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The Influence of The Problem Based Learning (PBL) Model and Learning Style on the Thinking Abilities

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Abstract: This research aims to investigate the effect of using the Problem-Based Learning (PBL) model and variations in learning styles on the critical thinking abilities of class IV students in Cluster V, Palembayan District. Critical thinking ability is a key skill in modern education, encouraging the development of analytical, evaluative and reflective thinking. The research method used in this research is a quasi-experiment with a research design using an experimental design with a 2x2 factorial design technique where there will be a control class and an experimental class. The research sample consisted of two groups of class IV students, one experimental group taught using the Problem-Based Learning (PBL) model and one control group taught using a conventional approach. In addition, student learning styles were also identified and analyzed in this research. The research results showed that the group of students taught using the Problem-Based Learning (PBL) model experienced a significant increase in critical thinking skills. This is reinforced by the results of statistical analysis which show that the value of t_{count} (1.910) is higher than t_{table} (1.708) at a significance level of 0.05. Therefore, it can be concluded that the Problem Learning (PBL) model has a positive effect on increasing students' critical thinking skills. Apart from that, this research also identified that student learning styles influence learning outcomes. Some learning styles may be better suited to a PBL approach, while others are better suited to a conventional approach. Therefore, educators are expected to consider variations in student learning styles in designing effective learning.

Keywords: Critical Thinking Ability; Learning Style; Problem Based Learning

Introduction

Since independence in 1945, Indonesia has experienced significant changes in its educational system. In the beginning, the main priority of education was to achieve high literacy rates and provide access to education to all citizens. For decades, the government has focused on increasing participation rates, building school infrastructure, and developing the national curriculum (Wildan, 2017). However, in recent years, attention to the education system has changed. The focus has shifted from access to education to improving the quality of education. National exam results and international rankings have revealed the challenges faced by the Indonesian education system in achieving higher standards.

The education system plays a key role in the development of a country. This is no exception in Indonesia, an archipelagic country that has a large and diverse population. The education system in Indonesia faces various challenges and continuous changes, in terms of quality, accessibility, and relevance to the demands of the times (UU Republik Indonesia, 2003). One of the main issues faced by the Indonesian

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education system is inequality. Geographic and economic disparities between Indonesia's islands result in disparities in the accessibility and quality of education. Schools in rural or remote areas often face limited resources, less qualified teachers, and limited facilities. This hurts learning opportunities for children in these areas.

Apart from that, the relevance of the curriculum is also an important issue in the Indonesian education system. Technological developments and changes in the world of work demand adjustments in the curriculum to prepare students with relevant skills. In recent years, efforts have been made to integrate vocational and skills education into the national curriculum, but there are still challenges in implementation. Education plays an important role in the development of a nation. In Indonesia, the education system continues to transform along with the times and societal demands. One of the latest efforts to improve the quality of education in Indonesia is through the concept of the Independent Curriculum.

The Ministry of Education, Culture, Research and Technology (Kemendikburistek) has created a policy related to the development of an independent curriculum which will later be used by educational units as an additional alternative in improving learning during 2022-2024 and increasing the quality of education. The Ministry of Education and Technology's policy regarding the national curriculum will be reviewed in 2024 based on evaluations during the learning recovery period. The Independent Curriculum is a new approach to curriculum development in Indonesia. This concept aims to give schools and educators the freedom to develop a curriculum that suits their local needs and context (Sesmiarni, 2022). In more traditional education systems, curricula are often determined nationally, with little room for adjustment at the school level. However, with the Independent Curriculum, educators have the freedom to adjust and customize the curriculum according to the characteristics and needs of their students.

The relevance of the Independent Curriculum is very visible in the development of the Indonesian education system. First of all, the Merdeka Curriculum encourages the development of a student-centered curriculum. In more traditional education, the curriculum is often more focused on material and learning that is considered to be of national importance. However, with the Independent Curriculum, educators can prioritize students' needs and interests in curriculum development, thereby creating a more relevant and meaningful learning experience for students.

One of the learning focuses in the independent curriculum that can improve students' thinking abilities is the science subject. Science (Natural and Social Sciences) learning is an approach to learning that integrates natural and social knowledge in one learning context. This approach aims to develop a holistic and comprehensive understanding in students, by connecting knowledge and concepts from various fields of study (Hattarina et al., 2022). In the context of the Independent Curriculum, which is designed with a holistic and flexible approach, science and science learning can be one of the approaches adopted. Independent Curriculum is a new approach to education that gives schools and teachers the freedom to design curricula according to the local needs and interests of students.

