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Profile of Problem Based Learning to Improve Students' Critical Thinking Skills

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ABSTRACT

This article was created to identify the effect of the Problem Based Learning model in improving students' critical thinking. The data collection method is in the form of a literature study. This article explains that problem-based learning is a learning model that focuses on students' solving problems in physics concepts. Critical thinking is the student's ability to analyze and evaluate the information received to conclude appropriately. The results of the literature study showed an increase in students' critical thinking skills in the learning process with the Problem Based Learning (PBL) learning model. The application of Problem Based Learning has an average increase of about 50% after the learning pattern is applied. The existence of the PBL learning model is effectively used to improve students' critical thinking, which incidentally in solving physics concepts requires the ability to analyze and evaluate to conclude.

INTRODUCTION

Physics is a science that studies natural phenomena and their interactions to instill interest in being able to think critically about concepts related to everyday life. Many students believe that physics is a complex subject to understand because they learn a lot about mathematical equations so that physics is identified with numbers and formulas. Learning that only receives material from the teacher causes students to be passive (Aisyah et al., 2013). Pelawi & Sinulingga (2016) stated that students tend to memorize understanding, formulas, and lack a learning approach related to natural phenomena, and accept whatever is explained by the teacher without knowing the meaning of the lesson.

Based on observations in several schools in Sumenep in September 2021, it was found that students' critical thinking skills in solving physics problems were still low. The low critical thinking ability is shown by the number of students who make mistakes in applying the basic concepts of physics and how to work on the problems given. This results in students working on the problem without solving steps and focusing on the final answer. As a result, students' reasoning abilities cannot develop optimally. The ability to reason cannot be separated from the ability to think critically. On the other hand, critical thinking is critical because students can choose the best choice carefully and behave according to logic (Novtiar & Aripin, 2017). Sunaryo and Fatimah (2019), in their research, confirm that there are five indicators of critical thinking skills, namely reasoning, inference, situation, clarity, and Overview. While Wuningsih (2019), namely analysis, formulating, strategies and conclusions.

The results of observations also show that in learning activities in the classroom, teachers still use conventional teaching methods and have not applied varied

In line with Mahmuzah (2015) opinion, one of the factors that can make students' critical thinking skills low is conventional learning, where teachers are more active in the classroom, so students become less active. approaches. The learning activities are monotonous, and the teacher is more dominant in the class while students just sit and listen to the explanations given so that students are not directly involved in learning and ultimately cause boredom and not interest in being active in learning.

Critical thinking skills can be developed by integrating problem-based learning (PBL) models in learning. The PBL model is one of several other approaches that can generate CBC students in situations that tend to real-world problems, including learning and how learning takes place (Rusman, 2010). In addition, the average level of critical thinking of students with PBL is in the "developing" category, meaning that this model helps support students' critical thinking because it can change students from passive recipients of information to become active, independent, and problem solvers (Furlog et al., 2003). The development of critical thinking is often cited as the fundamental reason for formal education because the model is significant for success in education where new levels of knowledge are created quickly (Marin & Diane, 2011). Susilo (2012); Nurlaila et al. (2013) concluded that there was an increase in critical thinking shown by the post-test results of students. The improvement of critical thinking is more successful when combined with the PBL model than the direct learning model (Redhana, 2012).

RESEARCH METHOD

General Background

Based on the results of observational learning, using a problem-based learning (PBL) approach is very effective and improves critical thinking in students and students. So that the PBL approach is a solution for teachers to enhance critical thinking and solve problems around us.

Instrument and Procedures

In completing this research, a qualitative research strategy was used, namely the data collected in relevant scientific works and supporting articles. According to Sugiyono (2013), the definition of qualitative research is research that is used to examine the condition of natural objects. The natural object in question is an object that is as it is and is not manipulated by the researcher. So that while conducting a literature review on the profile of the development of the PBL approach to improve critical thinking from 2021-2021*, the researchers did not change or manipulate existing data or information.

The method of data collection in this research is the literature study method (literature study). Data collection using the literature study method is carried out by studying topics related to the research and collecting or collecting data from various reliable literature that has existed before. The researcher collects and collects data from research that is relevant to the research being studied and from various articles that support this research problem, namely about the profile of the development of the PBL approach to improve critical thinking from 2021-2021*. Using this literature study method is to obtain new knowledge that can then be accepted and studied more deeply.

This research was conducted based on a literature study, where to obtain data, the authors analyzed the sources and data that had been collected previously and relied on existing concepts or theories to get answers to the problems discussed in the study.

Data Analysis

After the data is collected, the next step is to analyze the data. The data analysis was carried out to obtain valid data for research materials. In this case, the researcher uses two thinking methods, namely the inductive method and the deductive method. The inductive method is a method of thinking that concludes specific factors, which are then generalized. This method is used to complete various information. At the same time, the deductive method is a method of thinking that draws general conclusions to be specific. It used to describe the interpretation of the profile of the development of the PBL approach to improving critical thinking by using a literature review from 2012 to 2021.

RESULTS AND DISCUSSION

Results

Learning Problem Based Learning is a learning model based on problems. This learning involves the activeness of students to solve problems that are faced scientifically (Fatma and Budhi, 2018). The problem-based learning model is a learning model that requires students to play an active role so that it is excellent to apply; it aims to provide experience to students on a real problem with material that is following the lesson being studied (Sepriyani et al., 2018). This model will provide background for students to learn continuously in dealing with a given problem and solving new problems with their own experience.

Critical thinking is reflective and productive thinking that involves an active disciplined thought process and involves conceptualizing, applying, analyzing, synthesizing, and evaluating information collected through observation, experience, reflection, and reasoning as a result of beliefs and actions. Critical thinking is also a process to encourage students to think critically is not easy because students are used to doing teacher-centered learning. To overcome this, teachers can give students assignments that require students to focus on issues, questions, and problems and not just ask students to repeat facts

Table 1. Literature review of problem-based learning (PBL) approaches to improve critical thinking from 2012-2021*.

