thinking ability tests. The results of this research are; 1) students who are taught using the PBL learning model assisted by worksheet against critical thinking ability are said to be effective by obtaining learning completion has reached 75%, 2) students who are taught using the direct learning model against critical thinking ability are said to be ineffective by obtaining learning completion has not reached 75%, 3) critical thinking ability of learners taught using the worksheet-assisted PBL model more effective than using the direct learning model. This study implies differences in students' critical thinking abilities when comparing the worksheet-assisted PBL learning model to the direct learning model. Education needs to apply appropriate learning models to develop students' critical thinking skills.
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INTRODUCTION

One of the abilities that must be possessed by students is the ability to think critically. Of course, a teacher must play an important role in the process of developing students' critical thinking and logical thinking skills. This is in line with Lismaya (2019) explaining that critical thinking is an intellectual process by starting the step by creating a concept, applying, and doing synthetic or evaluating the knowledge that has been obtained through observation, experience, reflection, basic thinking to perform an action. Furthermore Surya (2011) explains that critical thinking is an active, persistent activity and carefully considers a decision or form of knowledge received, seen from various angles of reasons that support and

conclude. The ability to think critically is essential in delving into new material and relating to what learners already know, even if learners cannot know it all. Learners can learn to ask questions effectively and reach conclusions consistent with the facts.

According to Ennis (2011), critical thinking skills are grouped in the top five activities including (1) Elementary clarification, explaining simply by focusing the question on the problem, (2) Basic support, conducting observation and considering and observing the credibility of the source of completion, (3) Inference, making and considering of deductions, induction, and decisions, (4) Advanced clarification, making further explanations, namely defining terms and considering definitions, and (5) Strategy and tactics, managing strategies and tactics by performing an appropriate action in problem solving. Furthermore, Facione (2011), the ability to think critically has six basic skills, including (1) Interpretation, understanding a problem, (2) Analysis, the process of analyzing the relationships between concepts and statements, (3) Evaluation, determining and using the right strategy in solving problems, (4) Inference, making a conclusion, (5) Explanation, providing a reason based on the conclusions drawn and (6) Self-regulation, looking back at the answers given based on the ability of oneself to see the achievement of the expected goals. Critical thinking skills applied include (1) Focus, focusing on problems by providing problems with problems, (2) Analysis, identifying relationships between concepts and statements, (3) Evaluation, using appropriate problem-solving strategies, and (4) Inference, providing conclusions appropriately.

Based on discussions with grade VII mathematics teachers at one of the Public Junior High Schools in Magelang, Central Java, Indonesia, students are less active in the learning process so that learning tends to be passive. Students have not been able to express what is not yet understood and have not dared to explain what the teacher asked. Observations at there show that the learning process applied is teacher-centered. The results of the initial test of critical thinking ability of grade VII students showed that the average score obtained was 16.15 out of a maximum score of 100. These results are categorized very low based on the category of critical thinking ability according to Arikunto (2018). This shows that a teacher must be able to create a learning atmosphere that can train students' critical thinking skills with an appropriate learning model.

One alternative learning model that can train students' critical thinking skills is to apply PBL learning model. PBL is one of the learning models designed to develop students' problem-solving abilities. According to Jailani, Sugiman, and Apino (2017), PBL is a problem-based learning model. Using learning that starts from problems, students can learn concepts and principles while solving these problems. According to Octavia (2020), PBL is a learning that presents a variety of authentic and meaningful problem situations to students that serves as a foundation for investigation, learner investigation skills, and problem-solving skills. This is in line with Isrok'atun and Amelia's explanation (2018) that PBL is a learning approach that begins by exposing students to a real-world problem and guiding them to solve it through experiences gained during the learning process. The PBL model is thus a learning that focuses on problem-solving activities in real life, thus training students to use thinking skills in developing ideas to solve a problem skillfully, play an active role in learning, and confidence in making decisions.

PBL research that has been conducted by Setyaningsih and Abadi (2018) shows that mathematics learning with PBL with a collaborative group and collaborative setting in pairs is effective in terms of algebraic learning achievement, critical thinking ability, and student anxiety. PBL with a group collaborative setting is better than a paired collaborative setting in terms of algebraic learning achievement, but there is no difference in effectiveness. The results of another study conducted by Yuni, Bharata, and Caswita (2017) found that there was an influence of the PBL model on the mathematical critical thinking ability of students.