In science and science learning in the Merdeka Curriculum, students will be invited to study natural and social phenomena in an integrated manner. They will learn about how these phenomena relate to each other and influence each other so that they can develop a fuller understanding of the world around them. According to Fitria (2017) Science or Natural Sciences learning has an important position in efforts to improve the quality of education, especially in producing a quality generation, namely people who can think creatively, critically, and logically. Science learning is closely related to systematic natural relationships, therefore it is not only knowledge that must be carried out but also the process of discovery. Therefore, science learning in elementary schools focuses on providing direct experience to develop students' potential and understand the concept of science itself.

Critical thinking ability is one of the key aspects of human intellectual development which has long been the main focus in various scientific disciplines. These abilities not only play an important role in the learning process, but also have a significant impact on daily life, decision-making, and social development. In the last decade, research and interest in critical thinking abilities have increased, along with a deeper understanding of how these abilities can be developed and measured. In the elementary school education environment, two important factors that can influence critical thinking skills are the learning model and students' learning styles. The Problem-Based Learning (PBL) model is a learning approach that places students at the center of learning by providing authentic and complex problems that they must solve collaboratively. PBL aims to encourage students to develop critical thinking, problem-solving, and creativity skills.

Based on the results of observations made by the author on several class IV teachers in the Gugus V environment, Palembayan District, the results showed that the use of innovative learning models was very

rarely used by teachers in their respective classes. Teacher-centered learning is very often implemented in the classroom. This is in direct conflict with the aim of the independent curriculum where learning is student-centered. Students are more active in student-centered activities during the learning process. The PBL model provides opportunities for students to explore collecting and analyzing complete data to solve the problems they face. Through the PBL model, students actively think, communicate, search, and process data and finally draw conclusions. The PBL model prioritizes the learning process so that students have the basic abilities to develop optimally.

Critical thinking ability is an intellectual skill that is very important in everyday life and the world of education. It involves the ability to analyze information carefully, understand multiple points of view, and make informed decisions. One factor that has a big influence on a person's critical thinking ability is their learning style. Learning style refers to an individual's preferences in accessing, understanding, and processing information. The results of interviews conducted by the author with class IV teachers during the Teacher Working Group (TWG) activities of Cluster V which were held on July 15, 2023, the author found that the students' learning styles were still focused on the learning material. Meanwhile, we know that there are various learning styles that teachers can use when teaching. Meanwhile, the reality in the field is that the learning carried out by teachers still focuses on the reading texts in students' textbooks.

On the other hand, learning style is the unique way in which each student learns and processes information. Learning styles can be divided into several types, such as visual, auditory, and kinesthetic. Each learning style influences how students access, understand, and remember information. Therefore, understanding students' learning styles can help educators develop more effective approaches to delivering lesson material. Research on the influence of the PBL model and learning styles on the critical thinking abilities of students at the elementary school education level is very relevant. Several previous studies have shown mixed results regarding the effectiveness of PBL in improving students' critical thinking abilities. Apart from that, there is little research that combines aspects of learning styles in the context of PBL-based learning with students' critical thinking abilities.

The research method used is a quantitative approach. Data collection will be carried out through questionnaires to identify students' learning styles, critical thinking ability tests, and participatory observation in the PBL learning process. The data collected will be analyzed statistically to conclude the relationship between the PBL model, learning styles, and student's critical thinking abilities. Based on the problems above, the researcher was interested in seeing whether the Problem-Based Learning (PBL) learning model and learning style could improve students' critical thinking skills, so the researcher conducted a study with the title "The Influence of the Problem-Based Learning (PBL) Learning Model and Learning Style on Critical Thinking Ability Students in Class IV Cluster V, Palembayan District."

It is hoped that the results of this research will provide valuable insight for educators and policymakers in designing more effective curricula and learning strategies to improve student's critical thinking abilities so that they are ready to face the challenges of the complex and dynamic modern world.

Method

Based on the problems and objectives to be achieved, the type of research used in this research is quasi-experimental. This research uses an experimental design with a 2x2 factorial design technique. This design combines two factors into independent variables, namely the PBL Model (PBL vs. Non-PBL) and Learning Style (Visual vs Auditory). This research will compare four experimental groups formed from a combination of these two factors to observe their influence on the dependent variable, namely the critical thinking ability of class IV students in cluster V, Palembayan District. The factorial design paradigm can be described as Table 1.