Authors and journal type	Article title	Method	Findings
Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
Journal of Character Education (Ardyanto et al., 2018)	Media-Based Problem Based Learning (PBL) Model Interactive To Improve Thinking	The research to be carried out is Classroom Action Research (Classroom Action Research). Classroom action research	There was an increase in students' critical thinking skills by applying the PBL learning model. In the first cycle, students' fundamental level of thinking skills was 2.71 in the good category. In the second cycle, there

Authors and journal type	Article title	Method	Findings
Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
	Skills Critical and Learning Outcomes on the Sub-theme of the Place Environment I live in 4th grade	includes research that reflective	was an increase to 2.98
Proceedings of the National Seminar (Rosy and Pahlevi, 2015)	Application of problem-based learning to improve critical thinking skills and problem-solving skills	This research uses the type of classroom action research (Classroom Action). The subjects in this study were students of the Education Study Program Office Administration Department of Economics Education Faculty of Economics UNESA class of 2012 class A totaling 32 students.	Critical thinking ability increased by 2.87% with details in the first cycle, essential skills of thinking increased by 79.42%, and in the second cycle, critical thinking skills increased by 82.29%
Journal of Education (Theory and Practice) (Satwika et al., 2018)	Application of Problem Based Learning Model To Improve Students' Critical Thinking Ability	The research approach used by researchers is Classroom Action Research (CAR). Study Classroom action is a systematic study of efforts improvement of the implementation of educational practice by teachers in carrying out actions in learning, based on their reflection on the results of these actions.	Students' thinking ability increased after the actions were taken in cycle I and continued in cycle II. The increase that occurred was students who were categorized as "very critical" there were 29% of students who initially did not find students in the "very critical" category. An increase also occurred in students categorized as "critical" there were 58% of students who initially did not find any students who could be classified in the "critical" category. Before being given action, only 66.6% of students could be classified as "critical enough" and 33.30% of students entered the "not critical" category.
Indonesian Science Education Journal (Fakhriyah, 2014)	Application of problem-based learning to develop students' critical thinking skills.	This research is included in the research qualitative descriptive, because the data obtained more concerned with the process than the result. The research was conducted in September – October 2013. The subjects of this study is a student in the fifth semester of the study	Problems and challenges in real life today need to be solved appropriately. One of the abilities that students really need to have in dealing with problems and challenges is the ability to think critically. Therefore, students must have the ability to think critically and improve it for future needs. Learning that uses a learning model or PBL learning strategy, students' critical thinking skills can be developed by applying the PBL learning model.

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
		program PGSD FKIP UMK registered in the eye Science Learning course	
Journal of Education: Theory, Research, and Development (Ningsih et al., 2017)	Application of Problem Based Learning to Improve Critical Thinking Ability and Learning Outcomes of Class III Students	This study used a classroom action research design consisting of three cycles, each cycle consisting of: two meetings, each meeting held for 5 × 35 minutes. The research subjects were third-grade students of SDI Klojen Kidul Malang City in the even semester of the 2017/2018 academic year, totaling 21 students consisting of 8 male students and 13 students female student	In the first cycle, there was an increase in critical thinking skills of 63.49%. Followed by giving action in cycle II, in cycle II there was an increase in critical thinking ability to be 76.98% and in cycle III given measure again, in cycle III after being given the effort by providing PBL learning essential skills of thinking increased again to 84.12%
Proceedings of the National Seminar on Office Administration (Rizkianto, 2018).	Application of Problem Based Learning to Improve Students' critical thinking and creative thinking skills	The method used in The writing of this paper is a literature review. Literature review itself is a research-based on review – a review of the results of previous studies, data, and theoretical books that relevant to the written word made	The solution to improve students' critical thinking skills to face problems in real life is applying the Problem Based Learning learning model. Students must be equipped with high necessary thinking skills. It is an effort to train students in dealing with problems and challenges that will be faced in real life later
Indonesian Journal of Physics Education (Setyorini et al., 2011)	Application of problem-based learning model to improve critical thinking skills of junior high school students	This study uses a True. design Experimental Design. Sampling by simple random sampling. Class VIID is the class experimental class, and class VIIE is the control class.	The application of the PBL learning model is a solution to help improve students' critical thinking skills in GLBB material. After applying PBL in GLBB material, there was an increase in critical thinking skills by 75% of students who could be categorized as having necessary thinking skills and students who could be classified as having very critical thinking skills of 7.5% of students.
Proceedings of the National Seminar on Economics & Business Education (Sari et	I am applying the problem-based learning (PBL) model to improve critical thinking skills and	This research is included in classroom action research (CAR). Subject in this classroom, action	That before the action was taken, the student's critical thinking skills were 27.1%. After acting in the first cycle, there was an increase of 70.1%. Followed by giving action to students

