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Application of Problem Based Learning (PBL) Model to Improve Problem Solving Skill From Critical Thinking Skill Students on Dynamic Fluid Materials

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Abstract: The ability of students to solve problems is one of the benchmarks for the success of student learning. The increasing ability of students to be able to solve problems in learning is largely determined by the thinking skills they have. One of them is critical thinking skills. however, in reality, the problem solving skills of students at SMAN 1 Tapaktuan are still relatively low. The purpose of this study was to determine the application of the Problem Based Learning (PBL) model in improving the problem solving skills of students on dynamic fluid materials at SMAN 1 Tapaktuan and to determine the improvement of problem solving skills of students reviewed. of critical thinking skills on dynamic fluid material at SMAN 1 Tapaktuan by using the Problem Based Learning (PBL). The type of research used in this study is a quantitative approach with a quasi Experimental design method. The selected shape is nonequivalent control group dessign. The instrument used in this research is a test of problem solving skills and a test of critical thinking skills. The results of the implementation of the Problem Based Learning (PBL) model show that the increase in problem-solving skills in the experimental class is higher than the control class as seen from the N-gain of the two classes, namely the experimental class is in the high category (0.9) and the control class is in the medium category (0.6), and the improvement of problem solving skills in terms of students' critical thinking skills shows that for each indicator of problem solving skills the experimental class is greater than the control class.

Keywords: Problem-Based Learning; Student Worksheet; Problem Solving Skills; Learning outcomes

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Introduction

The 2013 curriculum contains several learning principles that are expected to support the quality of Indonesian education. Among the principles in the 2013 curriculum is encouraging students to become active learners. In the learning process to realize an active learning system for students, it is necessary to apply the right model in the implementation of learning. The use of learning models will provide optimal results and make it easier for students to understand the material of a lesson, for that we need a model that is in accordance with the 2013 graduate competency standards, one of which is a problem Based Learning (PBL) model. Problem Based learning model is an active learning and very effective in creating knowledge (Amalya et al., 2021). The problem Based Learning (PBL) model is a learning model that can help students to be more active during the learning process. The researchers have said that problem Based Learning (PBL) had a positive effect on the students (Suparman et al., 2021). As stated by Ngalimun ,(2017) the problem Based Learning (PBL) model is an

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innovative learning model that can provide active learning conditions for students. Panjaitan, (2021) also states that with the problem Based Learning (PBL) model, participants will be more active when carrying out learning in the classroom.

Research on the problem Based Learning (PBL) model has been carried out by several researchers. As Rerung et al, (2017) found that the problem Based Learning (PBL) model can improve student learning outcomes. Yulianti, (2019) also found that the application of the problem Based Learning (PBL) model was more effective in improving students' conceptual understanding and critical thinking. Ramdoniati et al, (2018) PBL is quite effective in improving students' metacognition skills.

Problem solving skills are skills that can be used in obtaining solutions to problems that require non-routine procedures or steps and are found in the form of texts, non-routine puzzles and situations in real life (Hudojo, 2005). The ability of students to solve problems is one of the benchmarks for the success of student learning (Ejin, 2016). To obtain good learning outcomes, an effort is needed that can direct students to be able to improve their problem-solving skills. Research on students' problem solving skills can be improved through the application of appropriate models in learning. As research that has been done by Medriati and Purwanto, (2018) states that to improve problem solving skills students need to be supported by the right model. One of the lessons that can improve problem solving skills is a creative problem solving model. Furthermore, Sujana and Mashkopipah, (2017) also state that the think pair share model can improve students' solving skills. Jana and Fahmawati, (2020) found that students' problem-solving skills could be improved with the discovery learning model. Rahmana et al., (2021) also found that video-assisted problem-Based Learning was effective in improving students' problem-solving abilities.

Critical thinking skills are abilities that are obtained by students well during the learning process that can develop cognitive abilities and understand the concepts of subject matter well Pasaribu, (2020). Efforts to hone participants' critical thinking are carried out by involving various activities that need to be carried out by students in each learning process in order to obtain good learning outcomes. Critical thinking skills are essential abilities in using intellectual tools by which one appropriately assesses thinking. In this case, by utilizing critical thinking skills, students can use the intellectual tools that critical thinking offers concepts and principles that enable them to analyze, assess, and improve thinking (Masduqi, 2011). Several studies on critical thinking skills have also been carried out by several previous researchers, widyaningsih and Yusuf (2018) stated that the application of project Based Learning (PJBl) can be used to develop critical thinking skills. Furthermore, research conducted by Mentari et al, (2015) stated that the discovery learning model had an effect on critical thinking skills and student learning outcomes. Ismayawati et al, (2016) research states that students' critical thinking skills in TGT type cooperative learning settings have a positive effect using a Problem-Based Learning Model (PBM).