Table 1. 2x2 Factorial Design

Instructional Media / Learning Style	Problem Based Learning (PBL) (X)	Conventional Learning (Y)	Total
Visual (GV)	XGV	YGV	
Visual-auditorial (GVA)	XGVA	YGVA	
Total			Total

From the Table 1, it can be explained that there are two groups in learning, namely the study group that uses the Problem-Based Learning model (X) and the group that studies using conventional learning (Y). In each group there are students in the visual learning style (GV) category and students in the visual-auditory (GVA) category.

There are four division groups in this research, namely: Group 1 (PBL + Visual): Students in this group will be taught using the PBL model, and learning material will be presented with a visual approach; Group 2 (PBL + Auditory): Students in this group will be taught using the PBL model and learning material will

be presented using an auditory approach; Group 3 (Non-PBL + Visual): Students in this group will be taught using conventional methods (non-PBL) and learning material will be presented with a visual approach; Group 4 (Non-PBL + Auditory): Students in this group will be taught using conventional methods (non-PBL) and learning material will be presented using an auditory approach.

In general, this research aims to investigate the effect of the Problem-Based Learning (PBL) Model and Learning Styles that use Visual and Audiovisual media on the critical thinking abilities of class IV students in Cluster V, Palembayan District.

Result and Discussion

Overall Data Description of Initial Knowledge of the Experimental Class and Control Class

Initial information in this research was obtained through pre-learning test assessments carried out before the learning process began at the first meeting or before the treatment was carried out. This initial knowledge test consists of 10 questions in the form of multiple-choice questions given to the experimental group and the control group. This objective test is prepared based on question guidelines related to the sub-theme of the process of processing clean air by the body. Overall, information regarding students' initial knowledge before treatment is given can be found in the following table, including the highest score, lowest score, and average.

Table 2. Initial Knowledge Data in Experimental Class and Overall Control

Result	Class	n	*x*	X min	X max
PA	Experiment	25	81.6	60	100
	Control	25	78.8	50	100

Description:
n : number of students
x : average
Xmin : lowest score
Xmax : highest score

The following graph shows the initial knowledge of students in the experimental class and control class, which can be seen in Figure 1.

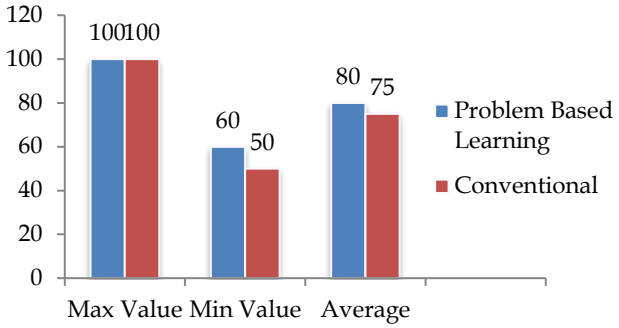

Figure 1. Highest Score, Lowest Score, and Average Initial Knowledge of Students in All Experimental Classes and Control Classes.

Results of Critical Thinking Skills Before and After Treatment in Experiment and Control Classes

The critical thinking abilities of this research participant were measured through a pretest in the form of a written quiz containing five essay questions covering four different aspects of critical thinking. The description of critical thinking ability data in this research includes all research participants from the experimental group and the control group, and the data is analyzed based on the total score, highest score, lowest score, and average for each class. A description of data regarding students' critical thinking skills is presented in Table 3.

Table 3. Data on the average value of critical thinking skills in experimental and control classes

Result	Class	n	*x*	X min	X max	s
Pretest	Experiment	25	77.2	50	95	12.76
	Control	25	74.2	50	90	12.13
Posttest	Experiment	25	81.2	70	100	10.66
	Control	25	75.2	50	95	12.35

Description:
n : number of students
x : average value
Xmax : maximum value
Xmin : minimal value
S : standard deviation

From the calculation results in Table 3, it is known that the average value of the critical thinking ability of experimental class students is higher than that of the control class before and after being given treatment. The data graph of students' critical thinking skills in the experimental class and control class can be seen in Figure 2.

