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The Effect of the Problem-Based Learning Model on Students Critical Thinking Skills and Self-Confidence

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Abstract: This study aims to determine the effect of the PBL model on students' critical thinking skills and self-confidence at State Senior High School 1 Amanuban Tengah, East Nusa Tenggara Province. This research was experimental research and the quasi-experimental design used in this research is a pretest-posttest control group design. The research results showed that the pretest average of critical thinking skills in the experimental class was 37.21, while in the control class, it was 37.14. The average prescale self-confidence score of students in the experimental class was 48.66, while in the control class, it was 48.60. Furthermore, the posttest average of critical thinking skills in the experimental class was 65.71, and in the control class was 45.71. The data analysis used the independent samples test method on students' critical thinking skills variable obtained a significance value (sig. 2-tailed) = 0.000 <0.05 and also on the students' self-confidence variable obtained a significance value (sig. 2-tailed) = 0.000 <0.05, which means H_0 rejected and H_a accepted. Based on the results of the research, it can be concluded that the PBL model has a positive effect on the student's critical thinking skills and self-confidence in senior high school.

Keywords: Critical Thinking Skills; Self Confidence; Problem-Based Learning.

Introduction

Education in the 21st century has a big role and responsibility to be able to overcome challenges in the world of education. The US-based Partnership for 21st Century Skills (P21), identifies critical thinking skills (Critical Thinking Skills), Creative Thinking Skills (Creative Thinking Skills), Communication skills (Communication skills), and collaboration skills (Collaboration skills) as competencies needed in the 21st century (P21, 2015). Critical thinking skills are fundamental skills in solving problems. This skill is important for students to have in finding the source of problems and how to find and find the right solution to the problem at hand (Anderson, 2010; Hastuti, 2016; Hendriana, 2018).

Critical thinking is logical and reflective thinking that is focused on making decisions that will be carried out. Critical thinking is an inseparable part of education and critical thinking is a very important cognitive ability (Ennis, 2011; Fisher, 2008). Critical thinking skills can be taught explicitly at school (Mahanal et al., 2019). Critical thinking skills really support the success of students in learning, so it can be said that improving and developing critical thinking skills is one of the goals of learning to be achieved (Magno, 2010; Robert, 2013;). In the learning process, several important things related to the thinking process include: thinking is needed to develop attitudes and perceptions that support the creation of positive classroom conditions; thinking needs to be developed to acquire and integrate knowledge; thinking needs to be developed to broaden knowledge insights; thinking needs to be developed to actualize meaningful knowledge; and thinking needs to be developed to develop beneficial thinking behavior (Fischer, 2009; Hackbarth, 1996; Januszewski, 2008).

In addition to critical thinking skills, another thing that needs to be improved in learning is self-confidence. Self-confidence is a very important attitude for students to have. There are many people who have great potential within themselves, but that potential does not develop because they do not have self-confidence (Hulukati,

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2016). Self-confidence is needed so that students are able to optimize their abilities. Believing in their abilities makes students accustomed to being independent in doing something, including solving problems in physics (Qoryana, 2020). Insecure people tend to rely on the acceptance of others in order to feel good about something and avoid risk for fear of failure (Goel & Anggarwal, 2012).

Learning physics can train students' critical thinking skills and can apply learning in everyday life. Students will understand the concept and keep it longer in their memory because students play an active role in discovering concepts independently. If a concept is embedded in students' knowledge, students can solve the problems given so that they can improve their learning outcomes (Illah & Yonata, 2015). In Indonesia, students' critical thinking skills and self-confidence are generally still considered low. The study conducted by PISA provides information about the achievements and challenges faced by students, as well as the factors that influenced international education in 2012, 2015, and 2018. The results of the study show that Indonesian students rank 64 out of 65 countries in one year. , ranks 69th out of 75 countries in other years (R&D, 2015), and ranks 74th out of 79 countries in certain years (OECD, 2018). These results prove that the critical thinking skills of Indonesian students need to be improved, especially in connecting scientific knowledge with relevant issues in everyday life.

