

## META-ANALYSIS OF PROBLEM BASED LEARNING MODELS ON PHYSICS PROBLEM SOLVING ABILITIES

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### Abstract :

The ability to solve these problems can be built and improved through the use of the Problem Based-Learning (PBL) learning model. This research aims to analyze the effect of using the Problem Based Learning model on students' Physics problem solving abilities. The method used in this research is meta-analysis. Meta-analysis is carried out by summarizing previously existing research data. Data collection was carried out by reviewing and searching ten online articles that examined the influence of the Problem Based Learning Model on physics problem solving abilities. The population in this study is research articles about the PBL model published online in the period 2018-2023. The samples taken were ten journals related to the research title. In this research, to find the right articles, search keywords were use, namely Problem Based Learning, the ability to solve problems on websites or online article pages. The criteria for articles taken as reference material in this meta-analysis are to contain at least the average pretest score before using the PBL model and the posttest score after using the PBL model to make it easier to determine the effect size. The results of the meta analysis carried out show that there is an influence of learning using the Problem Based Learning model on increasing students' Physics problem solving abilities.

Keywords: Problem Based Learning, Problem Solving Ability

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## INTRODUCTION

Education is an important process in forming individuals and society. Education provides a foundation for individual development, enables understanding of the world around them, and helps develop skills in life. Education aims to develop the potential of each individual to develop a superior personality (Ariyana et al., 2018; Swinton & Clark, 2021). The changes that occur in human life are due to the development of the times which requires everyone to have various skills so that they are able to compete and be able to face the changing times (Hao et al., 2017; Kolar & Hodnik, 2021). These skills include critical thinking skills, problem solving skills, creativity, innovation as well as communication

and collaboration skills. Other skills that support this are the skills to search, manage and convey information and use technology.

Physics is one of the subjects taught at the Senior High School education level. Physics learning in class is generally presented in a less interesting theoretical form, giving rise to the perception that physics is difficult to learn and understand. If physics learning patterns are implemented well, physics is actually not as difficult as people imagine (Mayanti et al., 2022). This is caused by several things, including the use of inappropriate learning models or methods and students not being used as the center of the learning process. As a result, students become less interested in learning, and the output produced is not optimal.

One of the efforts that can be made to improve learning output suggested by learning experts is the use of a constructivist thinking framework in classroom learning activities. So that physics learning does not only teach concepts but prioritizes the relationship between concepts and reality and phenomena in everyday life (Fatmaryanti et al., 2022; Sajidan et al., 2020). Physics itself is a science that discusses natural phenomena and behavior that humans can observe and all of these concepts have been applied in everyday life. In studying physics, students are invited to be able to understand, think about, analyze and solve various symptoms and problems that exist in everyday life (Nursita et al., 2015). The aim of studying physics itself is to help students gain knowledge in terms of concepts, principles, applications, skills and scientific attitudes.

21st century skills in terms of problem solving are one of the focuses of physics learning. When solving problems, critical thinking skills are also needed, which are the basis of problem solving (Azid & Md-Ali, 2020; Stephanou et al., 2020). Problem solving skills include other skills such as identifying and tracing, determining, testing, organizing and considering and interpreting various alternative solutions (Soboleva et al., 2020; Yuberti et al., 2019). So far, students' ability to solve physics problems is still very low, in working on physics problems given by the teacher, students more often use mathematical equations without doing analysis, guess the formulas used and memorize examples of questions that have been worked on to work on questions that show that students do not understand well how to solve physics problems.

Problem solving skills can be built and improved using the problem-based learning (PBL) model. Problem-based learning is a learning model that emphasizes problem solving or problem-based learning (Akben, 2019; Servant-Miklos, 2020). The PBL model is a problem-based learning model that requires real investigations, namely investigations that require real solutions to real problems (Bellová et al., 2017). In PBL learning, students are introduced to real world problems and encouraged to explore them, identifying existing problems and allowing students to draw their own conclusions about the problem, and in the end students can find a solution to the problem. Through the PBL model, teachers can encourage all students to play an active role in the learning process (Winarti et al., 2019). This is because the PBL model presents contextual problems that encourage students to learn. The focus of learning is on concepts and principles related to problems, by involving students in investigations for problem solving and other meaningful tasks. To summarize the influence of using the PBL model on physics learning, a meta analysis can be carried out.

