

# Improvement of Student's Critical Thinking Ability sin Physics Materials Through The Application of Problem-Based Learning

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## ABSTRACT

Students' skills in critical thinking are needed in learning for problem-solving. The purpose of this study was to analyze the concept of problem-based learning models, the implementation of problem-based learning models in improving students' critical thinking skills, the effectiveness of problem-based learning models in improving students' critical thinking skills, as well as the effect of problem-based learning models on improving high school students critical thinking skills. on physics. The method in this research is a descriptive research method through literature study. In this study, the results of a review of several articles related to the problem-based learning model were obtained. Based on the research that has been done, it can be concluded that the problem-based learning model is a problem-based learning model directly so that students are active in learning in class. The implementation problem-based learning model can train students to overcome various problems directly so that they can improve students critical thinking skills. The application of problem-based learning model is very effective when applied in the student learning process in the classroom because it can improve students' critical thinking skills. The application of the problem-based learning model affects improving high school critical thinking skills on physics material.

## INTRODUCTION

The industrial revolution 4.0 in the 21<sup>st</sup> century, information and digital technology has become a part of human life, including in the field of education in Indonesia, so it becomes a challenge for educators in the learning process. Learning that will occur in the future uses a technology-based model that has a very important role in problem-solving according to the needs of students and the demands of the times and technology (Risdianto, 2019). The implementation of student learning is expected to be involved in 4C higher-order thinking activities (Creativity, Critical, Communication, and Collaboration). Higher Order Thinking Skills (HOTS) is the ability to take new information from related information in memory and then rearrange and expand the information to find possible answers in making decisions, innovating, and being able to create something (Keleman, 2021).

One of the key elements of HOTS is the ability to think critically. Critical thinking is the most valuable skill that schools can give to their graduates which is a learning goal at all levels of disciplines to solve increasingly complex life problems and generate creativity and innovation that is competitive and globally competitive so that it can meet the needs of the labor market (Siberian et al. al., 2019). Critical thinking skills are very much needed for the future of students in facing global competition, so learning models that are following 21<sup>st</sup>-century education are needed (Agoestanto, 2016; Hamdalia et al., 2018; Masrinah et al., 2019; Wulandari, 2016; Yahdi et al., 2020).

The learning model is a conceptual framework used for the basic provisions of learning (Arifah et al., 2021). The learning model is a framework for presenting the material used by the teacher as a basic provision in the teaching and learning process. The learning model used in this study is a problem-based learning (PBL) model that uses problems that not only transfer knowledge from teachers to students but also contribute to the thinking of collaboration between teachers and students, students and other students to get the core solution of the problem. the problem being discussed.

The 21st-century learning is marked by Student Center Learning with four developed skills, namely Communication, Collaboration, Critical Thinking and Problem Solving, and Creativity and Innovation. One of the learning models that can be used to develop 21st-century skills, especially critical thinking skills, is PBL. In problem-based learning, there is a learning syntax that can be used to stimulate students' thinking skills, especially critical thinking (Masrinah et al., 2019).

Physics is a branch of natural science that is fundamental for students to understand natural phenomena that occur around them. The purpose of learning physics according to (Misbah et al., 2018) of which is to apply what is learned in everyday life, so students need to be trained to think critically to apply physics concepts in dealing with problems in everyday life. Through learning physics, it is expected to be able to grow and develop abilities and shape students' personalities in studying various other sciences. Physics as a part of science greatly contributes to the development of science and technology. Learning physics in schools can be important for scientific development at the next level. Physical phenomena are also easily encountered in real-world situations. Students often experience and see physical phenomena without realizing that the concept is part of physics. Therefore, matters relating to physical phenomena in everyday life can be solved and analyzed through the PBL model.

PBL is based on real problems in the surrounding environment in life so that students can construct their knowledge (Anindyta & Suwarjo, 2014). Where students are expected to be able to instill the basis of scientific thinking and develop thinking skills today (Diani et al., 2018). Students' higher-order thinking skills can be improved by implementing learning using a problem-based learning model. Critical thinking has the meaning of reflecting on problems more deeply, always keeping the mind open to different approaches and points of view, not immediately believing in information obtained from several sources in written or oral form, and thinking reflectively rather than just accepting ideas without thinking. have significant understanding and evaluation (Hidayati et al., 2019). Critical thinking is a disciplined and conscious way of thinking (Maqbullah et al., 2018) and in improving students' critical thinking skills, teachers use appropriate learning models in the teaching and learning process.