The increasing ability of students to be able to solve problems in learning is largely determined by the thinking skills they have. One of them is critical thinking skills. Critical Thinking Skills are one of the skills that students must have to deal with the complexities of future life (Aufa et al, 2021). Critical thinking is also defined as the reflective and reasonable thinking that is focused on deciding what to believe or do (Hakim et al., 2016). Problem solving is related to critical thinking skills, students who have good problem solving skills usually have good critical thinking skills. Through critical thinking skills, students are easier to understand concepts, sensitive to problems that occur so that they can understand and solve problems (Sutarji, 2018). Based on the results of observations made at SMAN 1 Tapaktuan, it can be seen that students are still unable to solve problems in learning, this can be seen when students are given assignments to work on practice questions, some students are less precise in working on questions so that many students' answers are wrong. Then the results of the review of the UN scores in physics lessons in 2018 and 2019 are also still below the average, in 2018 56.50 and 2019 42.71, this shows that the ability of students to solve problems in learning is still low.

The problem regarding the low ability of students to solve problems in learning is thought to be caused by several factors, one of which is the learning strategy applied by the teacher has not involved students in active learning, where student learning activities are still relatively low, in the sense that students tend to be passive in learning. study. So that the freedom of students in thinking is very minimal and cannot develop their cognitive intelligence to make predictions on the final result.

From the explanation above, no research has been found that uses the problem Based Learning (PBL) model in improving problem solving skills in terms of students' critical thinking skills. For this reason, this research is expected to improve students' problem solving skills in terms of critical thinking skills by applying problem Based Learning (PBL) models to dynamic fluid materials at SMAN 1 Tapaktuan.

Method

The type of research used in this study is a quantitative approach with a quasi Experimental

design method. The selected shape is Non equivalent Control Group design. In this design, the sample will be divided into two classes, namely the experimental class and the control class. The experimental class is the sample that will receive treatment in the form of problem Based Learning (PBL), while the control class is the sample that will receive treatment in the form of conventional learning.

Table 1. Nonequvalent Control Group design

Class	Preetest	Treatment	Posttest
Experiments	O_1	X	O_2
Control	O_3		O_4

(Sugiyono, 2008)

Description:

O_1 = Giving an initial test (pre-test) to the experimental class

O_2= Giving the final test (post-test) in the experimental class

X = Treatment using problem Based Learning (PBL) learning model

O_3 = Giving an initial test (pre-test) to the control class

O_4 = Giving a final test (post-test) in the control class

The population in this study were all students of class XI SMAN 1 Tapaktuan which consisted of 5 classes totaling 153 students. Next, the researcher determines the sample to be tested. This sampling technique is purposive sampling, namely by taking two classes whose average values are the same or almost the same as the previous daily test scores. So that the sample is two classes, namely class XI-IA 1 and XI-IA 2.

The research instrument here is a test of problem solving skills and a test of critical thinking skills. The instrument for measuring problem-solving skills is in the form of test question sheets made in the form of pre-test and post-test. Research data on problem solving skills were taken from the stage test scores of problem solving skills with item scores 1-4. The instrument for measuring critical thinking skills is in the form of a test question sheet arranged in the form of a description consisting of 5 questions. Research data, critical thinking skills are taken from the stage test scores of critical thinking skills themselves with item scores 1-4.

In this study using the N-gain test using Microsoft excel to determine the improvement of problem solving abilities in terms of students' critical thinking skills. The changes that occur before and after the learning is calculated with the formula of The Gain developed by Hake (1999).

$$\text{N gain} = \frac{S\,post - S\,pre}{S\,maks - S\,pre} \times 100\% \quad \text{.....(1)}$$

Table 2. N-Gain

Gain	Criteria
0.71-1.00	hight
0.31-0.70	currently
$0 < 0.30$	low

(Hake: 1999)

Then the normality of the data and the hypothesis test obtained were tested by using the statistical test of one sample shapiro wilk test and independent samples test using SPSS software version 20.