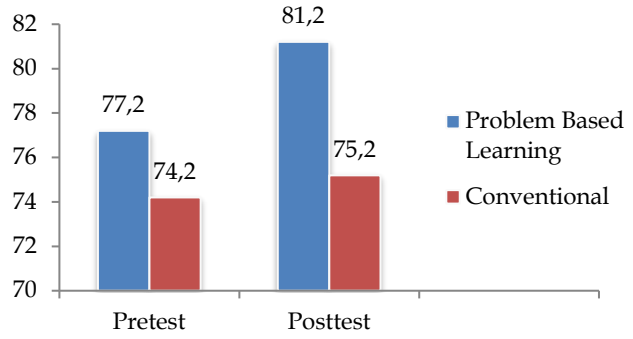

Figure 2. Highest and Lowest Scores on Students' Overall Critical Thinking Skills Before and After Treatment in the Experimental and Control Classes.

This happens because the experimental class has a higher level of prior knowledge compared to the control class when tested. Variance and standard deviation calculations are used to measure variation in a group of data. The above calculation of the standard deviation of the thickness also shows that the variation or diversity in the experimental group is almost comparable to that of the control group in the previous test.

N-Gain Calculation Data

Based on the average pretest results, it can be seen that the experimental class had a critical thinking skills score of 77.2, while the control class had a score of 74.2. The control class pretest score was lower than the experimental class. When looking at the average posttest score, the experimental class reached 80.60 while the control class reached 78.80. This shows that the post-test score for the experimental class was higher than the control class. Next, the average N-Gain for the experimental class and control class, can be seen in Table 4.

The table above shows that the N-Gain of the experimental class is higher than the control class. This is because the Problem-Based Learning model can make students active and pay attention during learning.

Table 4. Differences in N-Gain Average CTS Values in the Experimental and Control Classes Overall

Student Group	Average Pretest (x_1)	Average Posttest (x_2)	Difference Score ($x_2 - x_1$)	N-Gain	Des
Experiment	77.20	81.20	4	0.45	Medium
Control	74.20	75.20	1	0.13	Low

Hypothesis test

This hypothesis states that "the critical thinking skills of students who use the Problem-Based Learning model are higher than the critical thinking skills of students who use conventional learning". Based on the results of the t-test calculations, the analysis results for the two experimental classes and the control class are obtained in Table 5.

Table 5. Hypothesis Test Results

CTS	Class	n	X	T_{count}	T_{table}	Description
Pretest	Experiment	25	77.2	0.86	1.708	$t_{count} < t_{table}$
	Control	25	74.2			H_o accepted
Posttest	Experiment	25	81.20	1.91	1.708	$t_{count} > t_{table}$
	Control	25	75.20			H_o rejected

The results of the analysis of Table 5 using the t-test show that at the pretest stage, the calculated t-value was 0.86 with a significance level of $\alpha = 0.05$, while the t_{table} value was 1.708. Because the t calculated is lower than the t_{table}, the null hypothesis (Ho) is accepted. This indicates that there is no significant difference between the control class and the experimental class in terms of the average initial test score of critical thinking skills. However, at the posttest stage, a significant difference was seen between the control class and the experimental class with a calculated t-value of 1.91 at a significance level of $\alpha = 0.05$. The corresponding t_{table} value is 1.708. Because the t calculated is greater than the t table, the null hypothesis (H_o) is rejected and the alternative hypothesis (H_1) is accepted. These results indicate that the critical thinking skills of students taught using the reciprocal teaching strategy are significantly higher than those in the control class.

Educators and parents need to recognize the role of learning styles in shaping elementary students' critical thinking abilities. By understanding each student's learning preferences, more effective learning approaches can be designed, making a positive contribution to children's academic and cognitive development at the elementary school level (Irawati et al., 2021). This research shows that implementing learning strategies that are appropriate to student characteristics and subject matter will influence the learning outcomes obtained by students. Therefore, it is recommended for physics teachers to consider the characteristics of their students, especially in terms of learning styles, before choosing learning strategies that will be applied in teaching certain subjects, because students' learning style tendencies also have different influences on student learning outcomes (Widayanti, 2013).

Conclusion

The critical thinking abilities of students who follow learning using the Problem-Based Learning model are proven to be superior to students who follow conventional learning methods in the context of independent curriculum science learning in class IV. Therefore, it can be concluded that the use of the Problem-Based Learning model is effective in improving the critical thinking skills of elementary school students.

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Ade Islamiati: preparation of original manuscript, results, discussion, methodology, conclusions, editing; Yanti Fitria, Elfia Sukma, Yaswinda, Elwil Fitria, and Siska Tresia Oktari: discussion and review.

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Conflict of Interest
The authors declare that there is no conflict of interest concerning the publication of this paper.

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