Previous research on problem-based learning models can be used by teachers to develop students' skstudent'ritical thinking abilities as well as possible. The use of problem-based learning models can be used by teachers to develop student skills in their ability to think critically as well as possible in learning activities (Laura, 2020). Other researchers concluded that the problem-based learning model focuses students on solving problems independently so that with this activity students will get used to thinking critically and have high-level critical thinking skills.

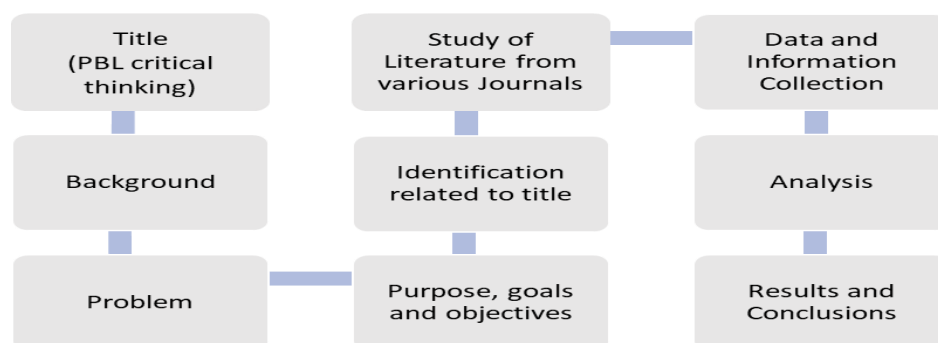
Meilasari et al. (2020) in their journal show that there is an effect of using problem-based learning models on students' critical thinking skills because learning by applying

problem-based learning models can train students to learn independently and think critically. Based on this description, the purpose of this study is to analyze the concept of problem-based learning models, the implementation of problem-based learning models to improve students' critical thinking skills, the effectiveness of problem-based learning models to improve students' critical thinking skills, and the effect of problem-based learning models to improve student critical thinking skills.

## RESEARCH METHOD

This descriptive research is a literature study research. The adoption of this literature study method is used to examine theoretical concepts. This literature study research is sourced from scientific articles, journals, and relevant research documents related to this research to examine the theoretical concepts of the PBL model on critical thinking skills from the results of research that has been done previously. So the method used in this study aims to conceptualize problem-based learning models, implement problem-based learning models to improve students' critical thinking skills, the effectiveness of problem-based learning models to improve students' critical thinking skills, and the effect of problem-based learning models to improve student critical thinking skills.

Researchers identified several articles published in scientific journals in the field of science education and indexed by several indexing institutions, namely Google Scholar, Sinta, and Scopus. The reference for this article is the primary research data with a focus on the problem-based learning model to improve the critical thinking skills of high school students. The literature study is done by browsing indexed article publications. Then perform an analysis of several articles and journals obtained. Problem-based learning models to improve high school students' critical thinking skills. The research flow can be described in Figure 1.



**Figure 1.** Literature study research flow

## RESULTS AND DISCUSSION

The problem-based learning model is an innovative learning model that provides active learning conditions for students to construct the concepts they learn and develop their abilities by applying scientific methods in solving problems and developing critical thinking (Fadilla et al., 2021). Problem-based learning provides a major role for students to be able to investigate problems in finding solutions to a given problem, this means educators provide space for students to criticize the extent to which problems can be overcome and what solutions can be applied as a way to solve problems (Ramadhani et al., 2020; Nopia et al., 2016).

This learning model presents real problems in everyday life so that students can think logically in solving a problem. This is because the use of the PBL model focuses on the chosen problem so that students not only learn the concepts related to the problem but also the scientific method to solve the problem (Fadilla et al., 2021). The Problem Based Learning (PBL) model emphasizes the center of the problem, from instructional objectives to student behavior, methods and techniques to be used, to the measurement and evaluation process that will be carried out (Bayrak & Gürses, 2020). Lieung, K. W. (2019) and Mundilarto (2017) stated that PBL learning provides students with opportunities to practice problem-solving. According to Abdullah (2017), the PBL model begins by presenting problems, formulating questions, facilitating investigations, and opening questions and answers between students to solve problems and apply concepts and principles (Saphira & Prahani, 2022). The principle in the PBL model is that students are not only equipped with knowledge but can apply concepts and knowledge in real situations. PBL learning is usually carried out in groups and ends with evaluation and review (Effendi et al., 2019).

