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# Problem Based Learning (PBL) Learning Model and Impact on Students' Critical Thinking Skills in Mathematics Learning

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**ABSTRACT**

Education is a basic need for human beings today the world of education is expected to be challenged to be able to produce individuals who can meet global demands. This study aims to describe students' critical thinking skills in mathematics learning with the Problem Based Learning model. The method used in this study is the SRL (Systematic Literatul Review) method. SRL is carried out by the researcher by identifying, reviewing, evaluating and interpreting all available research. The results of the study show that the Problem Based Learning learning model used can hone students' critical thinking skills, after using the Problem Based Learning learning model, students can have diverse critical thinking skills. The positive impact of PBL on students' critical thinking skills includes improving the ability to identify problems, collect and analyze information, and formulate appropriate solutions. In addition, PBL can also increase students' motivation to learn and promote collaboration and communication skills in the context of mathematics learning.



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## 1. INTRODUCTION

Education is a basic need for human beings today the world of education is expected to be challenged to be able to produce individuals who can meet global demands. According to Mandasari (2015). Education is a basic effort made so that students and students can achieve certain goals as we both know, currently all news can be accessed freely through the internet and there is no guarantee that news spread through the internet has true value. Therefore, every individual must have the ability to choose from all the news that exists, right or wrong, hence the need to be able to think more creatively or often called critical thinking. The level of thinking of students can be divided into two, namely basic level thinking and high level thinking. According to Resnick (in Fatmawati, 2014) lower order thinking

only uses limited abilities to complex and mechanical things. Higher order thinking makes manipulating previous information so that it does not watch.

Critical thinking skills are not skills that from birth to this skill can be applied, trained and developed through the process and assessment of learning points in the learning process, the teacher as a mediator and facilitator designs and implements a model approach or strategy that can facilitate and improve students' critical thinking skills. An individual has the ability to think critically, so the individual does not only believe in the existing facts without doing something proving so that the fact is really valid and believable, the importance of critical thinking skills that researchers believe is supported by the number of researchers who limit the ability to think critically.

According to crismasanti (2017), the current reality is that students' abilities in mathematics learning are still not optimal. This is because students only imitate what the teacher does and in solving the problem, students think it is enough to do what is exemplified. According to Fatmawati (2014), students are able to solve problems with calculations and solve problems that are almost the same as exemplified by the teacher, but it will be difficult if the questions are changed to other forms of questions and if they are made in story problems. As a result, students lack the ability to solve problems with other alternatives. Students also lack the opportunity to freely express themselves. Even though this kind of ability is needed by students to solve problems that they will face in the future.

With that, the researcher applied the Problem Base Learning learning model to be the solution, problem-based learning or first applied at McMaster University School of Medicine Canada in 1969 at the point since then Problem Base Learning learning has spread all over the world, especially in medical or nursing education and other fields of science in college, for example architecture, mathematics, occupation and physiotherapy, as well as pure science (Riyanto, 2009).

Problem-based learning is a learning approach that uses euthanasian problems as a learning resource, so that participants are trained to think at a higher level and develop their personality through problems and daily life. According to (Komalasari, 2010) problem-based learning or a learning based program is a learning strategy using real-world problems as a contest for students to learn about critical thinking and problem-solving skills as well as to acquire knowledge and concepts that are essential from the learning subjects. This study aims to describe students' critical thinking skills in mathematics learning with the Problem Based Learning model.

This study aims to describe students' critical thinking skills in mathematics learning with the Problem Based Learning model. It is expected that this research will have a positive impact on students' critical thinking skills, including increasing the ability to identify problems, collect and analyze information, and formulate appropriate solutions. In addition, this PBL model is also expected to increase students' learning motivation and improve collaboration and communication skills in the context of mathematics learning.

## 2. METHOD

The method used in this study is the SRL (Systematic Literatul Review) method. SRL is carried out by the researcher by identifying, reviewing, evaluating and interpreting all available research. With this research method, the researcher conducted a review and identified journals systematically which in each process followed the steps that had been set (Putra et al. 2019). SLR is beneficial for researchers, by

providing clear motivation for new research, and for practitioners, by providing comprehensive evidence to guide decision-making on their work (Al-Zubidy & Carver, 2019).