Result and Discussion

This study aims to see the improvement of problem solving abilities in terms of students' critical thinking skills. The problem solving skills of students in this study were measured using 5 questions in the form of descriptions. Before starting learning, the researcher first distributed pre-test questions that were carried out before being given treatment to find out and measure the students' initial abilities. after the students filled out the pre-test questions, then the researcher gave treatment to the learning process in the experimental class and control class in two meetings. After the treatment is complete, at the final stage, students complete the post-test questions which aim to measure the ability of students after the treatment. From the results of the study found an increase that can be seen from the value of N-gain in the experimental and control classes.

Table 3. Analysis of improving problem solving skills

Class	Average score		N-gain	Category
	Pretest	Posttest		
Experiment	33.0	92.2	0.9	Tall
Control	29.0	71.0	0.6	Currently

Learning outcomes can be seen from the acquisition of pretest and posttest scores that have been given to students. The average pretest score for both the control and experimental classes shows that it is still low. This explains that students' knowledge of dynamic fluid materials is still low. The posttest was conducted at the end of the lesson to see the improvement of students' problem solving skills after the teaching and learning process took place. The posttest results showed that both classes experienced. To determine the improvement that occurred in the control and experimental classes analyzed using N-gain can be seen in Figure below.

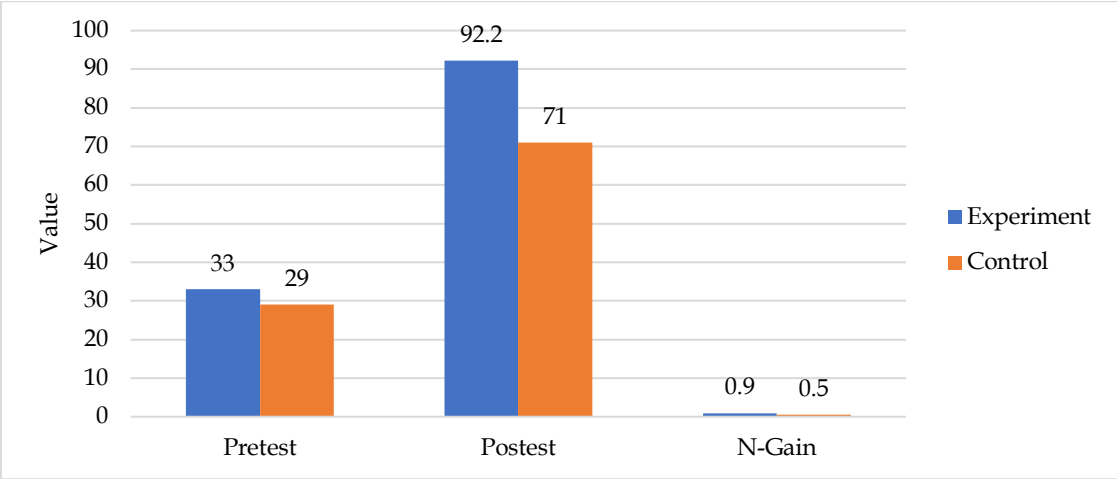

Figure 1. Improving Students' Problem Solving Skills

Figure 1 shows that there is a difference in the mean values of the pretest-posttest and the N-gain of the experimental class and the control class. In the experimental class, the average score obtained by students showed N-gain in the high category and the control class in the medium category. This means that the problem-solving skills of the experimental class are better than the control class. The high N-gain score in the experimental class is due to the Problem Based Learning (PBL) model that can provide opportunities for students to solve problems both individually and in groups. In Problem Based Learning (PBL), the students are working together as a group to figure out a problem solving and most importantly they can improve their ability to solve the problems (Haji, 2015). This is in accordance with the opinion of Abidin, (2014) that the Problem Based Learning (PBL) model is a model that challenges students to learn how to work in groups to find solutions to real-world problems. The Problem Based Learning (PBL) model is an innovative learning model that provides active learning conditions which involve students in trying to solve problems by going through several scientific stages so that they are able to learn and have problem solving skills. Problem Based Learning (PBL) makes students able to find problems and plan solutions, and train students on the effectiveness of their ways of thinking in solving problems faced (Widyatiningtyas et al., 2015).

The instrument to measure students' critical thinking skills in this study was in the form of test questions in the form of descriptions. The assessment of students' critical thinking skills is carried out once, namely after learning. The critical thinking skills of the students in this study were analyzed using Microsoft Excel to see the categories of critical thinking skills possessed by each student.