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
al., 2015)	learning outcomes of class X IIS 1 students on economics at SMA Negeri 3 Surakarta in the 2014/2015 academic year.	research is students of class X IIS 1 SMA Negeri 3 Surakarta even semester of the academic year 2014/2015	in the second cycle. In the second cycle, there was an increase of 82.52%. In this description, it can be concluded that students' critical thinking skills can be improved by applying the PBL learning model to learning.
Journal of Education Partners (JMP Online) (Nurochim, 2018)	Differences in the Application of Problem Based Learning and Discovery Learning in terms of the Mathematics Learning Outcomes of Class VIII SMP N 8 Salatiga	This study compares students' mathematics learning outcomes given the application of the PBL learning model and the DL learning model. all students of class VIII SMP Negeri 8 Salatiga. At the same time, the sample group used was class VIII E (24 students) as the experimental class, which was given treatment with the PBL model, and class VIII D (25 students) as the comparison class, which was given treatment with the DL model. The research used is The Randomized Control Group Pretest-Posttest Design	The results in the first cycle, after being given action, the ability of students to think critically can be categorized as high by 31.21%, students who can be classified as a medium by 31.25%, and students who are categorized as having low critical thinking skills by 37.5%. In the second cycle of indicator 1, indicator 2, and indicator 3 in students' essential skills of thinking, there was an increase. The indicator from moderately critical increases to critical and critical increases to very critical, and critical additions to very critical. So that in the second cycle, after being given the action of students who have critical thinking skills in the high category of 68.75%, students who have critical thinking skills in the medium category are 25% and for students with low critical thinking skills category of 6.25%
Tambusai Education Journal (Saputro et al., 2019)	Improving critical thinking skills and mathematics learning outcomes using the PBL model for class V students	This research is a Classroom Action Research (CAR) conducted at SD Negeri Kecandran 01. The complete address of SD Negeri Kecandran 01 is on Jl. Kyai Nurwahid Karangpadang, Kecandran village, district. Sidomukti, Salatiga city. The research was conducted from October 2018 to February 2019. The research subjects were fifth-grade students of SD Negeri Kecandran 01, totaling 36 children with a distribution of 21 boys and 15 girls.	That there was an increase in critical thinking skills after taking action in the first cycle, the increase that occurred was that 5 (13.89%) students experienced an increase in critical thinking skills. While in the second cycle, after being given the action, there were 8 (22.22%). From these results, students experienced an increase in critical thinking skills after the PBL learning model was applied; besides that, learning outcomes also improved after the PBL learning model was used.

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
Journal of Educational Research and Learning (Purnaningsih et al., 2019)	Efforts to improve critical thinking skills and thematic learning outcomes through problem based learning (PBL) models for class v elementary school.	The research method carried out includes the type of classroom action research (CAR). The subjects of this study were students of class V in the second semester at SD Negeri Tegalrejo 01 Salatiga City with a total of 28 students consisting of 13 male students and 15 female students.	That after the implementation of PBL, in the first cycle the average critical thinking ability is 58.57% and after an action has been carried out in the second cycle the critical thinking ability increases so that it becomes 76.19%
Journal of Education, History and Social Sciences (Maulida et al., 2020)	Application of Problem Based Learning Model to Improve Critical Thinking Ability and Cooperation Attitude in Elementary Schools	This research is a classroom action research conducted at SD Negeri 3 Karangnanas is located in Karangnanas Village, Sokaraja District, Banyumas Regency. The subjects of this study were fourth grade students of SDN 3 Karangnanas for the 2018/2019 academic year. There are 27 fourth grade students consisting of 9 male students and 18 female students.	In the first cycle, the students' critical thinking ability with fairly good criteria obtained an average score of 3.0 and while in the second cycle there was an increase in critical thinking skills in the good category, which the students achieved an average of 3.6.
Tambusai Education Journal (Zuriati and Astimar, 2020)	Improving Learning Outcomes in Integrated Thematic Learning Using Problem Based Learning Models in Grade IV Elementary School (Literature Study)	The type of research used is library research. process without requiring direct research (field research). The population in this literature study is 30 journals, so the sample taken as many as 25 journals. The method used in this research is the method documentation.	Real or realistic problems require critical thinking skills to solve them, in training critical thinking skills can be trained by applying the PBL learning model. Critical thinking skills, interactions and other cognitive processes are quality improvements in the learning process through the PBL learning model
Scientific Journal of Educational Technology (Rahayu et al., 2017)	Application of problem based learning (PBL) model to improve critical thinking skills and student achievement.	The research method used is classroom action research (CAR). The subjects in this research are students class XB SMK IT SI, where is the student	In the first cycle, the critical thinking ability was categorized as less with a value of 1.96. Furthermore, given the action in the second cycle, the students' critical thinking skills have increased which can be categorized as

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
		in even semesters, they get material for repairing and resetting PCs.	sufficient with a value of 2.61. While in cycle III, after being given the action there was a drastic increase again so that it could be categorized as good critical thinking skills possessed by students with a value of 3.36
Universal Journal of Educational Research (Risdianto et al., 2020)	The Effect of Ethno Science-Based Direct Instruction Learning Model in Physics Learning on Students' Critical Thinking Skill.	The research that will be conducted is a quasi-experimental design in which there is no group taken randomly. The population in this research is all classes of XI Natural Science at State High School 3 of Bengkulu City.	That in order to improve the critical thinking skills that students have, they can use the Ethno Science-based Direct Implementation learning model to improve it. In accordance with the research conducted, the results of the pre-test (13.87%) were obtained, after being given the action, namely the implementation of the Ethno Science-based Direct implementation learning model, the post-test results were (69.96%) because the learning model connected learning in the classroom. and what students experience in their daily life for example as dol music. Therefore, it motivates students to actively participate in the learning process
Journal of Baltic Science Education (Mundilarto and Helmiyanto, 2017)	Effect Of Problem-Based Learning On Improvement Physics Achievement And Critical Thinking Of Senior High School Student	The research was quantitative in approach and used a quasi-experimental research design. The population of the research consisted of seven classes or 224 students of Grade X in Semester 2 at a senior high school in the 2015/1016 academic year. By means of purposive sampling, two classes, namely, Classes X4 and X7, were selected as participants. Class X4, which consisted of 32 students served as experimental group and Class X7, which consisted of 32 students, served as control group.	The first cycle has a pre-test score (11.22%), while the post-test score is (53.23%). In the second cycle has a pre-test value (9.71%), while the post-test value is (73.01%). This is because the application of the PBL model in learning has a positive effect on student achievement and critical thinking skills. In addition, it was found that the average score for student achievement
Journal of Baltic	The Comparison Of	This research was	That before learning with the OR-IPA