This study uses a systematic literature review by collecting data according to the design of Zawacki-richter, O., Kerres, M., Bedenlier & Bond, M., & Buntins, (2020), namely 1) develop research question, 2) construct selection criteria, 3) develop search strategy, 4) select studies using selection criteria, 5) assess the quality of studies, and 6 Synthesis result of research question). Here's the explanation: 1) Develop a research question; the questions developed in this study are: How to improve students' critical thinking skills and after the implementation of the Problem Based Learning Model, students' critical thinking skills have increased. 2) Construct selection criteria; 3) Develop a search strategy; Publication year deadline from 2012 to 2024. 4) Select studies using selection criteria.

In the study selection process, the researcher reviews the title and abstract of the article to determine the relevance of the research. 1) Asses the quality of studies: 2) Synthesis result of research question.

The data found were evaluated based on the following criteria:

QA: Is the article published in a national journal or indexed by SINTA?

QB: Does the article write a definition of Problem Based Learning?

QC: What type of research is used to discuss Learning Outcomes?

QD: Is there a level of education in the Problem Based Learning Model research?

Each article was given a question as above with an answer of Yes (Y) or No (T)

At this stage, the data or information that has been collected is described according to the Research question (Prihastari et al., 2022): 1) Tahap Developing the Search Strategy; Using the help of Harzing's Publish of Perish software and google scholar, with the keyword Demonstration-Based Learning from 2019 to 2024, with a maximum number of results of 50 articles without duplication of articles: 1) Selection Criteria Stage; Then it is analyzed based on a) the title that is in accordance with the object being studied, namely Problem Based Learning, b) publication from 2019 to 2024). A total of 17 articles were received. The criteria for the rejected article are a) outside the topic of Problem Based Learning, b) not published in a national journal or indexed by SINTA, and c) the source or data is unknown. 2) The study Process Stage: The article that has been received is then read the title and abstract to determine whether it is relevant to the topic. At this stage, 14 articles were found out of 17 articles received. Both articles were rejected because they did not include the level of education studied or general, so it is not relevant to this study. 3) The Quality of Studies Stage; The results of the screening from the previous stages were obtained 14 out of 11 articles that met the quality of the study with Yes answers to all questions (QA, QB, QC, QD), with the results elaborated as follows; All articles have been published in 11 articles in national journals; Write a study related to the definition and indicators of Problem Based Learning; Write down the type of research used to examine demonstration-based Problem Based Learning; and Include the level of education in his research with the object of Problem Based Learning. 5) Synthesis Result Stage; Finally, synthesize data or information from relevant articles to obtain evidence that answers research questions (Latifah, L., & Ritonga, 2020).

## 3. RESULTS AND DISCUSSION

In this study, the articles were searched using Google Scholar, and the Garuda Portal. The articles searched had keywords, namely critical thinking, PBL model, and mathematics. The researcher obtained 12 articles relevant to the research topic. Furthermore, from some of the articles obtained from

the search process. The author took 11 articles relevant to the research topic. Then the article continues with the process of synthesizing the results which are described in the table below.