One of the learning media that can be applied to the PBL model is the Student Worksheet. This is strengthened by the results of research by Azmi, Rahayu, and Hikmawati (2016) that the PBL model with the help of worksheet can provide opportunities for all students to play an active role in solving problems both by means of experiments and group discussions. Worksheet is one of the alternative learning resources that can be applied because it can help students to add information about the material learned through structured learning activities (Islamiah, Rahayu, & Verawati, 2018). Worksheet usually contains titles, instructions for use, basic competencies, supporting information, tasks and steps to complete a task and assessment of learning objectives.

RESEARCH METHODS

This research is a type of quantitative research using quasi-experimental methods. The design model used is the nonequivalent posttest-only control group. In this study, there were free variables, namely the PBL learning model assisted by worksheet (X) and the direct learning model (Y), while the bound variables used were critical thinking skills. There are two classes in this study, namely the group given the worksheet-assisted PBL model treatment (X) called the experimental class (P_1) and the group given the direct learning model treatment (Y) called the control class (P_2). After being given treatment, a posttest was then carried out to measure critical thinking skills in both classes. The experimental class was given posttest questions (O_1) and the control class was given posttest questions (O_2). The research design can be seen in Table 1.

Table 1. Quasi experimental research design

Research class	Treatment	Posttest
P_1	X	O_1
P_2	Y	O_2

This research was conducted at one of the public junior high schools in Magelang, Central Java, Indonesia in the 2022/2023 academic year. The population in this study was all class VII students with a total number of 221 students. This study used class VII B as an experimental class and class VII C as a control class. The number of students in each class is 32 students, so the number of samples is 72 students. Sampling was carried out using the cluster random sampling technique.

The instruments used in this study were learning tools in the form of worksheet and critical thinking ability tests. Worksheet is used to assist the process of delivering learning materials by applying the learning steps of the PBL model. Meanwhile, the test instruments used are first validated and tested. Test instrument

validation consists of content validation and construct validation. Validation of the contents of the test instrument is based on the results of the assessment by both validators with three statements declared worthy of testing. Meanwhile, construct validation is carried out after testing the test instrument. Summary of the results of the experimental item analysis of the critical thinking test instrument in Table 2.

Table 2. Summary of instrument calibration analysis results

No.	Contents validity	Construct validity	Reliability	Difficulty level	Difference power	Conclusion
1	Highly	Valid	Very	Keep	Good	Used
2	Valid	Valid	Good	Keep	Bad	Discarded
3		Valid		Difficult	Bad	Discarded
4		Valid		Difficult	Bad	Discarded
5		Valid		Keep	Good	Used
6		Valid		Keep	Good	Used
7		Valid		Difficult	Good	Used
8		Valid		Difficult	Good	Used
9		Valid		Difficult	Enough	Discarded
10		Valid		Difficult	Enough	Discarded

Based on Table 2 of the questions used for the posttest, there are five question items. Three points of question at a moderate level of difficulty with good differentiability. Two points of question at the difficulty level are difficult with sufficient differentiability. The collection techniques carried out in this study were observation, interviews, tests and questionnaires as well as documentation. Test instruments are used to determine learners' critical thinking skills, while questionnaire instruments are used to validate test instruments.

The data analysis technique used in this study is the *Z* statistical test to determine the completeness of learning model, while the *t*-test is used if the data is normally distributed and homogeneous to determine the average difference between the two samples. Meanwhile, the Mann Whitney test if the data obtained is not normally distributed or inhomogeneous to find out the difference between the two samples from the posttest value results. However, before conducting the test, a prerequisite test is carried out consisting of a normality test and a homogeneity test.

RESULTS AND DISCUSSION

The effectiveness of the PBL model assisted by worksheets on students' critical thinking is evaluated through two stages: the achievement and ability difference tests. Prior to these, a prerequisite test is conducted to identify the analytical tools for the assessments, one of its benefits.

Prerequisite Test

The prerequisite tests carried out include normality and homogeneity tests. Normality testing using the Shapiro wilk sample test and homogeneity testing using the homogeneity of variances test. Normality tests are carried out to determine whether the experimental class and control class are normal or not. Summary of the normality test results presented in Table 3.