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
Science Education (Jatmiko et al., 2018)	OR-IPA Teaching Model And Problem Based Learning Model Effectiveness To Improve Critical Thinking Skills Of Pre-Service Physics Teachers	conducted at State University of Surabaya in June - December 2017. The scope of this research is the first-year students who took Basic Physics course in academic year 2017/2018. The research was conducted to 94 students of Physics Education Study Program, Unesa, Indonesia, which came from a population of 123 students in three groups (experimental group-1 / OR-IPA Model, experimental group-2 / PBL Model, and control group / Conventional Model).	Model, all students had low critical thinking skills. After the application of the OR-IPA Model, all students experienced an increase in critical thinking skills. In general, the critical thinking skills of pre-service physics teachers in the post-test are: in the high category 2.27 from the range 1 - 4 while the pre-test scores are in the low category, while after the implementation of learning with the OR-IPA Model, all critical skill indicators think kal has increased
Journal of Physics: Conference Series (Fadilla et al., 2020)	Effect of problem-based learning on critical thinking skills	This research was a research study literature examining related journal application of problem-based learning to improve critical thinking skills. This research was conducted by combining several journals to get comprehensive results. The steps taken include library data, reading, and comparing literature to be processed and produced.	That the implementation of PBL can help students motivate and provide learning experiences and is very useful in improving students' critical thinking skills, provided that teachers and students can apply each stage of PBL properly
IOP Conf. Series: Journal of Physics: Conf. Series (Zain and Jumadi, 2015)	Effectiveness Of Guided Inquiry Based On Blended Learning In Physics Instruction To Improve Critical Thinking Skills Of The Senior High School Student	This research was conducted in SMA Negeri 1 Bolo, Kabupaten Bima, West Nusa Tenggara. The time of the study was conducted in the second semester of the academic year 2017/2018. The population in this research is the	The results with the guided inquiry approach to improve students' critical thinking are in accordance with this study, where the pre-test average value is 50 and the post-test average value is 77. It is concluded that learning physics using a guided inquiry model based on blended learning is more effective to improve students' critical thinking skills

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Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling students of class XI IPA which amounts to 70 people divided into 2 classes.	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
Journal of Physics: Conference Series (Bonafide et al., 2020)	Problem-Based Learning Model On Students' Critical-Thinking Skills: A Meta-Analysis Study	This study employed the meta-analysis research with quantitative-descriptive methods. The electronic search found a total of one hundred and twenty-two articles in the Google Scholar, Scopus and ERIC databases searched using the keyword "Problem-based Learning model and students' critical-thinking skills" because the researcher focused this research on analyzing the effect Problem-based Learning model (PBL) on students' critical-thinking skills.	The results using the PBL approach to improve students' critical thinking, this is in accordance with this study, where the results of the average pre-t-test score (31.56%) and the post-test average value (66.67%) . So it can be concluded that using the PBL approach can improve students' critical thinking
Journal of Physics: Conference Series (Ranggi et al., 2020)	Meta-Analysis of The Effectiveness of Problem-Based Learning Towards Critical Thinking Skills in Science Learning	This meta-analysis research method consists of some steps, they are problem formulation, data collection (study), data coding, and data analysis and interpretation.	That the application of Problem Based Learning can improve students' critical thinking skills by 99.9%. Problem Based Learning is used as a learning model used in high schools and colleges has been effective and has an effect on increasing critical thinking skills
Journal of Physics: Conference Series (Styawan and Arty, 2020).	Inquiry-Based Learning And Problem-Based Learning : Which One Has Better Effect On Students Critical Thinking Skills Profile Of Thermochemistry?.	The design of this study uses a quantitative descriptive approach. There are 2 experimental classes used, the first-class applies the inquiry-based learning model and the second class applies the problem-based learning model. The research sample came from two science classes in West Bangka Regency, which were determined by a random sampling technique. The total	That the IBL and PBL approaches can help improve students' critical thinking, this is in accordance with the results of the study, where the IBL approach with an average value (81.1% and 67.3%) while the PBL approach with an average value (60, 4% and 59.4%). So it can be concluded that both approaches can improve students' critical thinking

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Journal of Physics: Conference Series (Mastyaningrum et al., 2020)	The Impact Of Problem Based Learning Model Through E-Learning On Students' Critical Thinking Ability	The method used in this research was qualitative with case-study approach. The study was implemented on 36 students of 8th grade Junior high School in Banyumas, Central Java. Data collection was conducted using observation, critical thinking ability written tests, and interview.	The results of using teaching materials with different scopes with a longer implementation time to obtain a more complete picture of students' critical thinking skills that have been taught with problem-based learning models, and increase students' thinking skills
iJIM (Wahyuni, 2020)	Edmodo-Based Interactive Teaching Materials as an Alternative Media for Science Learning to Improve Critical Thinking Skills of Junior High School Students	This study is development research with ADDIE (Analyze, Design, Development, Implementation, and Evaluation) model. The population of this study is all grade VII students at public junior high school 3 Jember. Sampling was carried out by cluster random sampling technique so that one grade VIIB was selected as a model testing group of 28 students.	The results using Edmodo-based teaching materials can help improve students' critical thinking, this is following this study where students' critical thinking skills are statistically significant at = 5%, with an average n-gain of 0.71 on high criteria, and obtain student responses during learning with an average percentage of 83% in very good standards. So that Edmodo-based teaching materials become alternative media for science learning to improve high school students' critical thinking skills
AIP Conference Proceedings (Astra et al., 2019)	Improvement of Students' Critical Thinking Ability through Problem-Based Learning (PBL) Model Class XI MIPA 3 on Temperature and Heat Material.	The research was conducted in SMA Lab school Jakarta, Indonesia. While the subjects in this study were students Three classes consisted of 34 students, 12 male students, and 22 female students. The approach used in this study is Action Research with a qualitative approach. While the type of research is used Classroom Action Research (CAR).	That the percentage of critical thinking in the indicators provides a simple explanation in cycle I, cycle II, and cycle III, there was an increase from 56% at the beginning of the cycle to 88% at the end of the cycle, then for the indicators of building basic skills in the original cycle, 41% to 91% at the end of the cycle, on the contrary an increase of 89% at the end of the cycle. Ability to make further explanations increased from the original 51% to 81%, as well as strategy and tactics increased from 49% to 79%
IOP Conf. Series:	Students' Critical	Participants who were	Overall 15% of students (n = 3) mostly