The problem-based learning model is considered to be able to assist students in developing their ability to understand physics concepts because this model has the following characteristics: (1) the learning process starts from a problem related to students' daily lives; (2) Organize the concepts (materials) that are studied based on problems, not around scientific disciplines; (3) Train students to be responsible for shaping and carrying out the learning process directly and independently; (4) Presentation learning in small groups; and (5) Guiding students to create products or performances from the concepts they have learned (Maesari et al., 2020). In other words, learning through the problem-based learning model begins with the disclosure of problems found in student life, where problems can be raised by students or lecturers, then students seek and determine methods to solve problems by deepening the knowledge that is known and what needs to be known in solving problems. the problem. Students can choose the problems to be solved so that they are motivated and active in learning (Nurhayati, 2019).

The description of the PBL model is explicitly reflected in the characteristics of the PBL model. Ariyana et al., (2019) described several characteristics, including: (1) The problem material was raised as a central topic from the beginning of learning; (2) The problems used are real (authentic) problems that are presented in an ill-structured manner so that it can lead to an open and multiple-perspective; (3) Problems can stimulate students to conduct investigations both individually and in groups; (4) Group investigations are designed collaboratively and cooperatively and rely on active interaction between members; (5) Utilizing various reference sources for the development of insight on related topics. PBL states that there are five skills needed in the 21st century in building a smart world society, including 1) Literacy of information technology and digital media; 2) Critical thinking; 3) Troubleshooting; 4) Effective communication; 5) Collaboration and network building (Anriani & Fathurrohman, 2019).

**Table 1.** Teacher and student activities in the PBL phase.

| No | Phase               | Teacher Activities  | Student Activities                          |
|----|---------------------|---|---|
| 1  | Problem orientation | Explain the purpose of learning, present problems related to everyday | Listen to the teacher's explanation and get |

| No | Phase  | Teacher Activities   | Student Activities  |
|----|--|--|---|
|    |  | life, and motivate students to be involved in problem-solving activities.  | involved in problem-solving activities  |
| 2  | Organizing students to solve problems            | Guiding/organizing students into groups and giving demonstrations regarding the description of the problem material            | Join in groups and understand the description of the problem explained by the teacher |
| 3  | Guiding individual or group investigations       | Guiding students in conducting experimental designs and guiding in filling out worksheets Conducting observations /experiments | Conduct observations /experiments and fill out the prepared worksheets                |
| 4  | Develop and present the work                     | Reviewing the process and student learning outcomes  | Students review learning outcomes   |
| 5  | Analyze and evaluate the problem-solving process | Analyzing the learning process and evaluating student learning outcomes  | Students reflect on the understanding of learning outcomes                            |

According to Eka (2019), the PBL model has the following advantages: (1) Problem-solving in PBL is good enough to understand the content of the lesson; (2) Problem-solving takes place during the learning process to challenge students' abilities and provide satisfaction to students; (3) PBL can improve learning activities; (4) Helping the transfer process of students to understand problems in everyday life; (5) Helping students develop their knowledge and helping students to take responsibility for their learning; (6) Helping students to understand the nature of learning as a way of thinking, not just understanding learning by teachers based on textbooks; (7) PBL creates a learning environment that is fun and enjoyable for students; (8) Enables real-world applications; (9) Stimulate students to learn continuously (Eka, 2019; Dwikoranto, 2022).

The disadvantages of the PBL model are as follows: 1) If students experience failure or lack confidence with low interest, students are reluctant to try again. 2) PBL requires sufficient time for preparation. 3) Lack of understanding about why the problems are solved, the students are less motivated to learn. The PBL model is one of the effective approaches for learning higher-order thinking processes (Nurdyansyah & Fahyuni, 2016). The PBL model is an innovative learning model that provides active learning conditions for students to construct the concepts they learn and develop their abilities by applying scientific methods in solving problems and developing critical thinking (Fadilla et al., 2021).

Critical thinking has the meaning of reflecting on problems more deeply, always keeping the mind open to different approaches and points of view, not immediately believing in information obtained from several sources in the form of writing or verbally (Dakabesi, 2019), and thinking reflectively. rather than just accepting ideas without having significant understanding and evaluation (Hidayati et al., 2019). Critical thinking is a disciplined and conscious way of thinking (Maqbullah et al., 2018). Lieung (2019) states that critical thinking is a process of identifying and finding out from several assumptions, having doubts about the opinions or statements of others, trying to find alternatives and new ideas, and giving clear reasons for arguing. Critical

thinking includes problem-solving, formulating conclusions, calculating possibilities, and making decisions. Based on the above definition of critical thinking, it can be concluded that critical thinking is a process of identification of several assumptions that combine previous knowledge to obtain relevant knowledge to reflectively generalize mathematical situations which include problem-solving, formulating conclusions, calculating possibilities, and making decisions.