Table 3. Summary of normality test results

Research class	<i>df</i>	<i>p</i> -value	Conclusion
P_1	26	0,000	Non-normal distribution
P_2	24	0,000	Non-normal distribution

Based on Table 3, it was obtained that after posttesting in both classes, a significance value of 0,000 was obtained. The value is less than the allowed significance value ($p\text{-value}=0,000<0,05=\alpha$), which means that the results of the posttest normality test in both classes are not normally distributed.

Furthermore, a homogeneity test is carried out. Homogeneity test is carried out to determine whether both classes are homogeneous or not. Summary of the homogeneity test results is presented in Table 4.

Table 4. Summary of Homogeneity Test Results

	Levene statistic	<i>df</i>	<i>p</i> -value	Conclusion
Mean	1.618	48	0.210	Homogene
Median	0,418	48	0,524	

Based on the calculation results of the Homogeneity test it was obtained that after posttesting in both classes, a significance value of 0.210. The value is greater than the permissible significance value ($p\text{-value}=0.210>0.05=\alpha$), which means that the two classes are homogene.

Based on the results of the normality and homogeneity test of the posttest of critical thinking ability, data were obtained not normally distributed and homogene. The data obtained were not normally distributed, followed by the Mann Whitney test to determine the difference between the experimental class and the control class.

Achievement Test

The results of the analysis of the test show the percentage of student learning completion in the PBL model assisted by worksheet and direct learning model, presented in Table 5.

Table 5. Result learning completion of the PBL model

Class	<i>N</i>	Mean	<i>Z</i>	$Z_{\alpha=0,05}$	Conclusion
P_1	26	74	0.68	1.64	Completeness score has reached 75%
P_2	24	65,6	-1,89	1,64	Completeness score has not reached 75%

The test criteria used are if $Z > -Z_{\alpha=0,05}$, so students' completeness score reached 75%. Based on the calculation results obtained: a) On students' group within the PBL model (P_1), $Z=0.68$, and the value is greater than $-Z_{\alpha=0,05}$, it means that learning completion testing of students taught using the worksheet-assisted PBL model achieved learning completion by obtaining a score of more than 70 and reached 75%; b) On students' group within the direct learning model (P_2), $Z=-1.89$, and the value is less than $-Z_{\alpha=0,05}$, it means that the completeness of learning for students who are taught using a direct learning model achieves learning completion by obtaining a score of more than 70 but has not reached 75%.

Ability Difference Test

The results of the analysis of Mann Whitney test, to determine whether there is a significant difference in critical thinking abilities between students group within worksheet-assisted PBL model (P_1) and direct learning model (P_2), are presented in Table 7.

Table 7. Mann Whitney posttest test results

Class	<i>N</i>	Mean	<i>U</i>	<i>Z</i>	Conclusion
P_1	26	74	124	-3,65	Students' critical thinking differed significantly
P_2	24	65,6	499		

Statistical value of *U* first converted into the form of a standardized normal *Z* value (Suyanto & Gio, 2017). The test criteria used are if *Z* is greater than $Z_{\alpha=0.05}$, so the students' critical thinking differed not significantly. Based on the calculation results obtained $Z = -3,65$ in the table the cumulative normal distribution is 0.0002 with two-way testing, so the students' critical thinking differed significantly. The Mann Whitney test obtained results that there was a difference between the critical thinking skills of the experimental class (P_1) and the control class (P_2). After that, judging from the average posttest score obtained, the critical thinking skills of experimental classes taught using the worksheet-assisted PBL model were more effective than the critical thinking skills of control classes taught using direct learning models.

Students' Critical Thinking by Worksheet-Assisted PBL Model

Sourced from the learning completeness test of the PBL learning model obtained $Z = 0.68 > -1.64 = Z_{\alpha=0.05}$. Result of *Z* is located in the reception area, so that the percentage of learning completion of students' critical thinking ability taught using the worksheet-assisted PBL model has reached 75%.

In the experimental class (the worksheet-assisted PBL model), posttest was attended by 26 students with 21 completed students, while 5 students who had not reached completion in learning. It can be said that in the experimental class taught using the worksheet-assisted PBL model, students' critical thinking skills have reached learning completion of 80.8% which can be categorized in the high category. Supported by the results of research from Azizah, Sugiyanti, and Happy (2019), it was obtained that the mathematical critical thinking ability of students using the PBL learning model has achieved classical learning completion of 92.28% with 26 completed students from 28.