In addition, the perspective on the results of the 2018 PISA study submitted by the Indonesian Ministry of Education and Culture argues that optimism in the self-confidence of students in Indonesia is still low (Makarim, 2019). This is also reinforced by Sari's study (2020) which reveals that students have a low level of self-confidence, reflected in behavior such as being reluctant to express arguments during the learning process, students are unsure of their abilities when completing homework, a tendency to follow friends' answers, feel afraid when appointed to express opinions regarding problems, feel afraid of facing exams, and feel worried when they have to appear and present in front of the class. The results of the pre-survey activities conducted by Sari (2020) using a self-confidence questionnaire, revealed that as many as 3.7% of students had very high self-confidence, as many as 29.6% of students had high self-confidence, as many as 59.25% of students had very high self-confidence. moderate confidence, as many as 7.40% of students have low self-confidence, while with very low self-confidence of 0%.

The results of the PISA study are in line with research from Hajrin, et al. (2019) which revealed that the average score of students' critical thinking skills in the pretest experiment class was 19.38, while the control class reached 24.03. In addition, research from Suardana et al. (2018) also found that the thinking skills of high school students with an average score of 59.00 in the sufficient category, 43.10 in the low category, and 34.70 in the very low category. Furthermore, a study by Ali, et al. (2020), shows that when presenting results of discussions, students are still lacking confidence in presenting the results of their discussions, lack of interaction between groups, and between groups, unsure to ask questions when these students don't understand what they are learning, and not sure or confident when facing the final test or exam.

From these studies, it can be said that students' critical thinking skills in Indonesia still need to be improved, especially in linking knowledge with problem-solving and thinking at a higher level. It is important for the education system to pay more attention to developing students' critical thinking skills so that they are ready to face challenges in life and the world of work.

In line with research by Dewi et al. (2019) which says that students' low critical thinking skills are caused by students not being able to concentrate in following lessons, not knowing how to evaluate arguments or answers from teachers and other students, and confused when making conclusions, only some are active and some are passive, as well as the inability to find solutions to problems and create learning materials. Based on this description, it can be said that students' critical thinking skills in Indonesia are in the low category (Hajrin et al., 2019, Suardana et al., 2018, Sari et al., 2019, & Dewi et al., 2019).

Based on observations made at SMAN 1 Amanuban Tengah from 2019-2021, it appears that there are still very few physics teachers who pay attention to developing science process skills. The learning that is carried out is still teacher-centered, students are only recipients of information from the teacher without understanding how this information is formed. In addition, students tend to only learn physics formulas without understanding the meaning or relevance of these formulas. As a result, students often think that physics is a difficult subject to understand because it focuses on complex formulas.

The opinion above is also supported by the results of dialogue with physics teachers and observations in the learning process at SMAN 1 Amanuban Tengah. The results of these interviews and observations show that the learning model that is often used in class is the expository model, with learning methods that include discussions, questions and answers, and lectures. In addition, there is the use of practicum and demonstration methods by some teachers, but the frequency is still relatively rare. In learning, domination

is still in the hands of the teacher, where the teacher actively describes material or physics concepts through the lecture method, then students are given practice questions that are relevant to the material being taught with the aim that students can master the material. Unfortunately, this learning process has not been directed at encouraging students to discover the principles of physics in accordance with their nature, namely as a product process that builds a deeper understanding.

As a result of this learning, students still face challenges in solving physics problems related to real situations. Physics is considered a difficult subject in school because the learning carried out still uses conventional models, such as memorizing concepts, resulting in low understanding of concepts (Shishigu et al., 2017). Basically, students need to think critically or analyze before answering. This can be seen from the results of studying physics in the daily assessment I semester II for the 2020/2021 school year in class X SMAN 1 Amanuban Tengah, the result of which is that 94% classically does not reach the set KKM, which is 70. Furthermore, in the first daily assessment of the even semester of 2021/2022, the results show that as much as 96% of students classically do not reach the set criteria or KKM.

In addition, according to the results of interviews with physics teachers at SMAK Stella Maris Niki-Niki, said that the learning process that was being carried out was one-way communication so students tended not to be active in learning activities. This resulted in students experiencing problems in understanding physics concepts because students were not stimulated to think critically in learning. This statement is proven from the results of students' physics learning in the first daily assessment of the even semester of the 2021/2022 academic year, the result of which is that 90% of students classically do not achieve the specified minimum completeness.