Thinking skills need to be trained from an early age to deal with advances and technological developments in the 21st century. Students need the skills needed in the 21st-century era called Higher Order Thinking Skills, especially critical thinking skills. Critical thinking is the ability to analyze and evaluate information obtained from observations, experience, reasoning, and communication to decide whether the information can be trusted so that it can provide the right conclusions (Purwati et al., 2016). Critical thinking skills are important for students to be more skilled in compiling an argument, checking the credibility of information sources, or making decisions.

Ennis in (Crismasanti & Yunianta, 2017) groups five indicators of critical thinking skills, including: a) Basic support (building basic skills), with indicators focusing on questions and analyzing an argument; b) Elementary clarification (providing a simple explanation), with indicators considering whether the source can be trusted or not and observing and considering the results of observations; c) Advance clarification (making further explanations), with indicators making deductions and considering the results of deductions, making inductions and considering the results of inductions, and making and considering decision values; d) Inference (conclude), with indicators defining terms and considering definitions; e) Strategies and tactics (strategy and tactics), with indicators determining action.

Good critical thinking skills can provide good recommendations for taking an action. Critical thinking skills can help students analyze information obtained from teachers so that students can analyze and conclude the information received (Gunawan & Liliasari, 2017) it can be concluded that critical thinking skills are a way of thinking to explore the truth of a concept by questioning things. Matters relating to information obtained in detail, so that the truth can be found in the objectively obtained information. The critical thinking skills possessed by students will facilitate the process of analyzing until the final stage, namely providing solutions, while the thinking indicators used are interpretation, analysis, evaluation, inference, and explanation (Effendi, 2019).

Several studies related to the problem-based learning model include (1) Cahyaningsih, F., & Roektingroem, (2018) which says that the STEM-integrated PBL model can improve critical thinking skills and student cognitive learning outcomes; (2) There is an increase in students' critical thinking skills in Physics subjects with a moderate improvement category after going through Physics learning activities with the Multirepresentation-based Problem Based Learning (PBL) learning model. (3) Farisi et al. (2017) which shows that the use of the Problem Based Learning learning model with Temperature and Heat material influences students' critical thinking skills; (4) Nurhayati et al. (2019) where there is an interaction between the implementation of the PBL model on students' critical thinking skills in solving HOTS-based Physics questions. (5) Eka (2019) which states that there is an effect of the application of the PBL model on the understanding of concepts and critical thinking of high school students. (6) Saputri (2020) states that Problem Based Learning can develop students' critical thinking skills in finding and solving problems related to everyday life.

Table 2 in the appendix can be seen that many previous researchers have conducted research related to the Problem Based Learning model. Based on Table 2, the application, implementation, and influence of the problem-based learning model can improve the critical thinking skills of high school students on physics material. This is because the problem-based learning model can organize and encourage students to learn and collect information related to the problems that exist directly. This is in line with the results of previous researchers who have conducted research related to the concept of problem-based learning models, implementation of problem-based learning models to improve students' critical thinking skills, the effectiveness of Problem Based Learning learning models to improve students' critical thinking skills and the effect of problem-based learning models to improve students' critical thinking skills. students' critical thinking skills. Problem-based learning provides a major role for students to be able to investigate problems in finding solutions to given problems, this means educators provide space for students to criticize the extent to which problems can be overcome and solutions (Diani, 2018). Problem-based learning models can be implemented starting from elementary schools to universities in improving students' critical thinking skills, but topics must be chosen according to the characteristics of the material and students. The limitations are in terms of a longer learning time and careful preparation of the teacher who will teach.

## CONCLUSION

Based on the research that has been done, it can be concluded that the problem-based learning model is a problem-based learning model directly so that students are active in learning in class. The implementation of the problem-based learning model can train students to overcome various problems directly so that they can improve the critical thinking skills of high school students on physics material. The application of the problem-based learning model is very effective when applied in the student learning process in the classroom because it can improve the critical thinking skills of high school students on physics material. The application of the problem-based learning model affects improving the critical thinking skills of high school students on physics material.