Meta-analysis of the Problem Based Learning (PBL) model on physics problem solving abilities has a very important urgency in the current educational context. First of all, by combining findings from various studies, meta-analysis can provide a more comprehensive picture of the effectiveness of PBL in improving physics problem-solving abilities (Kamid et al., 2022). This is important because it can provide a strong foundation for developing more effective curriculum and learning strategies in the future. In addition, meta-analysis can also identify factors that influence the success of PBL implementation, thereby helping practitioners optimize their learning strategies (Permatasari et al., 2019). Apart from providing benefits to educational practitioners, this research also has broad implications in the field of research, such as providing a basis for further research in understanding the mechanisms underlying the effectiveness of PBL. Thus, this meta-analysis not only makes an important contribution to learning practice, but also to the development of knowledge in the field of education and physics more broadly. So based on the description above, researchers are interested in conducting a Meta Analysis of the Effect of the Problem Based Learning (PBL) Learning Model on Students' Physics Problem Solving Ability.

**RESEARCH METHOD**

This research is research using a meta-analysis method. A meta-analysis is quantitative because it uses numerical calculations and statistics for a specific purpose. Meta analysis in the world of education aims to determine the significance of a research subject after treatment (Merriyana, 2006). Meta-analysis in this research was carried out by collecting existing research data.

The population in this study is research articles about the PBL model published online in the period 2018-2023. The samples taken were ten journals related to the research title. In this research, to find the right articles, search *keywords were used*, namely Problem Based Learning, the ability to solve problems on *websites* or online article pages.

The stages of this research are in accordance with the meta analysis steps which can be seen in the flow diagram presented in Figure 1.

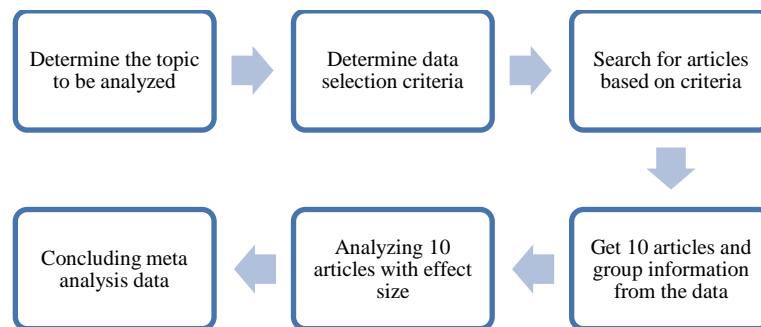


Figure 1. Meta Analysis Research Flow

After the Effect Size is obtained through the calculations above, it can be grouped in table 1:

Table 1. Effect Size Criteria

<i>Effect Size</i>	Category
0 – 0.20	Not enough
0.21 – 0.50	Low
0.51 – 1.00	Currently
> 1.00	Tall

Data collection was carried out by reviewing and searching several online articles. The criteria for articles taken as reference material in this meta-analysis are to contain at least the average pretest score before using the PBL model and the posttest score after using the PBL model to make it easier to determine the effect size. Effect size is a measure of the quantity of a research result to determine the correlation or difference between research variables. Based on these criteria, there are ten articles that meet to be used as reference material in the meta-analysis activities that will be carried out.

In meta-analysis data analysis, the initial step is to collect all important information from previous studies in the same field. After the data is collected, an evaluation is carried out on the methodological quality of each study to assess the brightness of the results. Then, data from the various studies are integrated using appropriate statistical methods, such as effect size analysis, to produce a reliable overall estimate. The final step includes interpreting the results of this meta-analysis to extract the main findings, identify the strengths and weaknesses of the conclusions, and provide recommendations for future research.

**RESULTS AND DISCUSSION**

The total number of articles in this research that were used as sources according to the title of the article, namely the influence of the PBL model on students' physics problem solving abilities, was ten articles.