In the first stage, presenting a problem students are divided into several groups to understand the given problem contained in worksheet. At this stage, train students to focus on the problems given by the teacher. The first meeting was given value comparison material and the second meeting was given value reversal comparison material, where students were asked to understand the concept of the material given.

In the second stage, exchanging information tries to find the right step in solving the problem by exchanging opinions within each group. At this stage, train students to analyze the relationship of questions, statements, and concepts to the given problem. At the first meeting, students were still hesitant to present arguments to their groups during the discussion activity. In the second meeting, students have

begun to be more active than previous learning and have dared to present the arguments needed to each other in the discussion activity.

In the third stage, solving problems outside the guidance of the teacher, where learners are given the freedom of how to solve problems with relevant sources. At this stage, train and give freedom to students to find and determine the right problem-solving strategies. At the first meeting there were some students who did not cooperate in their groups on problem-solving activities. In the second meeting there were changes during the learning process, where students became more active and very enthusiastic in working together to find solutions to the problems given.

In the fourth stage, presenting solutions, where students write down and present the solutions to the problems made to other groups. In the first meeting, some students divided group tasks well and there were some groups that divided tasks unevenly in presenting solutions. In addition, in presenting the results of group discussions, students hesitate to convey the results of discussions and group work to other groups. In the second meeting, where students become better than previous learning. This is because students become more enthusiastic and enthusiastic in working together to solve problems given with a good distribution of tasks. In addition, in presenting the results of group discussions and group work to other groups, there are more than two groups that deliver in front of the class.

In the fifth stage, reflecting, namely students expressing opinions related to things or material obtained during learning. In the first meeting, there was only one student who dared to convey the results of the material that had been learned, while for the second meeting, there were several students who dared to convey what had been learned during learning.

The PBL learning model provides an opportunity for learners to become more active in the learning process. This is shown in the learning step in the second stage to the fifth stage. In addition, the PBL learning model applied can help develop students' critical thinking skills. In line with Swiyadnya, Wibawa, and Sudiandika (2021), the PBL model provides real conditions for students by directing authentic learning and providing new information to students and making students continuously seek and find solutions to problems that can be utilized in life. This can be said through activities to exchange opinions or ideas and solve problems presented with the help of worksheet.

Students' Critical Thinking by Direct Learning Model

Sourced from testing the completeness of learning models directly obtained $Z = -1.89 > -1.64 = Z_{\alpha=0.05}$. Result of Z located outside the reception area, so that the percentage of learning completion of students' critical thinking ability taught using the direct learning model has not reached 75%.

In the posttest control class (the direct learning model), there were 24 students with 14 students who were complete in learning, while 10 students who had not reached completion in learning. It can be said that in the control class taught using a direct learning model on the critical thinking ability of students has not reached learning completion of 58.3% which can be categorized in the category of enough. Supported by the results of research from Azizah et al. (2019), it was obtained that the mathematical critical thinking ability of students using the direct learning model has not achieved classical learning completion of 53.57% with 15 completed students out of 28.

In the direct learning model, the instruction is teacher-centered in both the first and second meetings, so that students are less active and hesitant when they want to ask questions about learning materials or answer questions from the teacher. During learning, the teacher tries to build interaction in learning so that students become active and prevent students from becoming bored during learning and prevent students from becoming engrossed in their own activities. Direct learning activities do not provide opportunities for students to convey ideas or ideas in view of the learning steps. Learners obtain material based on submissions made by teachers without their own efforts to obtain material.

Difference in Students' Critical Thinking Abilities

Referring to Siregar (2015), based on the posttest average obtained, experimental classes taught using the worksheet-assisted PBL model were more effective than control classes taught using direct learning models on critical thinking skills. This result is in line with research from Mulyanto, Gunarhadi, and Indriayu (2018), that there are differences in learning outcomes seen from the ability to think critically using a PBL model with a direct learning model. The results of this study are also supported by the research of Prihono and Khasanah (2020), it was found that PBL learning has an influence on students' critical thinking skills, as well as critical thinking skills taught using the PBL learning model better than using the direct learning model.