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## Appendix

**Table 2.** Literature review article.

| Author                   | Research Purposes  | Interesting Finding   |
|--------------------------|--|---|
| Meilasari et al., (2020) | The purpose of this study was to analyze the application of the Problem Based Learning (PBL) model in learning in schools.   | 1. PBL is found in the field of science which is often applied in schools with a percentage of 77% and the field of mathematics at 31%; 2. The application of PBL has a positive effect on students; 3. The impact of PBL on learning can increase interest in learning, problem-solving abilities, learning motivation, critical thinking, and student learning outcomes. In conclusion, the PBL learning model based on the results of a literature review has a positive impact on improving students' learning abilities and interests. |
| Arifah et al., (2021)    | The purpose of this study was to analyze the relationship between problem-based learning (PBL) learning models and students' critical thinking skills in physics learning  | There is a significant relationship between the PBL model and students' critical thinking skills in learning physics. From this relationship, the PBL model has a significant influence on students' critical thinking skills in learning physics.  |
| Bintang et al., (2020)   | The purpose of this study was to analyze the difference in the percentage of conceptual, procedural, and metacognitive knowledge between the class that received the integration treatment of the flipped classroom and PBL models with the control class on the Straight Motion material. | In integrating flipped classrooms and PBL students have better conceptual, procedural, and metacognitive knowledge skills than in the control class that was not given treatment. Because students experience independent learning, mentoring, and deepening with contextual and challenging problem-based ones, which result in an authentic learning experience. PBL states that there are five skills needed in the 21st century to build a smart world society.   |
| Misbah et al., (2018)    | The purpose of this research is to analyze critical thinking skills.   | One of the objectives of learning physics is to apply what is learned in everyday life, so students need to be trained to think critically to apply physics concepts in dealing with problems in life.  |
| Rahmat et al., (2019)    | The purpose of this study was to identify the improvement of students' student's critical thinking skills of harmonic vibration problems through learning with a multi-representation-based Problem Based Learning learning model.   | There is an increase in students' critical thinking skills in Physics subjects with a moderate improvement category after going through Physics learning activities with the Multirepresentation-based PBL model.   |
| Eka et al., (2019)       | The purpose of this study was to determine the effectiveness of the problem-based learning (PBL) model in understanding concepts and critical thinking of high school students on the material of temperature and heat.  | The effect of applying the problem-based learning model on students' conceptual understanding and critical thinking. The effectiveness of using the PBL model is more effective in improving students' conceptual understanding and critical thinking. So it can be concluded that there is an effect of the application of the PBL model on the understanding of concepts and critical thinking of high school students.   |

| Author                    | Research Purposes  | Interesting Finding   |
|---------------------------|--|---|
| Al- Fikry et al., (2018)  | The purpose of this study was to determine the effect of the Problem Based Learning (PBL) model on students' critical thinking skills (KBK) on heat material.  | There is an effect of the PBL model on students' KBK on the heated material. These results can be seen from the increase in students' post-test results after the implementation of the PBL model, the pretest (44.32%) post-test (92.32%), and the N-gain (86.59%). This value shows that the PBL model is quite effective in improving student learning KBK on heat material. The use of online PBL mode can improve students' critical thinking skills in high school. |
| Sastaviana et al., (2022) | The purpose of this study is to improve critical thinking skills and mastery of the concept of elasticity through the application of PBL in online learning  | The use of online PBL mode can improve the mastery of concepts in elasticity material in high school. The application of online mode PBL using google classroom and WhatsApp groups is effective to improve critical thinking skills and mastery of the concept of elasticity in high school.   |
| Rohmah et al., (2021)     | The purpose of this study was to determine the improvement of critical thinking in students by using the application of STEM-based problem-based learning and to determine student responses to STEM-based Problem Based Learning. | Students' critical thinking skills have increased after treatment in the form of learning using STEM-based problem-based learning. This has been proven by calculating the pretest and posttest values using the n-gain test. Student responses related to the STEM-based problem-based learning model resulted in a positive response. So it can be said that learning with STEM-based problem-based learning models can be accepted and liked by students.              |
| Saputri, M. A. (2020)     | Improving Students' Critical Thinking Ability through the Application of Problem-Based Learning Models   | Application of Problem Based Learning Learning Model can Improve Students' Critical Thinking Ability.   |
| Fadilla et al., (2021)    | Investigating the effect of problem-based learning on students' critical thinking skills   | There is a positive effect from the application of problem-based learning on students' critical thinking skills   |
| Effendi et al., (2019)    | Mendeskripsikan pengaruh PBL dan PjBL terhadap hasil belajar siswa   | Terdapat efek positif Penerapan Model Problem Based Learning dan Model Project Based Learning terhadap Hasil Belajar Siswa.   |
| Ejin, S. (2016).          | Pengaruh Model Problem Based Learning (PBL Terhadap Pemahaman Konsep dan Keterampilan Berpikir Kritis.   | Temuannya: Pemahaman konsep dan keterampilan berfikir kritis Siswa pada Mata Pelajaran Ilmu Pengetahuan Alam dipengaruhi oleh model PBL.  |
| Mundilarto, H. I. (2017). | Investigate Effect of Problem-Based Learning on Improvement Physics Achievement and Critical Thinking  | There is Effect of Problem-Based Learning on Improvement Physics Achievement and Critical Thinking of Senior High School Students.  |