Suryawan et al. (2019) stated that teachers provide information to students with conventional models. Students are less active in class, often experience misconceptions, fail to transmit their knowledge in everyday life, students tend to prefer being explained by the teacher rather than group discussions, students only learn when there is homework or tests, learning in class is still centered on the teacher (teacher-centered). Research by Winiari et al. (2019) revealed that teachers use conventional learning models where the teacher is the center of learning which causes students to be inactive and not trained to think critically. This causes a feeling of boredom because students are only recipients of information, resulting in students not liking the subjects taught by the teacher.

The lack of application of innovative learning models causes low-quality learning and does not foster self-confidence in students so students' critical thinking skills do not appear. The low self-confidence of students also arises because students do not get used to doing assignments well, do not pay attention to directions or examples of questions given by the teacher, and teachers use inappropriate learning models causing students to feel bored (Witaheksantri et al., 2019).

Based on the problem, what can be done is to apply a learning model to see the effectiveness in increasing students' critical thinking skills and self-confidence. One of the learning models that can improve students' critical thinking skills and self-confidence is the problem-based learning model. The PBL model can train 21st-century skills (Mayasari at al., 2016).

According to Arends (2012), the problem-based learning model has several stages, namely orienting students when learning, organizing students while learning, guiding individual and group investigations, developing and presenting results, analyzing and evaluating processes, and problem-solving results. The problem-based learning model can improve students' critical thinking skills. Jufri (2013) suggests that there are six indicators of students' critical thinking skills, namely formulating problems, providing arguments, making deductions, performing induction, performing an evaluation, and making decisions and determining actions.

Problem-based learning has characteristics that can provide opportunities for students to increase self-confidence in learning . Learners are trained to be able to work together with members of their respective groups in generating ideas, exchanging ideas, and finally choosing ideas that are in accordance with the desired solution (Downing, 2010; Farij, 2019). Problem-solving skills must be trained and developed from an early age so that students are able to solve contextual problems through the material being taught (Kurniawan & Sofyan, 2020; Fikry, 2018). The problem-solving process contained in the problem-based learning model requires a confident attitude to determine the steps in solving the problem. The self-confidence indicators put forward by Lestari and Yudhanegara (2015), namely believing in one's own abilities, acting independently in making decisions, having a positive self-concept, and daring to express opinions. Students' self-confidence can also be increased through question-and-answer activities between teachers and students (Mulyani et al., 2020).

Based on the description of the background of the problem, the researcher is interested in empirically proving the effect of the problem-based learning model on the critical thinking skills and self-confidence of high school students based on the specified criteria. The

physics material used in this study is the studied effort and energy in class X. The reason for choosing this material is because it fits the criteria for judging the critical thinking skills and self-confidence of students. Therefore the topic determined in this study is the effect of the problem-based learning model on the student's critical thinking skills and self-confidence of class X at SMA Negeri 1 Amanuban Tengah.

Method

This research was conducted in class X SMAN 1 Amanuban Tengah from Maret to April 2023 with a total population of 250 people (8 classes) and a total sample of 72 people (2 classes) taken using cluster random sampling technique. The method used in this research is a quasi-experimental research method to measure the effectiveness of the problem-based learning model on the critical thinking skills and self-confidence of high school students. The research design used is a quasi-experimental design with the method pretest-posttest control group design using two classes as research samples, namely one class (36 people) as an experimental class which is taught using a problem-based learning model and one class (36 people) as a control class which is taught using expository model. Before learning was carried out, both classes were given a pre-test, then the experimental class was taught using a problem-based learning model and the control class was taught without the expository model. After learning ended, both classes were given a posttest. The research design can be seen in Table 1.

The study was conducted for 5 weeks with a duration of 3 hours of lessons per week. Before the experiment was carried out, the researcher carried out the preparatory stage by preparing learning tools which included lesson plans, worksheets, teaching materials, and assessment instruments to measure critical thinking skills and self-confidence. Furthermore, in the implementation stage, the teacher uses a problem-based learning model in the experimental class and an expository learning model in the control class. Implementation of learning in the experimental class and control class was carried out in the same week and at the same class level.

