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Critical Thinking Ability on Temperature and Heat in Learning with Problem Based Learning Models

Baiq Inayah Rahmaniah Puteri[1], Muh. Makhrus[2], Hikmawati[3]

[123)] Physics Education, University of Mataram, Mataram, West Nusa Tenggara, Indonesia.

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*Corresponding Author:
Baiq Inayah Rahmaniah Puteri[1], Physics Education, University of Mataram, Mataram, West Nusa Tenggara, Indonesia.
Email: baiq_inayah.rahmaniah@yahoo.com

Abstract: This study aims to determine the effect of the problem-based learning model on students' critical thinking skills in the subject matter of temperature and heat. This type of research is quasi-experimental with a pretest-posttest control group design. The population of this study was all students in class XI MIPA at SMAN 2 Praya, while the sample was taken using a random sampling technique so that students in class XI MIPA 3 were selected as the experimental class and students in class XI MIPA 4 as the control class. The instrument used to measure students' critical thinking skills during learning activities is LKPD which is equipped with questions that refer to indicators of critical thinking skills, and the non-test instrument used is in the form of student response questionnaires to LKPD. The results of the analysis of the level of critical thinking skills of students during learning activities show a very critical category for students in the experimental class and a critical category for students in the control class. The results of the student response questionnaire analysis showed that the student response to the LKPD was 79% in the positive category.

Keywords: Problem Based Learning, Critical Thinking Ability, Temperature, heat

Introduction

Educators are one of the main components of the learning process. The competence of the 21st-century teacher requires the teacher to be an agent of change in the school environment, where the teacher is a good example for the school community as stated by Makhrus et al. (2018) that professional teachers are not only teachers who can teach well but teachers who can become learners and agents of school change. Based on the basic view of the 2013 curriculum educators act as facilitators for students who guide and direct students to find the concept of learning material through a thought process. The thinking process carried out by students can be trained with good learning process planning to build students' understanding independently and be able to solve problems in learning through learning activities that are equipped with learning tools that will support learning activities so that in the learning process requires the existence of level thinking skills. One of them is the ability to think critically.

Critical thinking ability is the ability to analyze and evaluate information obtained from observation, experience, reasoning, and communication to decide whether the information can be trusted so that it can provide rational and correct conclusions (Karim, 2015). Referring to 21st-century learning what students must have to understand learning more easily is that students must have the ability to think critically. This is in line with Men's opinion (2017) that students who have critical thinking skills can study problems systematically, face challenges in an organized way, formulate questions, be innovative, and design solutions that are considered relatively new.

Critical thinking skills are still a concern to continue to improve because several phenomena in schools show that teachers are still constrained in improving students' critical thinking skills. The results of an interview with one of the physics teachers said that students were passive during the learning process and tended not to pay attention to learning. The same thing was expressed by Hidayatullah et al. (2018) state that students' thinking skills are rarely honed, especially critical thinking skills. Helyandari et al. (2020) also argue that students' physics subject scores are still relatively low, only a few students actively think about solving problems and the level of thinking in understanding lessons is still low. One of the causes is the learning model used by the teacher closes

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access for students to express opinions so that the class conditions become passive. The same observation results were shown by Yuliana et al. (2020) that students' critical thinking skills have not been trained in the physics learning process in class. The learning model used by the teacher tends to be lecturing, as a result, the learning model is only centered on the teacher while students only listen and are passive in class.

Selection of the right learning model is needed to overcome these problems and one way to improve critical thinking skills is to use an interactive learning model in the classroom that is associated with physical phenomena in everyday life which encourages students to be involved in the learning process at school. in class. One of the relevant learning models to overcome these problems is to apply the problem-based learning (PBL) model. According to Hidayah et al. (2021), the PBL model is a learning model that begins with problems in the real world, and solutions to the problem will be sought through investigative activities and an evaluation of the investigation. The PBL learning model is a learning process that presents phenomena that are close to everyday life. The PBL model emphasizes more on students being involved in learning.