Table 1. Results of Synthesis of Article Results

| NO | Author | Result |
|---|---|---|
| 1 | Author and Year: Isna Riska Amalia and Nuriana Rachmani Dewi (2020) | Based on the findings of the journal that has been analyzed above, the Problem Based Learning (PBL) model applied in learning is able to improve students' critical thinking skills. The application of the Problem Based Learning learning model can also be integrated with interesting learning media so that together it can improve students' critical thinking skills. |
| 2 | Author and Year: Jaya Yanti Nur Istiqomah and Endang Indarini (2024) | The Problem Based Learning learning model, to improve critical thinking skills in Mathematics learning for elementary school students using the meta-analysis method. From the results that have been found and proven, both Problem Based Learning and Problem Posing learning models are able to have a relatively large influence to improve the ability to think critically about mathematics learning of elementary school students. |
| 3 | Author and Year: Elva Pristy Afifah, Wahyudi, and Yohana Setiawan (2019) | Based on the discussion that has been described earlier, it can be concluded that there is a difference in the critical thinking skills of students from experiment class 1 who uses the Problem Based Learning model and experimental class 2 uses the Problem Solving model. Both models can improve students' mathematical critical thinking skills with the results of the NGain test to determine their effectiveness. |
| 4 | Author and Year: Sri Hastuti Noer and Pentatito Gunowibowo (2018) | learning with the Problem Based Learning model. effective judging from students' critical thinking skills and mathematical representations. This can be seen from the mathematical critical thinking skills of students who take part in Problem Based Learning. higher than the mathematical critical thinking ability of students who participate in learning. |
| 5 | Author and Year: Wa Ode Nurlina Mbay, Mustamin Anggo, and Asrul Sani (2017) | The learning model between students taught with the problem-based learning model is more effective than students taught with a jigsaw-type cooperative learning model on mathematical critical thinking skills. |
| 6 | Author and Year: Teguh Sumadi Suparwoto Cahyo and Budi Murtiyasa (2023) | In the analysis and evaluation of the problem-solving process related to critical thinking indicators, it includes aspects of evaluating facts and conclusions. Students still make mistakes often. In addition, students focus on the tasks assigned by the teacher with little precision. So, teachers must provide understanding to students so that they are more thorough in working on problems and understanding |

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|---|---|---|
| | | related to how to conclude a problem. The obstacle that is an obstacle to critical thinking is that students are still afraid to convey arguments to friends or teachers. |
| 7 | Author and Year: Siti Kholifah, Rasiman, and Widya Kusumaningsih (2024) | After using the PBL learning model, students began to change, namely: there was a difference in the effectiveness of using the PBL learning model, the learning outcomes of students who used the PBL model assisted by learning video media achieved individual and classical completeness, students who used the PBL learning model were more active and their critical thinking improved compared to using the previous learning model. |
| 8 | Author and Year: Neni Ferli Yanti and Ariyadi Wijaya (2023) | Based on the results of the analysis, it can be concluded that the problem-based learning model has a great influence on students' mathematical critical thinking skills. |
| 9 | Author and Year: Lilis Nuryanti, Siti Zubaidah, and Markus Diantoro (2018) | Based on the results of data analysis and discussion, it can be concluded that the critical thinking ability of junior high school students in grade VIII is still low, but after the implementation of the Problem Based Learning learning model, learning is more active and critical thinking students are improved. |
| 10 | Author and Year: Taruli Rahel Angelina Simatupang and Oce Datu Appulembang (2022) | In learning, especially mathematics, it is necessary to train students' critical thinking skills considering the importance of this ability possessed by individuals in the global era. Teachers should pay attention to learning models such as Problem Based Learning because they are used to train students' critical thinking skills. |
| 11 | Author and Year: Yustrisya Ni'mahtus Sa'diah, Kunti Dian Ayu Afiani, and Fajar Setiawan (2023) | This study aims to describe the critical thinking skills of elementary school students in mathematics learning with the Problem Based Learning model and to find out the indicators of critical thinking skills that students are most proficient in. This research is carried out so that in Mathematics learning students do not experience boredom, and students' critical thinking increases. |

Based on the results of the review of the 11 articles, it was found that the use of the Problem Based Learning learning model increased the achievement of learning objectives. And the use of the Problem Based Learning learning model can support students' completeness in understanding the material.

The results of this study indicate that the Problem Based Learning (PBL) model has a significant and consistent positive impact on students' critical thinking skills in mathematics learning. Through a systematic literature review of 11 relevant articles, it was found that PBL not only enhances students' ability to analyze and solve complex mathematical problems but also fosters a more active, independent, and reflective learning attitude. The results are aligned with previous studies that emphasize the essential role of learning models in developing higher-order thinking skills among students, particularly in subjects that are often perceived as rigid and procedural like mathematics.

In the study conducted by Amalia and Dewi (2020), it was concluded that integrating PBL with engaging learning media significantly improved students' critical thinking abilities. This finding is consistent with the theoretical framework proposed by Komalasari (2010), who argues that PBL provides a real-world problem context that stimulates students to think critically, solve problems creatively, and construct new knowledge. Similarly, Istiqomah and Indarini (2024) confirmed through a meta-analysis that PBL significantly influences the development of students' critical thinking in mathematics, aligning with the argument of Resnick (in Fatmawati, 2014) that higher-order thinking, such as critical thinking, can be nurtured through appropriate instructional strategies rather than being an innate skill.