To obtain data about students' critical thinking skills and self-confidence, learning outcomes test instruments have been tested for validity and reliability (Rahmelina et al., 2019). The data obtained were analyzed using a quantitative descriptive method, and then the results of the analysis were described and compared between the learning outcomes of the experimental class and the control class. Data testing is done by normality test, homogeneity test, and hypothesis testing. The hypothesis tested are "the PBL model has no effect on students' critical thinking skills and self-confidence" as H_o and "the PBL model has an effect on students' critical thinking skills and self-confidence" as H_a

Table 1. Pretest Posttest Control Group Design

Class	Pretest	Treatment	Posttest
Experiment	X_1	X	X_2
Control	Y_1	Y	Y_2

Information:
X : Learning to use multimedia
Y : Learning without using multimedia
X1 : Experiment Class Pretest
X2 : Experiment Class Posttest
Y1 : Control Class Pretest
Y2 : Control Class Posttest

The criteria for testing the hypothesis

Accept Ho if the significance value > 0.05, which means that there is no significant effect of using a problem-based learning model on students' critical thinking skills and self-confidence. Reject Ha if the significance value < 0.05, which means that there is a significant effect of using a problem-based learning model on students' critical thinking skills and self-confidence. Data analysis in this study used the SPSS version 25 data processing program.

Result and Discussion

The purpose of this study is to determine the effect of the problem-based learning model on the critical thinking skills and self-confidence of high school students. The implementation of the research was carried out in the experimental class and the control class. The experimental class in this study was students in class X MIPA 1 and the control class, namely class X MIPA 2. The experimental class was a class that was treated by learning to use model problem-based learning and control classes were given treatment by learning to use the expository model.

The research focuses on physics subjects in the matter of work and energy. In this research, a researcher acts as a teacher. Learning was carried out for 4 meetings in the experimental class and the control class outside the activity pretest and posttest. Experimental class learning with model problem-based learning and the control class studied with the expository model on the same sub-topic in each meeting. After carrying out the research, the next researcher processed the result data pretest and posttest students' critical thinking skills and processing results prescale post scale self-confidence students in the experimental class and control class.

Table 2 shows the highest pretest score of the critical thinking ability achieved by students in the experimental class was 67.50, while in the control class, it was 62.50. The lowest pretest score of students' critical thinking skills in the experimental class was 20, and in the control class, the lowest score was also 20. The pretest average of students' critical thinking skills in the experimental class was 37.21, while the mean in the control class was 37.14. In addition to the data presented in Table 2, it is known that the highest posttest score for critical thinking skills achieved by students in the experimental class is 90, while in the control class is 70. The lowest posttest score for students' critical thinking skills in the experimental class was 45, and in the control class, the lowest score was also 30. Then the posttest average of students' critical thinking skills in the experimental class was 65.71, while the average in the control class was 45.71.

Table 2. Descriptive data of students' critical thinking skills

	N	Min	Max	Mean	Std. Deviation
Pretest Experiment Class	35	20.00	67.50	37.21	11.74
Posttest Experiment Class	35	45.00	90.00	65.71	11.73
Pretest Control Class	35	20.00	62.50	37.14	11.33
Posttest Control Class	35	30.00	70.00	45.71	10.24

Table 3 shows that there is an increase in the average score (mean) of students' critical thinking skills both in the experimental class and in the control class, but the increase in the average score in the experimental class was higher than the increase in the average score in the control class. The increase in the average score in the experimental class was 28.50 while in the control class, it was 8.57. Table 4 shows that the highest prescale score self-confidence among students in the experimental class was 54, while in the control class, it was also 54. The lowest prescale score of self-confidence students in the experimental class was 42, and in the control class, the lowest score was also 44. Then the prescale average of self-confidence students in the experimental class was 48.66, while the mean in the control class was 48.60. In addition to the data presented in Table 4, it is known that the highest post-scale scores of self-confidence students in the experimental class were 86, while in the control class were 64. The lowest post-scale score of self-confidence students in the experimental class was 60, and in the control class, the lowest score was 44. Then the average score of post-scale self-confidence students in the experimental class was 71.17, while the average score in the control class was 53.17. Table 5 shows an increase in the average score (mean) level of self-confidence students both in the experimental class and in the control class, but the increase in the average score in the experimental class was higher than the increase in the average score in the control class. Level increase average score of self-confidence students in the experimental class is 22.51, while in the control class is 4.57.