Table 4. Categories of critical thinking skills for experimental and control class students

Category KBK	Experiment		Control	
	Frequency	%	Frequency	%
Very High	0	0	0	0
Tall	27	90	9	30
Currently	3	10	17	57
Low	0	0	4	13
Very low	0	0	0	0

Based on Table 4. it can be seen that the critical thinking skills of students in the experimental class and control class are different, the experimental class has two categories of critical thinking skills, namely high critical thinking skills and moderate critical thinking skills. while the control class has three categories of critical thinking skills, namely high critical thinking skills, moderate critical thinking skills and low critical thinking skills.

Problem solving skills in terms of students' critical thinking skills were analyzed using Microsoft Excel. To see problem solving skills in terms of critical thinking skills, the researchers linked the average N-gain of each indicator of problem solving skills with critical thinking skills based on the category of critical thinking skills possessed by each student. Indicators of problem solving skills in terms of critical thinking skills used in this study are problem-focusing, drawing physics situations, planning solutions, implementing plans and evaluating answers which are the adoption of the steps of Heller et al, (1992), and each indicator has three categories, namely high, medium and low categories, from these indicators we will see an increase in student problem solving based on the category of critical thinking skills possessed by each student.

Indicators seen from the increase in problem solving from each category of critical thinking skills possessed by students in the experimental class and control class can be seen in Figure 2 and Figure 3 below.

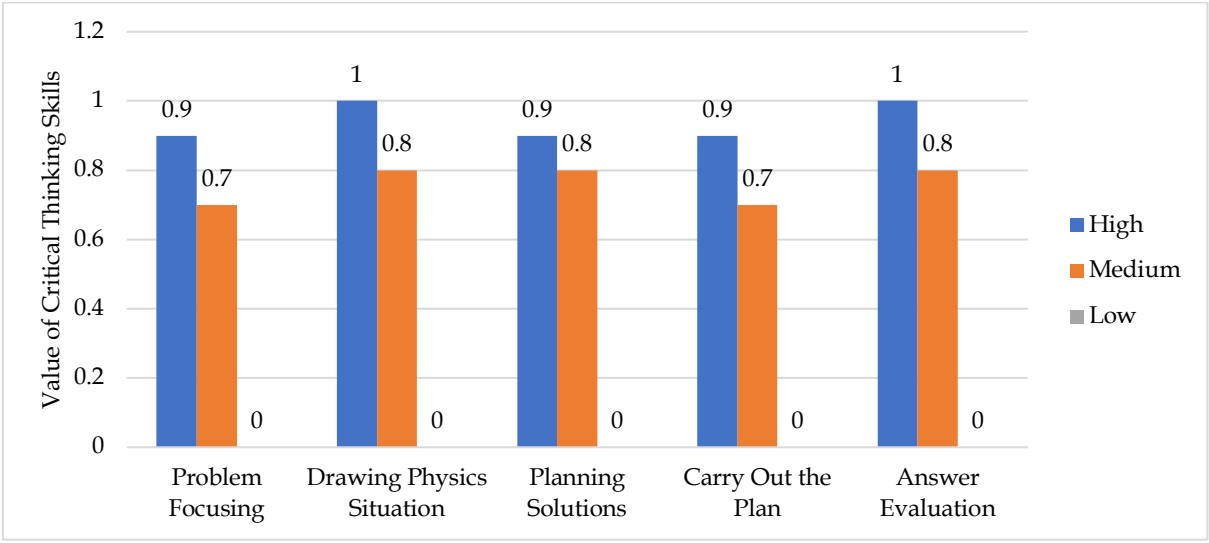

Figure 2 Improving Problem Solving Skills in terms of high KBK, Medium KBK and low KBK Experiment Class.