Based on the averages obtained, experimental classes taught using the PBL model are better or more effective than control classes taught using a direct learning model of critical thinking ability. These results are in line with research from (Mulyanto, Gunarhadi, & Indriayu, 2018), that there are differences in learning outcomes seen from the ability to think critically using a PBL model with a direct learning model. The results of this study are also supported by a study conducted by Prihono and Khasanah (2020), the results were obtained that PBL learning has an influence on students' critical thinking skills, as well as critical thinking skills taught using the PBL learning model better than using the direct learning model.

The relationship between the PBL model and worksheet learning media lies in the content of worksheet which can contain the steps of the PBL model and indicators of critical thinking skills. The PBL learning model using worksheet media plays an important role in the success of the learning process. Worksheet is very helpful for students to achieve the learning goals to be achieved. The activities contained in worksheet have been adjusted to the indicators of students' critical thinking skills and in accordance with the material studied. The steps contained in worksheet direct students in developing ideas for critical thinking skills. Students seem very enthusiastic in carrying out the activities requested in worksheet. This is in line with Florensia, Yurnetti, and Hamdi (2018), that worksheet in which there is a PBL model step becomes an exercise in developing learning aspects by changing one-way teaching habits in dominating teacher activities aimed at training and developing students' thinking skills, so that students can be more active in the learning process.

The successful application of the worksheet-assisted PBL model to the thinking ability of students found during the implementation of learning is 1) worksheet-assisted makes students able to understand the material more easily and develop the ability to solve problems, 2) increase student learning motivation which makes

students more enthusiastic in the learning process, and 3) provide opportunities for students to develop innovative ideas or ideas in their critical thinking ability to understand problems in real life.

The PBL learning model using worksheet media plays an important role in the success of the learning process. Worksheet is very helpful for students to achieve the learning goals to be achieved. The activities contained in worksheet have been adjusted to the indicators of students' critical thinking ability and in accordance with the material studied. The steps contained in worksheet direct students in developing ideas for critical thinking skills. Students seem very excited in carrying out the activities requested in worksheet. The application of worksheet in PBL learning stimulates the activeness of students, so that students are more challenged to determine the right steps in solving the problems found. The application of worksheet received a good response from students because students looked more enthusiastic in learning.

The learning process carried out in the control classroom is taught using a direct learning model, students tend to be more passive, so it feels boring and the learning applied is teacher-centered or learning that takes place in one direction. In line with the opinions of Rachmawati and Rukmi (2014), explained that an obstacle that exists in the direct learning model is that the classroom atmosphere during learning becomes rowdy. This can be one of the obstacles in the process of developing students' critical thinking skills.

The teacher provides an explanation related to the learning material accompanied by sample questions and steps to solve them directly. Practice questions are given after an explanation of the material from the teacher to be done by students, where practice questions are done with problems that are often encountered. Students do practice questions given in groups assisted by guidance from the teacher. Some students do practice questions according to the direction of the teacher, but there are still those who do practice questions by writing answers without any steps.

During learning in the control class, the teacher tries to implement more interactive learning by appointing several students to deliver their work in front of the class. This does not get a positive response from students, thus making learning less effective and making students less to explore themselves better.

CONCLUSION

Based on the results and discussion above, it can be concluded that 1) students who are taught using the PBL learning model assisted by worksheet against critical thinking ability are said to be effective by obtaining learning completion has reached 75%, 2) students who are taught using the direct learning model against critical thinking ability are said to be ineffective by obtaining learning completion has not reached 75%, 3) critical thinking ability of learners taught using the worksheet-assisted PBL model more effective than using the direct learning model.

REFERENCES

Arikunto, S. (2018). *Dasar-dasar Evaluasi Pendidikan*. Bumi Aksara.