Authors and journal type	Article title	Method	Findings
Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
Journal of Physics: Conf. Series (Nurjannah et al., 2018)	Thinking Skills Toward Analyzing Argumentation On Heat Conductivity Concept	involved in this research were 20 undergraduate students (4 male and 16 female, whose aged were around 20 years old). They were originated from different towns and enrolled in introductory physics I courses. The research was accompanied in the first semester of the academic year 2017/2018 at the Programme of Physics Education in Universitas Tadulako.	categorized as complete conclusion level. On the other hand, critical thinking skills towards argumentation analysis for 11 students (55%) were categorized as wrong conclusion category and for 6 students (30%) as partial conclusion category.
Journal of Physics: Conference Series (Yusal et al., 2019)	Profile Of Pre-Service Physics Teachers' Critical Thinking Skills Related To Heat Transfer	This research is a descriptive research conducted at Physics Education Study Program in one of the private universities in Jakarta. The research subject was the 1st semester students consisting of 38 students.	Low critical thinking ability reaches 75%, moderate critical thinking reaches 25%, while high critical thinking ability reaches 0%. The low critical thinking ability of students is caused because students are not trained to think critically in learning. Whereas critical thinking can be trained through learning that contains stages that involve students in critical thinking so that students are trained
Cite as: AIP Conference Proceedings (Astra et al., 2021)	The Analysis Of Cognitive Abilities And Critical Thinking Skills With Contextual Approaches On Heat Transfer Concepts For Junior High School Students.	This study aims to analyze the cognitive abilities and critical thinking skills of junior high school students on heat transfer concepts. The research method used is quantitative descriptive. The research subjects were Grade VII students of TB Junior High School, Jakarta in the academic year 2019/2020.	That 50% of students can work on questions on indicators identifying the reasons stated in indicator 1, 37.50% of students can work on indicators of agreement between sources on indicator 2, 18.75% of students can work on questions on indicators concluding explanations, conclusions, and hypotheses on indicator 3, and 12.50% of students can work on problems on indicators of choosing criteria to consider possible solutions in indicator 4. The results of the analysis of critical thinking skills show that students' ability to identify related reasons is in the good category, students' ability to make agreements between sources includes in the low category, students' ability to conclude explanations, conclusions, and

Authors and journal type	Article title	Method	Findings
Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
			hypotheses, are included in the good category
Journal of Physics: Conference Series (Malik et al., 2019)	Optimizing Students Critical Thinking Skills Related To Heat Topics Through The Model Of Content, Context, Connection, Researching, Reasoning, Reflecting (3C3R).	This study used the pre-experimental method with the design of one group pretest-posttest. The selected population is all students of class X SMAN 25 Bandung which consists of six classes, with a simple random sampling technique selected a sample of X MIA 6 with a total of 37 people.	Results on the application of Content, Context, Connection, Model Researching, Reasoning, Reflecting (3C3R) to improve students' thinking skills. The average teacher activity is 98.23% in the excellent category, and the moderate student activity is 88.93% in the excellent category. Thus, the application of the 3R3C model can improve students' higher-order thinking skills and can be applied to other physics topics
IOP Conf. Series: Journal of Physics: Conf. Series (Sya'bandari et al., 2018)	The Validation Of Science Virtual Test To Assess 7th Grade Students' Critical Thinking On Matter And Heat Topic (SVT-MH).	The method used in this research was descriptive research for profiling the validation of science virtual tests to measure students' critical thinking on matter and heat topics. The location of this research is Public Junior High School "X" in Kabupaten Bandung. The school uses Bahasa Indonesia in the teaching-learning process, implements 2013 curriculum, and is supported by multimedia facilities, e.g., personal computers.	The instrument for measuring students' critical thinking on the topic "Material and Heat" in grade 7 SMP shows that all the developed tests are accepted but need revision. The reliability of the test is also acceptable. This means that the test instrument is sufficient to measure students' critical thinking.
Journal of Physics: Conference Series (Aminudin et al., 2019)	Measuring Critical Thinking Skills Of 11th Grade Students On Temperature And Heat	Subjects are students who have received temperature and heat material. Participants in this study were 29 of 11th-grade students, consisting of 10 males and 19 females in the city of Bandung. The research is a single case study with an embedded design that aims to measure the extent to which critical thinking skills	For each indicator value obtained, only the fundamental importance of support is included in the good category. At the same time, the other four indicators include primary clarification, inference, and further clarification in the less class. The average value for the five indicators of critical thinking ability is 31 out of a maximum weight of 100. This value indicates that the critical thinking skills possessed by students are included in the poor category. So that applying learning models that can

Authors and journal type	Article title	Method	Findings
Indonesian Journal of Science Education (Al-Fikry et al., 2018)	The Effect of Problem Based Learning Model on Ability Critical Thinking of Students on Heat Material	The quasi-experimental method with pretest-posttest control group design. This study took place at MAN Rukoh Banda Aceh with a population of all class students X MIA and the samples were students of class X MIA-2 and X MIA-3, which were taken purposively Sampling	To improve the critical thinking skills that students have, they can use the PBL learning model to improve it. Following the research conducted, the results of the pre-test (44.32%) were obtained; after being given action, namely the application of the PBL learning model, the post-test results were (92.32%) with an N-Gain of (86.59%). They have seen that there has been a drastic increase.
		students have on temperature and heat.	improve these skills, and students can maximize their thinking skills, one of which is critical thinking skills

Discussion

Problem Based Learning (PBL) can be concluded that Problem Based Learning is a learning model that exposes students to real-world problems to start learning and is one of the innovative learning models that can provide active learning conditions to students. This model will provide experience for students to learn continuously in dealing with a given problem and solving new problems with their own experience. The characteristics of Problem Based Learning (PBL) are as follows: The learning process focuses on students. This is so that students can construct their own knowledge with their own experiences and The problems given to students are problems related to everyday life so that they are still relevant to students' lives.

