

META-ANALYSIS OF THE EFFECT OF PROBLEM-BASED LEARNING MODEL ON CRITICAL THINKING SKILLS

Aidina Milla Fitri¹ , Fatni Mufit²

¹Student of Physics Department FMIPA Padang State University

²Teaching Staff of Physics Department FMIPA Padang State University

Padang State University

aidinamillafitri@gmail.com , fatni_mufit@fmipa.unp.ac.id

ABSTRACT

This study aims to analyze the effect of the Problem Based Learning (PBL) learning model in improving critical thinking skills, the influence of PBL in education labels and subject matter. This research compares the PBL learning model with the conventional one. This research is a meta-analysis study. By finding the effect size value. The average value of the effect size or critical thinking skills was 0.52 in the medium category. At the level of education, it is more effective learning materials on Optical instruments material at the high school education level. The conclusion of this research is that Problem Based Learning can improve critical thinking and problem solving skills.

Keywords: *Problem Based Learning and Critical Thinking*

INTRODUCTION

Education is an open teaching and learning process carried out effectively and efficiently through formal and non-formal activities between teachers and students. Physics learning plays a role in developing science. One of the important roles in physics learning is to shape and develop one's thinking character.

Physics is knowledge that is obtained through experimentation, and the student's thinking process. Physics is also a science that contains concepts that can test analytical knowledge in interpreting when conducting experiments or solving problems. (Muhammad Zunanda, 2015). Therefore, the ability to think critically is needed to solve the problems that exist in physics learning.

According to the 2013 curriculum, which is the current curriculum, learning activities cannot only be teacher-centered. Learners are subjects in searching, processing and analyzing and using knowledge in a sustainable manner. (Ahmad Farisi, Abdul Hamid, 2017). Therefore, a learning process is needed that is able to stimulate students' thinking skills.

The curriculum guides education units to develop education both in terms of school characteristics, school and community needs and for the development of students. (Irfilla Ramadhani, 2014)

Critical thinking is thinking that involves the logical aspects of higher order thinking. (Andriani, 2016). Critical thinking is the ability to think in improving the ability to handle a problem skillfully. Creative thinking is needed by learners to listen and analyze other people's opinions and be able to convey their own opinions. Critical thinking skills can help students in solving a problem (Unita S. Zuliani, 2016). (Unita S. Zuliani Nasution, Sahyar, 2016)..

Critical thinking is logical thinking, *convergent* and *reasoning*. Because

critical thinking can be used in problem-solving activities, analyzing a problem, making decisions and conducting scientific research. Critical thinking also plays a role in revealing the truth (Ahmad Farisi, Abdul Hamid, 2017).

If the ability to find out and develop a problem is still low, it can be said that the ability to think is also still low. (Andriani, 2016). In general, students in elementary school are also in the operational development phase so that elementary schools are not yet able to think formally and abstractly. Therefore, the ability to think critically to deal with problems in everyday life is built. (Widodo Budhi and Siti Suwarni, 2019)..

In class X SMA N 2 Pematangsiamtar, it was also found that the solving ability in the school was still low. Where teachers also still use conventional learning models (Andriono Manalu, S.Pd., 2016). Learning optical devices at MAN 3 Malang shows that students' thinking skills are still poor. It is also seen that the teacher at MaN 3 is still using a conventional learning model with a memorization level that makes students' critical thinking levels low. (P. Parno, A. Asim, P. Suwasono, 2019). In social studies class VII-H SMPN 1 Kepanjen students look less active in participating in learning. This is due to the way the teacher is still using the lecture method which is less interesting to students. This condition also has an impact on the lack of critical thinking in students (Qomariyah, 2016).

The low ability to think critically can be caused by the learning model used by the teacher is not appropriate. So that the learning experience of students is less developed (Ahmad Farisi, Abdul Hamid, 2018). Therefore, teachers must use an appropriate learning model to be able to improve students' higher-level thinking skills.

The learning process that is still dominated by the teacher cannot provide opportunities for students to think independently. If the teacher teaches only one way, there will be a buildup of information. Where there are still many students who do not understand the concept of the material taught by the teacher. Some students are also still unable to understand and connect what they learn with their daily lives. (U. Setyorini, S.E. Sukiswo*, 2011).

Based on some of these problems, it is found that the low ability to think critically and solve problems is due to an inappropriate learning model. Where teachers tend to use conventional learning models with the lecture method. This can be overcome by using an appropriate learning model. For example, the Problem-Based Learning (PBL) learning model.