Table 2. Effect Size Category: Influence of the PBL Model on Problem Solving Ability

No.	Title	Year of Research	Effect Size	Category
1.	The Influence of the Problem Based Learning Model on the Physics Problem Solving Ability of Class X Students at SMK Negeri 1 Batang Angkola (Rangkuti et al., 2023)	2023	0,19	Not enough
2.	The Influence of the Problem Based Learning (PBL) Learning Model on the Physics Problem Solving Ability of Students at SMA Negeri 11 Muaro Jambi (Firmansyah et al., 2022)	2022	1,19	Tall
3.	The Effect of Problem Based Learning (PBL) with Multirepresentation on the Problem Solving Ability of High School Level Students on Momentum and Impulse Material (Putri & Marpung, 2020)	2020	1.47	Tall
4.	The Influence of the Problem Based Learning Model Assisted by Macromedia Flash on Student Learning Outcomes in the Main Material of Static Fluids in Class X-MIA Semester II Man Binjai (Tampubolon et al., 2020)	2020	1.62	Tall
6.	The Influence of the Problem Based Learning (PBL) Model on Problem Solving Ability in the Main Material of Fluid Dynamics in Class (Suharni & Rahmatsyah, 2020)	2020	1,176	Tall
7.	Scaffolding in Physics Learning Based on Problem Based Instruction (PBL): Its Effect on Concept Understanding and Self-Efficacy (Diani et al., 2019)	2019	3.37	Tall
8.	Approaching Problem-Solving Skills of Momentum and Impulse Phenomena using Context and Problem-Based Learning (Yuberti et al., 2019)	2019	0.69	Currently
9.	The Influence of the Problem-Based Learning Model Assisted by Mobile Pocket Book Physics on Students' Problem Solving Abilities (Noviatika et al., 2019)	2019	4.06	Tall
10.	The Influence of the ICT-Assisted Problem Based Learning Model on the Physics Problem Solving Ability of the Class of 2016/2017 in Static Fluid Material (Suwasono & Puspitasari, 2017)	2017	0.73	Currently

Effect size calculations on the influence of Problem Based Learning on students' physics problem solving abilities, of the ten research articles analyzed, there were 6 articles in the high effect size category, 3 articles in the medium category and 1 articles in the low enough category. So from the results of the data analysis it can be concluded that there is an influence of the Problem Based Learning model on students' physics problem solving abilities. From the aspect of the media used in Problem Based Learning, the analysis results show that the Problem Based Learning model with the help of Mobile Pocket Book is the media that has the highest effect size with a value of 4.60 which is in the high category.

Problem solving ability is an ability that students must have. Physics learning is expected to foster problem solving abilities in students (Kim & Pak, 2002). Good problem solving skills will make it easier for students to understand the concepts being studied. In solving problems, students involve thinking processes to collect facts, analyze information, develop various alternative solutions, and choose effective solutions (Pratiwi & Setyarsih, 2015).

The influence of the Problem Based Learning learning model has been able to improve students' problem solving abilities. Based on the results of the meta analysis carried out, the Problem Based Learning model has a good effect size in improving students' problem solving abilities. Through this learning model students can use the knowledge they have to solve problems. Through this learning model, students not only learn concepts related to the problem but also scientific methods to understand concepts that are appropriate and relevant to the problem that is the learning topic.

So far, the Problem Based Learning model has been widely used in Physics learning (Phasa, 2020). The form of application varies depending on the type of variable and the focus of the need. Use of learning models using learning media. The presence of media can help convey material more clearly and more interestingly. Learning media is a teaching aid to convey material so that messages are more easily received and make students more motivated and active (Irwandani & Juariyah, 2016). Based on the results of the meta analysis carried out, the presence of media has an influence on problem solving abilities (Setiyani et al., 2020). With media, it will be easier for students to apply and understand concepts, thereby making problem solving easier as well. The ten articles analyzed showed high and medium influence. Apart from that, there is an influence of the use of media in Problem Based Learning where each media has a good effect on students' problem solving abilities.

## CONCLUSION

Based on the results of the meta-analysis carried out in this research, it was concluded that there was an influence of the application of the PBL model on students' physics problem solving abilities. From the effect size calculation, the highest effect was obtained at 4.06 and the lowest at 0.19. Apart from that, there is an influence of media use on students' problem solving abilities. In this way, the Problem Based Learning model is able to improve students' problem solving abilities.

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