The role of a teacher in learning is very important as a facilitator for students who provide learning experiences to students. Teachers can design interactive and interesting learning using the PBL model. So this PBL model can be used as an alternative to improve students' critical thinking skills because according to Suharta & Putri (2013), the PBL model during learning activities helps students to think not memorize, and understand learning through group discussion activities.

Methode

This type of research is quasi-experimental or quasi-experimental. According to Sugiyono (2019), experimental research is a method used to determine the effect of independent variables on the dependent variable under controlled conditions. The goal is to make a comparison of the effects of certain treatments with other different treatments, so two groups are taken as a comparison, namely the experimental class and the control class.

The research data was obtained through two assessment instruments, namely assessment sheets in the form of LKPD and student response questionnaires. During the lesson, students are given LKPD which is used to measure the level of critical thinking skills of students during learning activities, the LKPD prepared is equipped with questions that refer to indicators of critical thinking ability, LKPD assessment is carried out using the following formula.

$$\mathrm{N} = \frac{\text{total score}}{\text{maximum score}} \times 100\%$$

Berdasarkan hasil yang diperoleh, maka hasil dikelompokkan menurut kategori berikut.

Table 1: Classification of Critical Thinking Ability

Skor Perolehan	Klasifikasi
$81{,}25 < x \leq 100$	Very critical
$62{,}50 < x \leq 81{,}25$	Critical
$43{,}75 < x \leq 62{,}50$	Less critical
$25{,}00 < x \leq 43{,}75$	Very less critical

Yuliati (2011)

Meanwhile, at the end of learning students were asked to respond to the learning activities that had taken place by filling out a response questionnaire that had been prepared with the following criteria.

Table 2: Student Response Criteria

Persentase	Kriteria
$80\% \leq RS < 100\%$	Very positive
$60\% \leq RS < 80\%$	Positive
$40\% \leq RS < 60\%$	Quite positive
$20\% \leq RS < 40\%$	Less positive
$RS < 20\%$	Very less positive

(Arikunto, 2010)

Result and Discussion

The learning model used in this study for the experimental class is a problem-based learning model while students in the control class use a conventional learning model.

The level of students' critical thinking skills during learning activities is measured using the LKPD assessment sheet which consists of 5 specified indicators. The results of the analysis of the level of students' critical thinking skills during learning activities are as follows.

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Table 3: Level of Students' Critical Thinking Ability during Learning Activities

Class	Meeting	Critical Thinking Ability Indicator					Average	Category
		A	B	C	D	E		
Experiment	I	97%	83%	88%	97%	78%	89%	Very Critical
	II	97%	73%	87%	83%	88%	86%	
	III	88%	77%	78%	84%	86%	82%	
Control	I	85%	75%	65%	85%	75%	77%	Critical
	II	90%	60%	80%	80%	80%	78%	
	III	87%	65%	75%	67%	68%	72%	

Description: A: Basic Classification; B: Basic Decision; C: Inference; D: Further Explanation; E: Reasoning

This study not only measures the level of students' critical thinking skills through essay questions but also measures the level of students' critical thinking abilities during learning activities by using an assessment sheet for the level of critical thinking skills which refers to the LKPD equipped with questions related to thinking skills. critical. The critical thinking skills measured in this study during the learning process consisted of five indicators based on the opinion of Ennis (2011), namely basic classification, basic decisions, inference, further explanation, and reasoning and integration. The results of the pretest critical thinking skills of the experimental class students were classified as less critical, with an average score of 46.10, and the control class students were classified as very less critical with an average of 38.64. However, during learning activities, the level of students' critical thinking skills increased, and students in the experimental class experienced a greater increase in critical thinking skills compared to students in the control class.