Table 3. Increasing the average score of critical thinking skills in the experimental class and control class

Class	Pretest average score	Posttest averange score	Improvement score
Experiment	37.21	65.71	28.50
Control	37.14	45.71	8.57

Table 4. Scale descriptive data of student self-confidence

	N	Min	Max	Mean	Std. Deviation
Prescale Experiment class	35	42.00	54.00	48.66	3.04
Postscale Experiment class	35	60.00	86.00	71.17	6.15
Prescale control class	35	44.000	54.00	48.60	2.83
Postscale control class	35	46.000	64.00	53.17	4.32

Table 5. The improved level average score of self-confidence students in experimental class and control class

Class	Prescale average score	Postscale average score	Improvement score
Experiment	49	71	22.51
Control	49	53	4.57

Table 6 shows the results of the pretest and posttest data normality test of students' critical thinking skills. The results of the normality test showed that the pretest and posttest data were in the experimental class and the control class distributed normally because all data had a significance value greater than 0.005. Likewise Table 7, namely the results of the normality test for prescale and post-scale data levels of self-confidence students in the experimental class and control class show data distributed normally because all data has a significance value greater than 0.005. Table 8 is a test of the

homogeneity of the critical thinking skills data. The result of the homogeneity test shows that the significance value based on Mean critical thinking ability is 0.281 > 0.05, it can be concluded that the variance of the data in the experimental class and in the control class is the same or homogeneous. Likewise, the self-confidence data shown in Table 9 it is known that the significance value Based on Mean scale self-confidence is 0.093 > 0.05, it can be concluded that the variance of the data in the experimental class and in the control class is the same or homogeneous.

Table 6. Normality test of critical thinking skills data

		Kolmogorov-Smirnov[a]		
	Data	Statistic	df	Sig.
Critical thingking skill data	Pretest -Ex	.111	35	.200*
	Posttest-Ex	.103	35	.200*
	Pretest-Control	.118	35	.200*
	Posttest-Control	.128	35	.160

Table 7. Normality test of self-confidence scale

		Kolmogorov-Smirnov[a]		
	Data	Statistic	df	Sig.
Self Confidence data	Pretest -Ex	.129	35	.153
	Posttest-Ex	.133	35	.200*
	Pretest-Control	.135	35	.106
	Posttest-Control	.114	35	.200*

Table 8. Homogeneity test of students' critical thinking skills data in the experimental class and control class

		Levene Statistic	df1	df2	Sig.
Critical Thinking Skills Data	Based on Mean	1.18	1	68.00	.281
	Based on Median	1.05	1	68.00	.309
	Based on Median and with adjusted df	1.05	1	67.68	.309
	Based on trimmed mean	1.32	1	68.00	.254

Table 9. Homogeneity test of student *self-confidence* data in the experimental class and control class

		Levene Statistic	df1	df2	Sig.
Self-confidence scale date	Based on Mean	2.89	1	68.00	.093
	Based on Median	2.16	1	68.00	.146
	Based on Median and with adjusted df	2.16	1	57.53	.147
	Based on trimmed mean	2.66	1	68.00	.107

The influence of model problem-based learning on critical thinking skills and self-confidence students can be known by testing the hypothesis with the method independent sample test which is shown in Table 10 and Table 11. In Table 10 the results of calculating students' critical thinking skill data between groups of students who learn to use model problem-based learning and expository model, obtained a level of sig. (2-tailed) = 0.000. This shows that the level of sig. (2-tailed) = 0.000 <0.05 so it can be concluded that there are significant differences in critical thinking skills in students learning to use the problem-based learning model with students who learn to use the expository learning model. Next in Table 11, based on the results of data calculations, self-confidence learners between groups of students who learn to use model problem-based learning and expository models through statistical tests with the independent sample test method obtained a level of sig. (2-tailed) = 0.000. This shows that the level of sig. (2-tailed) = 0.000 <0.05 so it can be concluded that there is a significant difference in self-confidence between students who learn to use the problem-based learning model with students who learn to use the expository learning model.