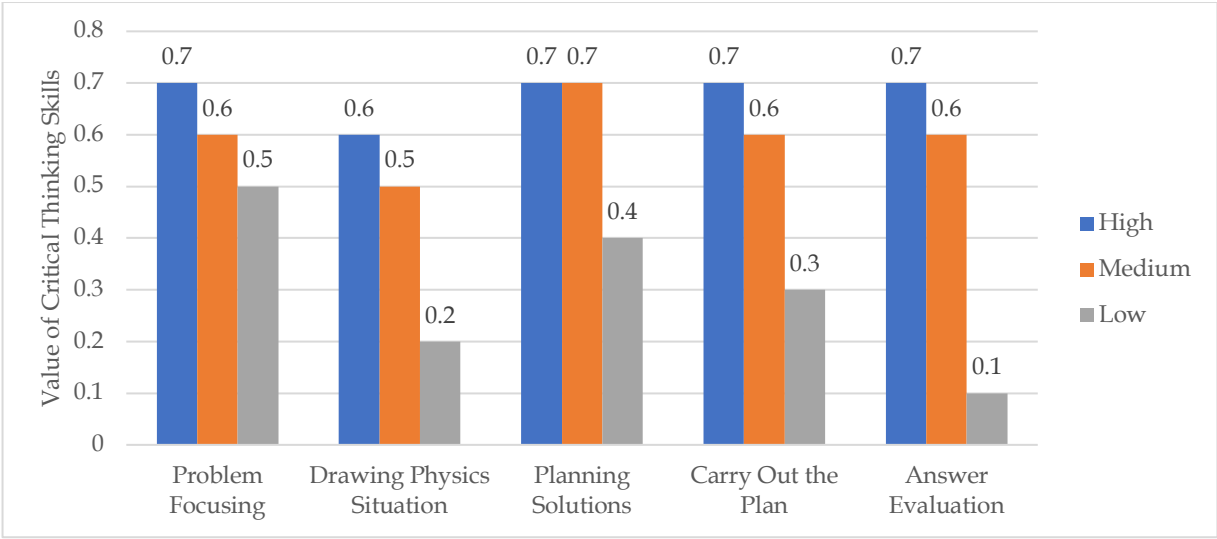

Figure 3. Improvement of Problem Solving Skills in terms of high KBK, Medium KBK and low KBCK Control Class.

Based on Figure 2 and Figure 3, it can be seen that the improvement in problem solving in each indicator of problem solving skills in terms of critical thinking skills is different, in each category the increase in problem solving in the experimental class is greater than the control class. This is because in the experimental class there is the application of a Problem Based Learning (PBL) model that can help students improve their problem solving skills.

On low critical thinking skills, the increase in problem solving on each indicator of problem solving skills of students in the experimental class is zero (0), this is because in the experimental class students do not have low critical thinking skills.

Conclusion

Based on the problems, data analysis, research results and discussions that have been described previously, it can be concluded that: The application of the Problem Based Learning (PBL) model can improve students' problem solving abilities. The increase in problem solving skills in terms of high critical thinking skills in the experimental class is greater than the control class with learning achievement (0.9) for the experimental class, and (0.7) for the control class. The increase in problem solving ability in terms of critical thinking skills was in the experimental class greater than the control class with achievements (0.7) for the experimental class, and (0.6) for the control class. The improvement of problem solving skills in terms of low critical thinking skills in the control class reached (0.3), while the experimental class did not have low critical thinking skills.

Acknowledgments

Based on the conclusions above, the authors suggest teachers to be able to apply the Problem Based Learning (PBL) model in the physics learning process or in other learning. Other researchers who use the Problem Based Learning (PBL) model are expected to be able to use a review of other variables besides critical thinking skills in research, because in addition to learning models that can improve students' problem solving skills, there are other factors that can be classified in improving students' abilities.

References

Abidin, Y. (2014). *Design of Learning Systems in the Context of Curriculum 2013*. Bandung: Refika Aditama.

Amalya, C. P., Artika, W., Safrida, S., Nurmaliah, C., Muhibbuddin, M., & Syukri, M. (2021). Implementation of the Problem Base Learning Model combined with E-STEM Based Student Worksheets on Learning Outcomes and Self Efficacy on Environmental Pollution Materials. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 37–38. https://doi.org/10.29303/jppipa.v7iSpecialIssue.962

Aufa, M. N., Rusmansyah, R., Hasbie, M., Jaidie, A., & Yunita, A. (2021). The Effect of Using e-module Model Problem Based Learning (PBL) Based on Wetland Environment on Critical Thinking Skills and Environmental Care Attitudes. *Jurnal Penelitian Pendidikan IPA*, *7*(3), 401–407. https://doi.org/10.29303/jppipa.v7i3.732

Ejin, S. (2016). The Effect of Problem Based Learning (PBL) Model on Concept Understanding and Critical Thinking Skills for Class IV Students of SDN Jambu Hilir Baluti 2 in Natural Science Subjects. *Jurnal Pendidikan, 1(1)*.