The category of level of critical thinking skills of students in the experimental class is included in the very critical category, while students in the control class are included in the critical category. The level of critical thinking skills of the experimental class students is included in the very critical category because the experimental class students answer the questions given in detail and completely and can draw conclusions according to the concepts and results of the experiments carried out. The level of critical thinking ability of the control class students is included in the critical category because the control class students answer the questions given incompletely and draw conclusions that are lacking or not in accordance with the experiments carried out. One of the differences in the level of critical thinking ability is caused by the difference in the treatment of the learning model given to students in the experimental class and the control class. According to Makhrus et al. (2018) state that in the 2013 curriculum it is no longer possible to use teacher-centered models/methods/strategies/approaches, but it is necessary to activate students in learning. Experimental class students were given treatment using the problem-based learning model because the problem-based learning model involved students in an active, collaborative, student-centered learning process, which developed problem-solving skills (Aripin et al. (2021). So the results of the analysis of the level of critical thinking skills of students during learning activities show that the critical thinking skills of the experimental class are higher than the control class.

The highest critical thinking ability score of the experimental class students was the first meeting on the basic classification indicator and the further explanation indicator with a percentage of 97%, and the second meeting on the basic classification indicator with a percentage of 97%. The highest critical thinking ability value of control class students is the second meeting on the basic classification indicator with a percentage of 90%. Whereas the lowest score for the critical thinking ability of students in the experimental class during learning was the second meeting, namely the basic decision indicator of 73%, and the lowest value of critical thinking ability of the control class students, namely the second meeting, namely the basic decision indicator with a percentage of 60%. Based on the results of students' critical thinking skills during learning activities, it shows that the LKPD assessment sheets that are made and used can help students develop a level of critical thinking skills because the results of critical thinking abilities with LKPD assessment sheets show good results. Learning using LKPD which is prepared by applying indicators of critical thinking skills can involve students actively in learning activities so that learning is carried out in accordance with the expectations of 21st-century learning, namely being able to develop higher-order thinking skills (HOTS). In line with the opinion of Makhrus et al. (2018) that learning tools developed by teachers must be able to

implement 21st-century skills in implementing curriculum 13, and it is proven that learning can help students develop critical thinking skills.

The results obtained as a whole during the three meetings, the experimental class which received treatment by applying the problem-based learning model obtained a higher average score compared to the control class which used a conventional learning model. This fact shows that the problem-based learning model is able to improve student's critical thinking skills.

The results of the student response questionnaire analysis based on the aspects assessed can be seen in the following table

Table 4: Results of Student Response Questionnaire Analysis

Aspect	Results	Criteria
Problem Based Learning	78%	Positive
Critical thinking	80%	Very Positive

Based on the table above, student responses based on problem-based learning aspects were 78% which were positive criteria, while student responses based on critical thinking aspects were 80% with very positive criteria.

The results of the questionnaire analysis in terms of two aspects, namely the problem-based learning model aspect shows a percentage of results of 78% with the category that the student response is positive, meaning that the problem-based learning model used in learning makes it easier for students to solve problems by using real-world problems as a context. for students to learn problem-solving during the learning process takes place. This is in accordance with the statement of Trianto (2012) which states that problem-based learning is learning that presents real-life problems that require real solutions.

The next aspect is the critical thinking aspect which shows 80% results with a very positive student response category. meaning that the use of problem-based LKPD can increase the activeness of students in learning. This is in accordance with the opinion of Mahanal (2007), which states that one of the advantages of learning that emphasizes aspects of critical thinking is that students will have problem-solving abilities during the learning process in class and in everyday life. From these two aspects, if the average percentage results are calculated, a percentage result of 79% is obtained with positive criteria, meaning that the use of problem-based worksheets gets a positive response from students. This is in accordance with the research of Aripin, et. al. (2021) which states that physics learning tools based on problem-based learning models are effective and efficient for improving students' problem-solving abilities and critical thinking.

Conclusion

Based on the results of data analysis and discussion, it can be concluded that the level of critical thinking skills of students in the experimental class is higher than that of students in the control class, so the treatment using the problem-based learning model affects the level of students' critical thinking skills, and the responses of students in the experimental class on the LKPD assessment sheet in the positive category, which means that the LKPD is well received by students..

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