Table 10. The differences test in students' critical thinking abilities between groups of students who learn to use the problem-based *learning model* and expository model

	Levene's Test		t-test		
	F	Sig.	T	df	Sig. (2-tailed)
Critical thinking skill	1.18	0.28	7.59	68	0.000
	sig.(2-tailed) = 0.000 <0.005 (H_0 rejected)				

Table 11. The Difference test of self-confidence students between groups of students who learn to use the problem-based learning model and the expository model

	Levene's Test		t-test		
	F	Sig.	T	df	Sig. (2-tailed)
Self Confidence	2.89	0.09	14.17	68	0.000
	sig.(2-tailed) = 0.000 <0.005 (H_0 rejected)				

Based on hypothesis testing on both variables, it is known that the problem-based learning model has a positive effect on critical thinking skills and self-confidence in high school students in physics subjects. Problem-based learning model used in learning provides opportunities for students to understand, plan, and solve the problems presented. The PBL model starts by introducing students to a problem, which allows them to understand the connection between the problem at hand and the subject matter they are studying (Kartini at al., 2019). Problem-based learning can be said to

improve critical thinking skills because the learning process always with the presentation of the problem in real conditions so this must stimulate students not to think only to understand at the level of memorization but also to interpret the problem (Wulandari, 2015; Yuliati & Gunawan, 2019). In presenting the problem, problem-based learning is more likely to emphasize problems that exist in the real world so that learning will be more meaningful (Kemendikbud, 2013; Haryanti, 2017).

The steps of the problem-based learning model develop students' ability to think systematically in solving problems in learning (Masek & Yamin, 2011). Learning is done in groups consisting of 5-6 students who are more active in learning so that students are easier to understand learning materials. This learning activity improves the self-confidence of students because in solving problems given in groups students have high self-confidence. This was also stated by Dewi, et al (2019) who said that the problem-based learning model is applied to learning, students will be more interested because the PBL model is active learning where students are active in the learning process in class so learning is applied in class will affect in student self-confidence.

The effect of problem-based learning model not only on students' critical thinking skills but also on self-confidence students because when students develop higher-order thinking skills, one of which is critical thinking ability students have a confident attitude (self-confidence) is an attitude of self-confidence to achieve learning goals. Therefore in this study, the ability to think critically is accompanied by psychological aspects, namely self-confidence influenced by the problem-based learning model contributes to one's success in completing tasks properly. According to Delina, et al. (2018), to grow self-confidence is to provide a democratic atmosphere or condition, in which individuals are trained to be able to express opinions to other parties through social interaction, are trained to think independently, and are given a safe atmosphere so that individuals are not afraid to make mistakes. Students with high self-confidence are more motivated to learn and achieve better learning outcomes (Nisa & Wulandari, 2019).

Research conducted by Awami, et al. (2022) suggests that there is an influence of the problem-based learning model on critical thinking skills and there is also an influence on students' self-confidence compared to conventional learning models. This is because, with the problem-based learning model, students better understand learning concepts because students try to find solutions to the problems themselves. If students are able to solve these problems then the knowledge will be embedded in these students. In this case, it will lead to meaningful learning. By implementing meaningful learning students will be able to grow their creativity in developing science (Khaeroh et al., 2020). In developing critical thinking skills students have an attitude of confidence and believe in their own abilities so as to avoid feelings of anxiety and doubt. Students who have high self-confidence are more motivated and prefer to study physics. Conversely, those who have low self-confidence or lose self-confidence have negative feelings about themselves and have weak confidence in their abilities.

Conclusion

Based on the analysis and discussion, it can be concluded that the problem-based learning model positive effect on critical thinking skills and self-confidence in high school students. This is shown from the hypothesis test of the influence of the problem-based learning model on these two variables obtained at a significance level (2-tailed) = 0.000 < 0.005.

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Ronisius Otu: writing-original draft preparation, result, discussion, methodology, conclusion; C. Asri Budiningsih: proofreading, review, and editing.

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Conflicts of interest
No conflicts of interest in this article.

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