The study by Afifah et al. (2019) also reveals that PBL, compared to other models like Problem Solving, yields higher gains in mathematical critical thinking skills. This reinforces the idea that PBL's structured yet flexible problem-based approach pushes students to engage with content at a deeper level, supporting the claim by Riyanto (2009) that PBL, initially developed for medical education, is universally effective across disciplines, including mathematics. Furthermore, Noer and Gunowibowo (2018) provided empirical evidence that students exposed to PBL outperform their peers in both critical thinking and mathematical representation skills, demonstrating the model's holistic impact on cognitive and metacognitive aspects of learning.

However, some studies, such as Suparwoto and Murtiyasa (2023), identified challenges in students' critical thinking processes, noting that despite PBL's effectiveness, students often struggle with evaluating facts, drawing conclusions, and articulating arguments confidently. This aligns with Crismasanti (2017), who highlighted that conventional learning habits, where students merely imitate teacher demonstrations, hinder the development of independent problem-solving and critical reasoning abilities. The PBL approach, therefore, addresses this gap by encouraging exploration, inquiry, and argumentation, which are critical for fostering higher-order thinking.

Moreover, findings by Yanti and Wijaya (2023) and Nuryanti et al. (2018) reinforce the assertion that critical thinking skills in mathematics remain low under traditional learning models but significantly improve with the application of PBL. This improvement is theoretically supported by the work of Fatmawati (2014), who emphasized that critical thinking is a skill that can be taught and developed systematically through problem-based tasks, rather than being a natural outcome of rote learning. The evidence provided by these studies clearly indicates that PBL transforms mathematics classrooms from passive knowledge transfer settings into active learning environments where students are empowered to question, analyze, and construct solutions independently.

Furthermore, the research by Simatupang and Appulembang (2022) stresses the urgency of equipping students with critical thinking skills to face the demands of the global era, resonating with the broader educational goals discussed by Mandasari (2015), who advocates for education that produces individuals capable of navigating the complexities of modern information landscapes. Lastly, the study by Sa'diah et al. (2023) provides practical insight by identifying specific critical thinking indicators that students master under the PBL model, illustrating the model's targeted effectiveness in promoting measurable cognitive development.

## 4. CONCLUSION

The findings of this study answer the researcher's initial concern regarding the low critical thinking skills of students in mathematics learning, which often stem from conventional teaching models that emphasize memorization and imitation rather than exploration and problem-solving. Through the systematic literature review conducted, it is evident that the Problem Based Learning (PBL) model effectively addresses this issue by creating a learning environment that fosters students' ability to analyze, evaluate, and solve problems independently. The application of PBL not only enhances critical thinking but also stimulates students' engagement, motivation, and active participation in mathematics learning, providing a solution to the gap identified by previous studies regarding passive learning habits in the classroom.

However, despite these positive impacts, this research has several limitations that need to be acknowledged. The data obtained are based solely on secondary sources through a literature review, without direct implementation or experimental testing in real classroom settings by the researcher. Additionally, the studies included in this review are limited to articles published between 2019 and 2024, potentially overlooking relevant research from other periods or unpublished data. Furthermore, most of the analyzed studies focus only on the short-term effects of PBL, with limited discussion on its long-term impact, sustainability, or adaptation in diverse educational contexts, especially for students with different cognitive abilities or learning difficulties.

Therefore, future research is recommended to conduct experimental studies or classroom action research that directly applies the PBL model in mathematics learning to strengthen empirical evidence of its effectiveness. It is also suggested that researchers explore the integration of technology and interactive learning media within PBL to further enhance students' critical thinking skills and overcome students' fear of expressing arguments, which remains a noted challenge. In addition, longitudinal studies are needed to investigate the long-term impact of PBL on students' cognitive development, ensuring that the improvements in critical thinking are sustained and applicable beyond the classroom environment. The conclusion that the results show that there is a significant influence of the problem-based learning model on improving the mathematical critical thinking skills of grade VII students of SMPN Surulangun.

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