

# Problem Based Learning (PBL) Effectivenessless in Improving Critical Thinking Ability: Meta-Analysis Study

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## Abstrak

This meta-analysis research aims to see the effectiveness of problem-based learning (PBL) to increase critical thinking skills. The study involved 20 research journals with 1386 participants. The analysis was carried out using the Meta-mar (Free Online Meta-Analysis Service) website based on the number of samples (N), mean (M), and standard deviation (SD). The analysis results showed that the value of the g random model effect size was -0.58 (95% CI = -0.878 to -0.278, p = 0.0002) with an inconsistency (I<sup>2</sup>) value of 86.4%. These results indicate that problem-based learning (PBL) has a less significant effect on increasing critical thinking skills.

## Keywords

problem based learning; PBL; critical thinking skills

## Abstrak

Penelitian meta-analisis ini bertujuan untuk mengetahui efektivitas *Problem Based Learning (PBL)* dalam meningkatkan kemampuan berpikir kritis. Penelitian yang dilakukan melibatkan 20 jurnal penelitian dengan jumlah partisipan sebanyak 1386. Analisis dilakukan dengan menggunakan website *Meta-mar (Free Online Meta-Analysis Service)* berdasarkan pada jumlah *sample (N)*, *mean (M)* dan *standard deviation (SD)*. Hasil analisis menunjukkan nilai *g random model effect size* sebesar -0.58 (95%CI = -0.878 sampai -0.278, p = 0.0002) dengan nilai *inconsistency (I<sup>2</sup>)* sebesar 86.4%. Hasil ini menunjukkan bahwa *Problem Based Learning (PBL)* memberikan efek yang kurang signifikan dalam meningkatkan kemampuan berpikir kritis.

## Kata kunci

problem based learning; PBL; kemampuan berpikir kritis

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## INTRODUCTION

The learning process cannot be separated from the ability to think. Thinking skills need to be trained so that a person does not experience difficulties solving problems that occur every day. Critical thinking skills are essential and valuable for life (Zubaidah,2010). Critical thinking ability is the ability to understand concepts, apply them, and integrate and evaluate the information obtained or generated. According to Ennis (in Zubaidah,2010), critical thinking consists of character and skills. These two things cannot be separated from a person's personality. Based on the view of developmental psychology, character and skills must be taught simultaneously.

Conclusion: there are several characteristics of critical thinking (Wade,1995): making questions and problem boundaries, testing data, analyzing opinions and biases, avoiding highly emotional considerations, avoiding oversimplification, considering various interpretations, and tolerating ambiguity. These indicators have a relationship with the universal intellectual standard or universal intellectual standard. This standard is considered essential to ensure the quality of thinking in formulating problems. This standard is also applied to critical thinking processes. The aspects of the universal intellectual standard are clarity, accuracy, precision, relevance, depth, breadth, and logic.

Schools and universities are formal institutions that can help someone develop their critical thinking skills. One of the interactive learning models schools can improve critical thinking skills is problem-based learning (PBL). This learning model is student-centered by using everyday problems as learning materials. It is applied so that students can improve critical thinking skills in overcoming problems and become independent students (Aryanti et al.,2017).

This meta-analysis was conducted because several schools and universities have implemented the PBL method to improve their students' critical thinking skills. In addition, research on the effectiveness of the PBL method in improving students' critical thinking skills has been carried out by researchers from various countries. Most of the research that has been done shows that PBL has succeeded in increasing the critical thinking skills of students and students who receive learning with this method. Therefore, this research needs to be done to ensure the effectiveness of the PBL learning method in improving critical thinking skills.

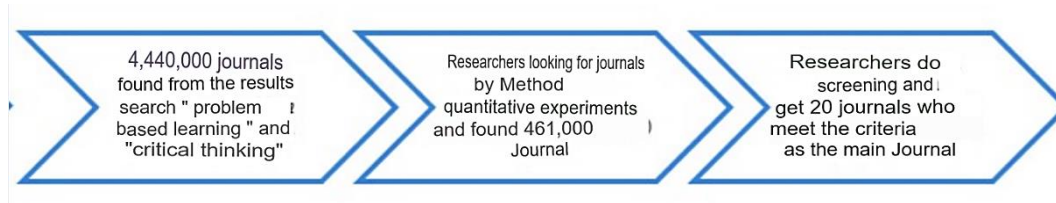
## METHOD

The research method used is the meta-analysis method. Meta-analysis is done by looking for studies that have been done and published by other researchers. Then several studies that have been found will be analyzed systematically and quantitatively to obtain accurate conclusions about the size of the effect of a treatment on the final result. Researchers apply this method by analyzing data from several studies that have been conducted on the effectiveness of PBL to improve critical thinking skills.

In this study, researchers analyzed data using the Meta-mar (Free Online Meta-Analysis Service) website for free. The journal criteria used are journals with the last 15 years using experimental quantitative methods with details of the number of participants and the mean and standard deviation of both the experimental and control groups. The writing of this meta-analysis followed the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) and Meta-analysis Reporting Standards (MARS).

Researchers collected research data by searching online for articles and journals at Google Scholar, PubMed, Researchgate, Academia.edu, Semantic Scholar, ScienceDirect, and Elsevier. The keywords used are "Problem-based learning" and "critical thinking." Based on the search, 20 journals that met the criteria were found and will be used as the prominent journals in this study. Effect size in this meta-analysis is divided into three categories, namely small effect size ( $g < 0.2$ ), medium effect size ( $g \pm 0.5$ ), and large effect size ( $g > 0.8$ ).