Problem Based Learning Model is a learning model that focuses on problems. So that in this PBL students not only gain problem-solving skills but also gain essential knowledge and concepts from the material being taught. Where students are trained on how to think critically and solve a problem. (Melin Novitri, 2016). If this ability is already owned by students, then learning activities and student learning outcomes can increase.

Based on this description, this study aims to analyze the effect of problem-based learning model on the ability to think critically and solve problems in students. It is hoped that this research can be useful in the field of education, especially in physics learning.

In addition to student learning activities that link student involvement

directly without the presence of an educator. According to erawanto's research (2016) research was developed to encourage students to be actively involved in solving problems so that they can understand the material given.

Learning includes basic competencies subjects, indicators of achievement and references. This development emphasizes more on students to learn self-taught and solve problems independently. Because in this case the module becomes a reference where a module is designed that contains student activities that include student activities in learning. According to Anita et al (2017) stated that the learning was considered feasible to be used in presenting the material in order to streamline the time required for the learning to be used. In this case, the learning module is used, because at this time learning is mostly done just looking for learning outcomes without knowing the process that has been carried out. Because it also encourages students to receive more results without wanting to seek first, even though the 2013 curriculum emphasizes students playing an active role and learning independently.

METHODS

This study uses the meta-analysis method. Where the research uses articles in national and international journals. This study used 8 articles from national journals and 2 articles from international journals. This metaanalysis is quantitative because the calculations use numbers and statistics. It aims to process information from many data sources. (F Mufit, Asrizal, S A Hanum, 2020)

Coding is used to facilitate data collection and analysis. This data analysis process is used to calculate the effect value to determine the effect of the *Problem Based Learning (PBL) learning* model on critical thinking and problem solving skills in students. The following are the steps used to tabulate the data in the study: 1) identification of research variables mean value and standard deviation of experimental class and control class, 2) identification of mean value and standard deviation of experimental class and control class, 3) analyzing the t value for each article if the standard deviation is unknown, 4) data analysis to find the effect size value with the equation:

$$ES = \frac{x_{eksperimen} - x_{kontrol}}{SD_{kontrol}} \dots\dots\dots(1)$$

$$ES = t \sqrt{\frac{1}{N_E} + \frac{1}{N_C}} \dots\dots\dots(2)$$

Description:

ES = *effect size*

SDcontrol = standard deviation of control class

x = average value

t = t test value

N_E = number of experimental class samples

N_C = number of control class samples

By using the following *effect size* criteria (Glass, 1981):

Table 1. Effect Size Criteria (ES)

No.	ES	Category
1	$ES \leq 0.15$	Negligible
2	$0.15 < ES \leq 0.40$	Small
3	$0.40 < ES \leq 1.10$	Medium
4	$0.75 < ES \leq 1.10$	High
5	$1.10 < ES \leq 1.45$	Very High

RESULT & DISCUSSION

The results of this study are the *effect size* which shows the effect of the PBL model in terms of learning materials and student skills.

article	Skills	Effect Size	Category
A1	Critical Thinking	0,51	Medium
A2	Critical Thinking	0,52	Medium
A3	Critical Thinking	0,43	Medium
A4	Critical Thinking	0,42	Medium
A5	Critical Thinking	0,62	Medium
A6	Critical Thinking	0,50	Medium
A7	Critical Thinking	0,43	Medium
A8	Critical Thinking	0,77	high
A9	Critical Thinking	0,80	high
A10	Critical Thinking	0,49	Medium

Based on the table above, it can be seen that the highest *effect size* value is 0.80 and the lowest is 0.42. The average effect size value of the 10 articles is 0.52. This *Problem Based Learning* model also has an effect on students' critical thinking and problem solving skills. So in the table above,

Effect of Problem Based Learning model in terms of education level

	Level Education	Effect Size	Category
10	A SD	0,4	Medium
2	A SMP	0,5	Medium
	A	0,5	Medium

6		0	
4	A	0,4	Medium
5	A	0,6	Medium
3	A	0,4	Medium
7	A	0,4	Medium
8	A	0,7	high
9	A	0,8	high
1	A	0,5	Medium

Based on the table above, the effect size result at the elementary education level is 0.49. The average effect size at the junior high school education level is 0.51, at the high school level 0.50 and at the university 0.51. So that in the table it is obtained that the Problem Based Learning model is more influential at the junior high school and university education levels.

Effect of Problem Based Learning on the Subject Matter

Article	Material	Effect Size	Category
A2	Temperature and Heat	0,52	Medium
A9	Optical Tools	0,80	high

Based on the table above, the effect size value of temperature and heat material is 0.52 with a medium category and on optical instrument material 0.80 with a high category. So that the Problem Based Learning model is more effective in improving critical thinking skills in optical instrument learning material at the high school education level.