The problem-based learning model is one of the models that is widely used to conduct research as research (Ningsih et al., 2017) says that using a problem-based learning model can improve students' critical thinking. This is also done by (Wahyuni et al., 2020) using the help of Edmodo teaching materials with a problem-based learning model, which is also effective in improving students' critical thinking. From the results of the review of articles conducted, it is said that the problem-based learning model is able to improve students' critical thinking.

Like research (Styawan and Arty, 2020) which uses the IBL and PBL approaches to improve student's critical thinking, it turns out that it is able to improve students' critical thinking by using the PBL approach. This is also the research conducted (Malik et al., 2019) articles that focus on the application of Content, Context, Connection, Model Researching, Reasoning, Reflecting (3C3R) to improve students' and teacher's critical thinking. So from the application, it states that there is an increase in critical thinking experienced by teachers and students after the application is carried out.

Based on the literature review, it was stated that the PBL model was able to improve students' and students' critical thinking, although with so that the formation of students' critical thinking skills can be improved by the application of PBL. PBL was very helpful for students in improving critical thinking skills. Critical thinking skills in studying physics are needed in solving existing problems. Many research results reveal that PBL is very influential in improving critical thinking skills. The application of Problem Based Learning (PBL) shows the results of students' critical thinking skills have increased very significantly so that the application of Problem Based Learning (PBL) is the most effective answer or solution to improve critical thinking skills.

The advantages of the PBL model include; Students become accustomed to facing problems and will be challenged to solve new problems and practice a sense of togetherness, intimacy, and cooperation between friends so that they are accustomed to having discussions together in dealing with a problem. Research conducted (Astra et al., 2021) stated that students were able to work on questions on indicators to conclude explanations, conclusions, and hypotheses; this was in accordance with the indicators on critical thinking. Problem Based Learning is emphasized to train students in the ability to analyze a given problem so that students can practice critical thinking skills. This critical thinking ability is needed in the face of an increasingly varied era of problems that must be faced.

The suggestion for the problem-based learning model is to develop a lot of approach models, which are then compared with the problem-based learning model to determine the effectiveness of increasing students' critical thinking, as well as developing teaching materials that are able to improve critical thinking according to students' needs and current needs. This has been proven in research (Wahyuni et al., 2020) using Edmodo teaching materials to improve students' critical thinking.

CONCLUSIONS

Based on the literature review conducted, it can be concluded that the Problem Based Learning model has a positive impact on improving students' critical thinking. The PBL learning model is applied with the aim of providing the experience for students to solve a real problem in the material being studied. So with the Problem Based Learning learning model is expected to be the most effective solution to improve students' critical thinking. Future research needs to implement the PBL to enhance higher-order thinking skills, critical thinking skills, creativity, and problem-solving skills.

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REFERENCES

Aisyah, N., Subiki., & Lesmono, A. D. (2013). Model creative problem solving (cps) disertai metode eksperimen dalam pembelajaran fisika di SMA. *Jurnal Pendidikan Fisika, 2*(2), 196-200.

Al-Fikry, I., Yusrizal, & Syukri, M. (2018). Pengaruh model problem based learning terhadap kemampuan berpikir kritis peserta didik pada materi kalor. *Jurnal Pendidikan Sains Indonesia (Indonesian Journal of Science Education)*, *6*(1), 17-23. https://doi.org/10.24815/jpsi.v6i1.10776

Aminudin, A. H., Rusdiana, D., Samsudin, A., Hasanah, L., & Maknun, J. (2019). Measuring critical thinking skills of 11th grade students on temperature and heat. *Journal of Physics: Conference Series, 1280*(5), 1-11. https://doi.org/10.1088/1742-6596/1280/5/052062

Astra, I. M., Sasmito, R. N., & Wibowo, F. C. (2019). Improvement of students' critical thinking ability through problem-based learning (PBL) model class XI MIPA 3 on temperature and heat material. *AIP Conference Proceedings, 2169*(1), 1-7. https://doi.org/10.1063/1.5132648

Astra, I. M., Henukh, A., & Loupatt, M. (2021). The analysis of cognitive abilities and critical thinking skills with contextual approaches on heat transfer concepts for junior high school students. *AIP Conference Proceedings, 2320*(1), 1-8. https://doi.org/10.1063/5.0037573

Ardyanto, Y., Dewi Koeswati, H., & Giarti, S. (2018). Model problem based learning (PBL) berbasis media interaktif untuk meningkatkan keterampilan berpikir kritis dan hasil belajar pada sub tema lingkungan tempat tinggalku kelas 4 sd. *Pendekar: Jurnal Pendidikan Berkarakter, 1*(1), 189-197. https://doi.org/10.31764/pendekar.v1i1.358

Bonafide, D. Y., Yuberti, Saregar, A., & Fasa, M. I. (2020). Problem-based learning model on students' critical-thinking skills: A meta-analysis study. *Journal of Physics: Conference Series, 1796(*1), 1-8. https://doi.org/10.1088/1742-6596/1796/1/012075