Haji, A., Safriana, S., & Safitri, R. (2015). The Use Of Problem Based Learning To Increase Students' Learning Independent And To Investigate Students' Concept Understanding On Rotational Dynamic At Students Of SMA Negeri 4 Banda Aceh. *Jurnal Pendidikan IPA Indonesia, 4*(1), 67-72. https://doi.org/10.15294/jpii.v4i1.3503

Hake, R. (1999). Interactive-engagement versus traditional methods: A six-thousand-student survey of mechanics test data for introductory physics courses, *American Journal of Physics. 66*, 64-74 (1998) https://doi.org/10.1119/1.18809

Hakim, A., Liliasari, L., Kadarohman, A., & Syah, Y. (2018). Improvement of Student Critical Thinking Skills with the Natural Product Mini Project Laboratory Learning. *Indonesian Journal of Chemistry, 16*(3), 322-328. https://doi.org/10.22146/ijc.21149

Heller, P., Keith R & Anderson, S. (1992). Teaching Problem Solving Trough Cooperative Grouping. Part 1: Group Versus Individual Problem Solving. *American Journal of Physics*. 60, 637-644. https://doi.org/10.1119/1.17118

Hudojo, H. (2005). *Curriculum Development and Mathematics learning*. Malang: State University of Malang Press.

Ismayawati, B, Purwoko, A.A, Muntari. 2016. The Effect Of Problem-Based Learning Model (PBM) In Cooperative learning Settings Type TGT and Gi On Critical Thinking Skills And learning Outcomes Of Chemistry Students of SMA 1 Aikmel. *Jurnal Penelitian Pendidikan IPA* 2(1). https://doi.org/10.29303/jppipa.v2i1.33

Masduqi, H. (2011). Critical Thinking Skills And Meaning In English Language Teaching. *TEFLIN Journal, 22*(2), 185-200. http://dx.doi.org/10.15639/teflinjournal.v22i2/185-200

Medriati, R., & Purwanto, A. (2018). Application of Creative Problem Solving Model to Improve Physics Problem Solving Ability of Class XI MIA 4 MAN 2 Bengkulu City Students. *Jurnal Kumparan Fisika. 1(3)*.

Mentari, W. (2015). *The Effect of the discovery learning Model on Critical Thinking Ability and Student learning Outcomes*. Article Faculty of Teacher Training and Education, University of Bandar lampung.

Ngalimun. (2017). *Strategies and Learning Models*. Yogyakarta: Aswaja Presindo.

Panjaitan, M.A. (2021). Analysis of Problem Based Learning Model Analysis on Increasing Students' Mathematical Ability. *Jurnal Inspiratif*, 3(2).

Pasaribu, S. (2020). Comparison of the Critical Thinking Ability of Middle School Students Taught Using Problem Based Learning and Discovery Learning Models. *Jurnal Mimbar Ilmu*, 25(3).

Rahmana, F., Susilawati, S., & Kosim, K. (2021). The Effectiveness of Video-Assisted Problem-Based Physics Learning Devices to Improve Students' Problem-Solving Ability on Elasticity Materials. *Jurnal Penelitian Pendidikan IPA*, *7*(SpecialIssue), 326–330. https://doi.org/10.29303/jppipa.v7iSpecialIssue.1237

Ramdoniati, N., Muntari, M., & Hadisaputra, S. (2018). Pengembangan Bahan Ajar Kimia Berbasis Problem Based Learning Untuk Meningkatkan Keterampilan Metakognisi. *Jurnal Penelitian*

Pendidikan IPA, *5*(1). https://doi.org/10.29303/jppipa.v5i1.148

Rerung, N, Sinon, I.I.S, & Widyaningsih, S.W. (2017). Application of learning Based Learning (PBL) Models to Improve Student learning Outcomes on Business and Energy Materials. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni.* 06(1).

Sugiyono. (2008). *Quantitative Qualitative Assessment dan R&d*. Bandung: Alfabeta.

Suparman., JuandI, D., & Tamur. M. (2021). Review of Problem-Based Learning Trends in 2010-2020: A meta-Analysis Study of The Effect of Problem-Based Learning in Enhancing Mathematical Problem-Solving Skills of Indonesian Students. *Journal of Physics: Conference Series* ***1722*** *012103.*

Widyaningsih, S.W & Yusuf, I. (2018). Project Based Learning Model and Critical Thinking Skill. *Jurnal Physic Education*. 1(1).

Widyatiningtyas, R, Kusumah, Y.S, Sumarmo, U, Sabanda, J. (2015). The Impact Of Problem-Based Learning Approach To Senior High School Students' Mathematics Critical. *Journal on Mathematics Education* 6(2). https://doi.org/10.22342/jme.6.2.2165.107-116

Yulianti, E. (2019). Problem Based Learning (PBL) Model: Its Effect on Concept Understanding and Critical Thinking. Indonesian *Journal of Science and Mathematics Education* 02 (3).