Chart 1. Stages of collecting reference data

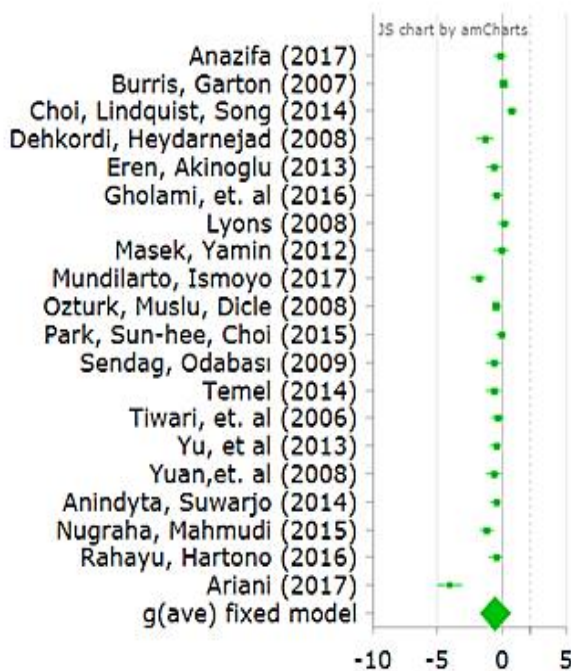


## RESULT AND DISCUSSION

The results of data analysis showed that the value of inconsistency ( $I^2$ ) was 86.4%. According to Higgins et al. (2003), the inconsistency value ( $I^2$ ) is divided into three namely, the low category ( $I^2 < 25\%$ ), the medium category ( $I^2 \pm 50\%$ ), and the high category ( $I^2 > 75\%$ ). Based on this category, the inconsistency value ( $I^2$ ) obtained in this study is included in the high category, so it can be concluded that the heterogeneity of this study is quite significant and allows researchers to use the Hedges'g value (SMD) in the random-effects model. In addition, the differences in the methods and measuring instruments used in each study have strengthened the researcher to use the random effect model. This is also supported by Borenstein, Hedges, Higgins, Rothstein (2009), which suggests that differences in research methods impact the results. We should not assume the exact effect sizes in meta-analytical studies such as this; the random-effects model is justifiable.

Based on the explanation above, the effect size value used is the Hedges'g (SMD) value in the random effect model of  $-0.58$  ( $95\%CI = -0.878$  to  $-0.278$ ,  $p = 0.000156$ ). Effect size is divided into three categories, namely small ( $g < 0.2$ ), medium ( $g \pm 0.5$ ), and large ( $g > 0.8$ ). Referring to this category, the effect size in this study is included in the category of medium effect size. The medium effect size obtained shows that PBL has a moderate or less significant effect in improving critical thinking skills.

Figure 1. Forest plot random effect models



The lack of effectiveness of PBL could be due to PBL implementation procedures that are not following the research situation. The influencing factor is the difference in each child's ability who participates in the research and past habits of always studying with the lecture learning model. In addition, the PBL learning model can be considered relatively new in several fields of science, and not all schools or colleges apply this learning model. The exact period for providing problem-based learning (PBL) has not yet been found. So this ineffective result could be obtained because Problem Based Learning (PBL) is given in a too short period. It should show optimal results (Choi, Lindquist, songs, 2014 and Anazifa, Djukri, 2017).

In a meta-analysis study conducted by Kong et al. (2014), it was found that research results can be less effective if the number of samples used in the study is only tiny. A small sample makes the researcher lack data, and the accuracy of the results can be disrupted. In addition, the method of measuring critical thinking skills is quite diverse, and the validity and reliability results that vary between studies can also affect the results obtained. The limitations of search tools or software in collecting journals and research data also play a role in determining the results of meta-analyses.

In addition, various studies using the Randomized Controlled Trials (RCT) method have been found, proving that PBL can improve critical thinking skills. However, the researcher said that the method and content of the delivery that was successfully carried out in this study would not necessarily be successful if it was delivered in other research groups. The results of the study may also change due to memory bias. Researchers offer the method to minimize possible bias in selecting subjects with strict criteria, well-trained researchers, and standardized treatment of all research subjects. Besides that, (2014).

Furthermore, in a systematic review study conducted by Yuan et al. (2008), the results obtained do not provide strong evidence regarding the effectiveness of PBL in improving critical thinking skills. Researchers are not sure about the research results obtained because participants in this study may get PBL and learn other methods in other subjects. In addition, the studies used as data in this study were also considered unsatisfactory by the researchers.

Various factors that affect the effectiveness of this Problem Based Learning (PBL) learning method need to be reviewed to obtain accurate and precise research results. There may be other learning methods that are more effective in improving students' critical thinking skills. In this meta-analysis, several weaknesses were found, namely the possibility of publication bias because this meta-analysis research uses more journals that show positive results. There are variations in implementation procedures and research measuring instruments that differ between studies and individual characteristics in each study.

## CONCLUSION

PBL learning method is not effective in improving critical thinking skills. Suggestions that can be given for research on problem-based learning (PBL) are using a larger sample size to better the preparedness of researchers. Methods appropriate to the situation or condition of the group being studied, and more efforts to reduce possible research bias. Occur. In addition, researchers who are interested in this topic need to consider conducting a longitudinal study.

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