Fadilla, N., Nurlaela, L., Rijanto, T., Ariyanto, S. R., Rahmah, L., & Huda, S. (2021). Effect of problem-based learning on critical thinking skills. *Journal of Physics Conference Series 1810*(1), 1-7. https://doi.org/10.1088/1742-6596/1810/1/012060

Fakhriyah, F. (2014). Penerapan problem based learning dalam upaya mengembangkan kemampuan berpikir kritis mahasiswa. *Jurnal Pendidikan IPA Indonesia, 3*(1), 95-101. https://doi.org/10.15294/jpii.v3i1.2906

Fatma, A. N., & Budhi, W. (2018). Pengaruh model pembelajaran problem based learning terhadap prestasi belajar fisika. *COMPTON: Jurnal Ilmiah Pendidikan Fisika, 5*(1), 23-29. https://doi.org/10.30738/cjipf.v5i1.4141

Furlog, M. J., Whipple, A. D., Jean, S. G., Simental, J., Soliz, A., & Punthuna, S. (2003). Multiple cotexts of school engagement: Moving toward a unifying framework for educational research and practice. *The California School Phychologist, 9*(1), 99-114.

Jatmiko, B., Prahani, B. K., Munasir, Supardi, I.Z.A., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., & Zainuddin, A. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education, 17*(2), 300-319. https://doi.org/10.33225/jbse/18.17.300

Mahmuzah, R. (2015). Peningkatan kemampuan berpikir kritis matematis siswa smp melalui pendekatan problem posing. *Jurnal Peluang, 4*(1), 65-67.

Malik, A., Yuliani, Y., Rochman, C., Zakwandi, R., Ismail, A., & Ubaidillah, M. (2019). optimizing students critical thinking skills related to heat topics through the model of content, context, connection, researching, reasoning, reflecting (3C3R). *Journal of Physics: Conference Series, 1521*(2), 1-7. https://doi.org/10.1088/1742-6596/1521/2/022001

Marin, L. M., & Diane, F. H. (2011). Pedagogy for developing critical thinking in adolescents: Explicit instruction produces greatest gains. *Thingking Skills and Creativity, 6*(1), 1-13.

Mastyaningrum, I. D., Juandi, D., & Jupri, A. (2020). The impact of problem based learning model through e-learning on students' critical thinking ability. *Journal of Physics: Conference Series*, 1806(1), 1-7. https://doi.org/10.1088/1742-6596/1806/1/012085

Maulida, Y. N., Eka, K. I., & Wiarsih, C. (2020). Penerapan model problem based learning untuk meningkatkan kemampuan berpikir kritis dan sikap kerjasama di sekolah dasar. *MUKADIMAH: Jurnal Pendidikan, Sejarah, dan Ilmu-ilmu Sosial, 4*(1), 16–21. https://doi.org/10.30743/mkd.v4i1.1521

Mundilarto, & Ismoyo, H. (2017). Effect of problem-based learning on improvement physics achievement and critical thinking of senior high school student. *Journal of Baltic Science Education, 16*(5), 761-779. https://doi.org/10.33225/jbse/17.16.761

Ranggi, N. L., Yokhebed, Ramli, M., & Yuliani, H. (2020). Meta-analysis of the effectiveness of problem-based learning towards critical thinking skills in science learning. *Journal of Physics: Conference Series, 1842*(1), 1-10. https://doi.org/10.1088/1742-6596/1842/1/012071

Ningsih, P. R., Hidayat, A., & Kusairi, S. (2017). Penerapan problem based learning untuk meningkatkan kemampuan berpikir kritis dan hasil belajar siswa kelas III. *Jurnal Pendidikan: Teori, Penelitian, dan pengembangan, 3*(12), 1587—1593. http://doi.org/10.17977/jptpp.v3i12.11799

Nurjannah, N., Setiawan, A., Rusdiana, D., & Muslim. (2018). Students' critical thinking skills toward analyzing argumentation on heat conductivity concept. *IOP Conf. Series: Journal of Physics: Conf. Series, 1157*(3), 1-7. https://doi.org/10.1088/1742-6596/1157/3/032053

Nurlaila, N., Suparmi, & Widha, S. (2013). Pembelajaran fisika dengan PBL menggunakan problem solving dan problem posing ditinjau dari kreativitas dan keterampilan berpikir kritis siswa. *Jurnal Inkuiri, 2(*2), 114-123.

Nurochim, S. R. (2018). Perbedaan penerapan problem based learning dan discovery learning ditinjau dari hasil belajar matematika siswa kelas VIII smpn 8 Salatiga. *Jurnal Mitra Pendidikan (JMP Online), 2*(3), 143-147.

Novtiar, C., & Aripin, U. (2017). Meningkatkan kemampuan berpikir kritis matematis dan kepercayaan diri siswa smp melalui pendekatan open ended. *Jurnal Prisma Universitas Suryakancana, 6*(2), 120-129. https://doi.org/10.35194/jp.v6i2.122

Pelawi, H. S., & Sinulingga, K. (2016). Pengaruh model PBLd an motivasi belajar terhadap hasil belajar peserta didik di kelas X SMA swasta sinar husni. *Jurnal Pendidikan Fisika, 5*(1), 32-37.

Purnaningsih, W., Relmasira, S. C., & Asri Hardini, A. T. (2019). Upaya peningkatan kemampuan berpikir kritis dan hasil belajar tematik melalui model problem based learning (PBL) kelas V SD. *Jurnal Kajian Penelitian Pendidikan dan Pembelajaran, 3*(2), 367–375. https://doi.org/10.35568/naturalistic.v3i2.406

Rahayu, S., Sapri, J., & Alexon. (2017). Penerapan model problem based learning (PBL) untuk meningkatkan keterampilan berpikir kritis dan prestasi belajar siswa. *DIADIK: Jurnal Ilmiah Teknologi Pendidikan, 7*(2), 98-110.