Based on the results of the analysis and the effect size results in the table above, the average effect size value is 0.52 in the medium category. This states that the Problem Based Learning model can improve students' critical thinking skills. Because the PBL model students are required to solve a problem. Where this can improve students' higher-level thinking skills. In PBL students are trained to be active in the learning process. So that students do not only depend on their group, but students are able to be independent in exploring and analyzing the information they get.

Based on the table in terms of education level, it can be seen that PBL is more effective at the junior high school and university education levels. And based on the subject matter, PBL is more effective on Optical equipment material in high school education PBL also trains students to always seek and dig deeper information, students are trained not to be satisfied with just a little information. This requires teachers to guide students in discussions and participate actively in discussing, finding problems and solving these problems.

PBL characteristics include problems at the beginning of learning. The problem is a problem given in everyday life that the teacher gives in a floating manner before entering the learning that will be done. The teacher provides a reference that stimulates the student's thinking process.

With the division of groups, students can conduct group discussions actively and independently. Not only depending on the group.

PBL is a student-centered learning model. Where students have full responsibility for the individual and also for the group. In learning, PBL is very useful by students where PBL can improve students' thinking skills, how to work together in a discussion group, and PBL can also foster students' habit of self-learning.

However, there are still many shortcomings in the learning process carried out by teachers that can make the Problem Based Learning model not so effective. Because most of the students are still not independent and only depend on their group. So that some or some students have low thinking skills.

CONCLUSION

Based on the description above, it is concluded that the *effect size* of critical thinking skills is 0.52 with a moderate category. At the education level, it is more effective at the junior high school and university education levels, the effect size is 0.51 and 0.51 respectively. And for learning materials, it is more effective on Optical Equipment material at the high school education level. Judging from the effect size value, it can be concluded that the *Problem Based Learning* model can improve critical thinking skills in students.

BIBLIOGRAPHY

- nad Farisi, Abdul Hamid, M. (2017). *The Effect of Problem Based Learning Model on Critical Thinking Ability in Improving Student Learning Outcomes on the Concept of Temperature and Heat*. 283-287.
- nad Farisi, Abdul Hamid, M. (2018). *The Effect of Problem Based Learning Model on Physics Learning Interest and Critical Thinking Ability of SMA N 1 Bengkulu Students*. *Journal of Physics Coils*.
- Iriani, A. A. (2016). *The Effect of Problem Based Learning Model on Critical Thinking Ability of Physics Education Study Program Students at Muhammadiyah Makassar University*. *Journal of Physics Education*, 4.
- Iriono Manalu, S.Pd., M. P. (2016). *Effects of Problem Based Learning Model on Problem Solving Ability of Students of SMA Negeri 2 Pematangsiantar*. *INPAFI Journal (Physics Learning Innovation)*, 4.
- Aufit, Asrizal, S A Hanum, and A. F. (2020). *Preliminary Research in the Development of Physics Teaching Materials That Integrate New Literacy and Disaster Literacy*. *Ahmad Farisi, Abdul Hamid, Melvina*.
- la Ramadhani, M. (2014). *The Effect of Problem Based Learning (PBL) Implementation on Students' Critical Thinking Skills in Physics Learning Class XI*

- SMA N 5 Padang. *Pillar of Physics Education*, 49-56.
- hammad Zunanda, K. S. (2015). The Effect of Problem-Based Learning Model and Critical Thinking Ability on Physics Problem Solving of Vocational Students. *Journal of Physics Education*, 4, 63-70.
- arno, A. Asim, P. Suwasono, M. A. (2019). The Influence of Problem Based Learning on Critical Thinking Ability for Students in Optical Instrument Topic. *Indonesian Journal of Physics Education*, 15.
- nariyah, E. N. (2016). The Effect of Problem Based Learning on Critical Thinking Skills in Social Studies. *Journal of Education and Learning*, 23.
- Setyorini, S.E. Sukiswo*, B. S. (2011). APPLICATION OF PROBLEM BASED LEARNING MODEL TO IMPROVE CRITICAL THINKING SKILLS OF JUNIOR HIGH SCHOOL STUDENTS. *Indonesian Physics Education*, 52-56.
- ta S. Zuliani Nasution, Sahyar, M. S. (2016). The Effect of Problem Based Learning Model and Critical Thinking Ability on Problem Solving Ability. *Scientific Journal of Physics Education*, 5, 112-116.
- lodo Budhi and Siti Suwarni. (2019). Effect of problem based learning on critical thinking ability on science. *Scientific Journal of Physics Education*.