- Azizah, L. I. R., Sugiyanti, S., & Happy, N. (2019). Efektivitas Model Pembelajaran Problem-Based Learning (PBL) dan Guided Inquiry terhadap Kemampuan Berpikir Kritis Matematis Siswa. *Imajiner: Jurnal Matematika dan Pendidikan Matematika*, 1(4), 30-36. <https://doi.org/10.26877/imajiner.v1i4.3853>
- Azmi, M. K., Rahayu, S., & Hikmawati, H. (2016). Pengaruh model problem based learning dengan metode eksperimen dan diskusi terhadap hasil belajar fisika ditinjau dari sikap ilmiah peserta didik kelas X MIPA SMA N 1 Mataram. *Jurnal Pendidikan Fisika dan Teknologi*, 2(2), 86-94. <https://doi.org/10.29303/jpft.v2i2.294>
- Ennis, R. H. (2011). The nature of critical thinking: An outline of critical thinking dispositions and abilities. *University of Illinois*, https://education.illinois.edu/docs/default-source/faculty-documents/robert-ennis/thenatureofcriticalthinking_51711_000.pdf
- Facione, P. A. (2011). Critical Thinking: What It Is and What It Counts. *Insight Assesment*. https://www.academia.edu/download/71022740/what_why98.pdf
- Florensia, Y., Yurnetti, Y., & Hamdi, H. (2018). Pengaruh penggunaan LKPD berbantuan model problem based learning (PBL) terhadap kompetensi keterampilan peserta didik. *Pillar of Physics Education*, 11(1), 193-200. <http://dx.doi.org/10.24036/2730171074>
- Jailani, J., Sugiman, S., & Apino, E. (2017). Implementing the problem-based learning in order to improve the students' HOTS and characters. *Jurnal Riset Pendidikan Matematika*, 4(2), 247-259. <http://dx.doi.org/10.21831/jrpm.v4i2.17674>
- Islamiah, A. F., Rahayu, S., & Verawati, N. N. S. P. (2018). Efektivitas model pembelajaran problem based learning berbantuan lks terhadap kemampuan berpikir kritis fisika peserta didik SMAN 1 Lingsar Tahun Ajaran 2016/2017. *Lensa: Jurnal Kependidikan Fisika*, 6(1), 29-36. <https://doi.org/10.33394/j-lkf.v6i1.933>
- Isrok'atun, I., & Amelia, R. (2018). *Model-model Pembelajaran Matematika*. Bumi Aksara.
- Lismaya, L. (2019). *Berpikir Kritis & PBL (Problem Based Learning)*. Media Sahbat Cendekia.
- Mulyanto, H., Gunarhadi, G., & Indriayu, M. (2018). The effect of problem based learning model on student mathematics learning outcomes viewed from critical thinking skills. *International Journal of Educational Research Review*, 3(2), 37-45. <https://doi.org/10.24331/ijere.408454>
- Octavia, S. A. (2020). *Model-model Pembelajaran*. Budi Utama.
- Prihono, E. W., & Khasanah, F. (2020). Pengaruh Model Problem Based Learning Terhadap Kemampuan Berpikir Kritis Matematis Siswa Kelas VIII SMP. *EDU-MAT: Jurnal Pendidikan Matematika*, 8(1), 74-87. <http://dx.doi.org/10.20527/edumat.v8i1.7078>
- Rachmawati, D. & Rukmi, S. A. (2014). Penerapan model pembelajaran langsung untuk meningkatkan keterampilan membaca permulaan siswa kelas II SDN Rejosari Mojokerto. *Jurnal Penelitian Guru Sekolah Dasar*, 1(2), 1-11.
- Setyaningsih, T. D. & Abadi, A. M. (2018). Keefektifan PBL seting kolaboratif ditinjau dari prestasi belajar aljabar, kemampuan berpikir kritis, dan kecemasan peserta didik. *Jurnal Riset Pendidikan Matematika*, 5(2), 190-200. <http://dx.doi.org/10.21831/jrpm.v5i2.11300>

- Siregar, S. (2015). *Statistika Terapan untuk Perguruan Tinggi*. Kencana.
- Surya, H. (2011). *Strategi itu Mencapai Kesuksesan Belajar*. Gramedia
- Swiyadnya, I. M. G., Wibawa, I. M. C., & Sudiandika, I. K. A. (2021). Efektivitas Model Problem Based Learning Berbantuan LKPD terhadap Hasil Belajar Muatan Pelajaran IPA. *MIMBAR PGSD UNDIKSHA*, 9(2), 203-210. <https://doi.org/10.23887/jjsgsd.v9i2.36111>
- Suyanto, & Gio, P. U. (2017). *Statistik Nonparametrik dengan SPSS, Minitab, dan R*. Universitas Sumatera Utara Press.
- Yuni, S., Bharata, H., & Caswita, C. (2017). Pengaruh model problem based learning terhadap kemampuan berpikir kritis matematis siswa. *Jurnal Pendidikan Matematika Universitas Lampung*, 5(7), 725-736.