Redhana, I. W. (2012). Model pembelajaran berbasis masalah dan pertanyaan socratik untuk meningkatkan keterampilan berpikir kritis peserta didik. *Cakrawala Pendidikan, 31*(3), 351-365.

Risdianto, E., Dinissjah, M. J., Nirwana, & Kristiawan, M. (2020). The effect of ethno science-based direct instruction learning model in physics learning on students' critical thinking skill. *Universal Journal of Educational Research, 8*(2), 611-615. https://doi.org/10.13189/ujer.2020.080233

Rizkianto, F., & Murwaningsih, T. (2018). Penerapan problem based learning untuk meningkatkan kemampuan berpikir kritis dan berpikir kreatif siswa. *Prosiding Seminar Nasional Pendidikan Administrasi Perkantoran, 2018*(1), 77-82.

Rosy, B., & Pahlevi, T. (2015). Penerapan problem based learning untuk meningkatkan kemampuan berpikir kritis dan keterampilan memecahkan masalah. *Prosiding Seminar Nasional, 2015*(1), 160-175.

Rusman. (2010). *Model-model pembelajaran*. Bandung: PT. Raja Grafindo Persada.

Saputro, B., Sulasmono, B. S., & Widyanti, E. (2019). Peningkatan kemampuan berpikir kritis dan hasil belajar matematika menggunakan model PBL pada siswa kelas V. *Jurnal Pendidikan Tambusai, 3*(1), 621-631.

Sari, D. T., Kristiani, & Wardani, D. K. (2015). Penerapan model problem based learning (PBL) untuk meningkatkan kemampuan berpikir kritis dan hasil belajar siswa kelas X IIS 1 pada materi ekonomi di sma negeri 3 Surakarta tahun pelajaran 2014/2015. *Prosiding Semiar Nasional Pendidikan Ekonomi & Bisnis, 1*(1), 1-15. https://doi.org/10.20961/bise.v1i1.19918

Satwika, Y. W., Laksmiwati, H., & Khoirunnisa, R. N. (2018). Penerapan model problem based learning untuk meningkatkan kemampuan berfikir kritis mahasiswa. *Jurnal Pendidikan (Teori dan Praktik), 3*(1), 7-12. https://doi.org/10.26740/jp.v3n1.p7-12

Sepriyani, S., Asyhar, R., & Asrial, A. (2018). Pengaruh model pembelajaran problem based learning dan gaya kognitif terhadap hasil belajar IPA siswa di kelas VII MTSN 2 Tanjung Jabung Timur. *Edu-Sains: Jurnal Pendidikan Matematika dan Ilmu Pengetahuan Alam, 7*(1), 1–7.

Setyorini, U., Sukiswo, S. E., & Subali, B. (2011). Penerapan model problem based learning untuk meningkatkan kemampuan berpikir kritis siswa smp. *Jurnal Pendidikan Fisika Indonesia, 7*(1), 52-56.

Styawan, A & Arty, I. S. (2020). Inquiry-based learning and problem-based learning: Which one has better effect on students critical thinking skills profile of thermochemistry?. *Journal of Physics: Conference Series, 1806*(1), 1-7. https://doi.org/10.1088/1742-6596/1806/1/012177

Sugiyono. (2013). *Metode penelitian pendidikan pendekatan kuantitatif, kualitatif, dan R&D*. Bandung: Alfabeta.

Sunaryo, Y., & Fatimah, A. T. (2019). Pendekatan kontekstual dengan scaffolding untuk meningkatkan kemampuan berpikir kritis matematis. *Jurnal Nasional Pendidikan Matematika, 3*(1), 67-79.

Susilo, A. B. (2012). Pengembangan model pembelajaran IPA berbasis masalah untuk meningkatkan motivasi belajar dan berpikir kritis siswa SMP. *Jurnal Pendidikan Dasar, 1(*1), 57-63.

Sya'bandari, Y., Firman, H., & Rusyati, L. (2018). The validation of science virtual test to assess 7th grade students' critical thinking on matter and heat topic (SVT-MH). *IOP Conf. Series: Journal of Physics: Conf. Series, 1013*(1), 1-8. https://doi.org/10.1088/1742-6596/1013/1/012067

Wahyuni, S., Erman, Sudikan, S., & Jatmiko, B. (2020). Edmodo-based interactive teaching materials as an alternative media for science learning to improve critical thinking skills of junior high school students. *iJIM, 14*(9), 166-181. https://doi.org/10.3991/ijim.v14i09.13041

Wuningsih. (2019). Efektivitas pendekatan problem posing dan kontekstual ditinjau dari kemampuan berpikir kritis dan kreatif siswa. *Journal of Mathematical Science and Mathematics Education, 1*(1), 125-134.

Yusal, Y., Suhandi, A., Setiawan, W., & Kaniawati, I. (2021). Profile of pre-service physics teachers' critical thinking skills related to heat transfer. *Journal of Physics: Conference Series, 1731(*1), 1-5. https://doi.org/10.1088/1742-6596/1731/1/012075

Zain, A. R., & Jumadi. (2018). Effectiveness of guided inquiry based on blended learning in physics instruction to improve critical thinking skills of the senior high school student. *IOP Conf. Series: Journal of Physics: Conf. Series, 1097*(1), 1-7. https://doi.org/10.1088/1742-6596/1097/1/012015

Zuriati, E., & Astimar, N. (2020). Peningkatan hasil belajar pada pembelajaran tematik terpadu menggunakan model problem based learning di kelas IV SD (studi literatur). *Jurnal Pendidikan Tambusai, 4*(3), 2071-2082. https://doi.org/10.31004/jptam.v4i3.684

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