

COMPARATIVE ANALYSIS OF CRITICAL THINKING USING PROBLEM-BASED LEARNING (PBL) AND PREDICT OBSERVE EXPLAIN (POE) MODELS IN CELL MATERIAL

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ARTICLE INFO:

ABSTRACT

Article History

Received June 7st, 2024

Revised June 14st, 2024

Accepted June 15st, 2024

Keywords:

PBL, Model POE, critical thinking

This study aims to examine the difference in critical thinking abilities using the Problem-Based Learning (PBL) and Predict-Observe-Explain (POE) models in the topic of cells. The research design employed in this study is quasi-experimental with a Nonequivalent Control Group design. The population in this research consists of two classes of XI IPA, totaling 60 students. Sampling was conducted using the Saturation sampling technique. The instrument used to measure critical thinking abilities was a set of ten essay-type questions. The average scores of pretest and posttest critical thinking abilities of students using the POE and PBL models were as follows, respectively: 54.83; 72.75 and 52.67; 78.83. The data results for critical thinking abilities across 5 indicators using the PBL and POE models were 79.90 and 71.50, respectively, categorized as high. The t-test results indicate that critical thinking abilities using the PBL model are superior to those using the POE model. The N-gain test results reveal that both models are equally effective in enhancing students' critical thinking abilities.

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How to Cite:

Husna, Rahmiati & Pranoto, Hendro. (2024). Comparative Analysis Of Critical Thinking Usinfg Problem-Based Learning (PBL) And Predict Observe Explain (POE) Models In Cell Material. *Jurnal Pelita Pendidikan*, 12(2). 040-046.

INTRODUCTION

Human resources excellence is the goal of education and serves as a benchmark for a nation's progress. Skills that students must possess to achieve this goal include problem-solving, critical thinking, collaboration, communication, creativity, and innovation (Roudlo, 2020; Wahyuni et al., 2015). One of the skills highly needed today is critical thinking. According to Astuti et al. (2021), critical thinking skills are crucial to be developed in biology education. Students should not only acquire knowledge through the educational process but also become objective critical thinkers who are open-minded and value the opinions of others.

Based on the data from the Programme for International Student Assessment (PISA) in 2018, Indonesia ranked among the bottom 10 out of 79 countries. Consistent with this, Agnafia (2019) revealed that the critical thinking abilities of students in Indonesia are still relatively low.

Many factors contribute to the low competency of students, including internal factors such as self-motivation, resilience, and competitiveness, as well as external factors such as the learning environment at school and at home, teaching practices implemented by teachers, and the adequacy of learning resources (Fransisca et al., 2021).

Based on a preliminary study conducted through the analysis of lesson plans at MAS Al Washliyah 12 Perbaungan, teachers utilize the Problem-Based Learning (PBL) model of instruction. However, it appears that this model is not effectively implemented in the teaching process. Observations during classroom activities indicate that most students tend to be inattentive to the material presented by the teacher, resulting in their inability to answer questions posed. Furthermore, discussions are often ineffective as students are difficult to control, and learning lacks proper direction, leading to student passivity. Additionally, a test was administered on cell material to assess students' critical thinking abilities, revealing that 90% of students have inadequate critical thinking skills. Failure to address these issues promptly may have adverse effects on students, such as difficulty in solving problems, analyzing information, making decisions, lacking confidence in their own opinions, and inability to tackle simple to complex problems, ultimately resulting in a decline in learning outcomes (Nursyifah, 2019; Agustina, 2020; Cahyaningsih & Nahdi, 2020).

The cell material is part of the 11th-grade science curriculum. Cells are the smallest structural

and functional units of living organisms. Due to their minuscule size, cells require a microscope for observation. However, observations using microscopes may not be maximized because cell organelles are often not clearly visible. Additionally, students need to understand the functions of each cell organelle, which contributes to their difficulty in grasping the concept of cells (Hidayati, 2020). Therefore, it is crucial to address this issue promptly by employing various strategies such as teaching methods or instructional models that can assist students in solving problems related to everyday life.

Educators, in their efforts to create quality learning experiences, are required to utilize various instructional models tailored to the characteristics of their students. Two of these models are Problem-Based Learning (PBL) and Predict-Observe-Explain (POE). PBL is a learning model that engages students in solving a problem through the steps of the scientific method, enabling them to acquire knowledge related to the problem while also developing problem-solving skills (Cahyani et al., 2021). Based on research conducted by Rahmawati et al. (2019), this model is more effective in enhancing critical thinking abilities compared to guided inquiry models because its learning process is student-centered, thus increasing student engagement.

Another instructional model that can enhance students' critical thinking abilities is Predict-Observe-Explain (POE) (Yulianto, 2014). POE is a strategy used in learning activities to achieve learning objectives. This instructional model emphasizes process activities with three main steps: prediction, observation, and explanation. According to research by Simarmata & Ely (2017), this model can improve critical thinking skills compared to other models such as Think-Pair-Share (TPS). The advantage of this model lies in its ability to identify students' skills and abilities during the learning process and increase enthusiasm as students play a direct role in defining concepts and learning process skills (Parafia et al., 2022). Based on these descriptions, both models can effectively enhance students' critical thinking abilities. However, there has been no research comparing these two models. Therefore, this study aims to investigate the difference in critical thinking between the Problem-Based Learning (PBL) and POE models in the topic of cell systems at MAS Al Washliyah 12 Perbaungan.

METHOD

This research was conducted at MAS Al

Washliyah 12 Perbaungan, located at Jln Malinda II, Batang Terap, Perbaungan District, Serdang Bedagai Regency, North Sumatra. The type of research is a quasi-experiment with a Nonequivalent Control Group design. This study involved two different treatments. For Experiment I, the PBL model was applied, while for Experiment II, the POE model was applied. The population in this study consisted of all 11th-grade science students at MAS Al Washliyah 12 Perbaungan, totaling 60 students divided into 2 classes. The sample in this study comprised two classes, selected using saturation sampling. The data collection technique in this research involved using essay tests. Data analysis was conducted using the Independent Sample T-Test and N-gain analysis.

RESULTS AND DISCUSSION

Data from the pre-test results in both treatment groups are presented in Table 1.

Tabel 1 Pre-test Results of Critical Thinking Ability

Class	Pre-test
PBL	52.67 ± 8.41
POE	54.83 ± 8.28
Signifikasi Independent Sample T-Test	0.319

Based on Table 1, it can be observed that the average score for the pre-test in the class using the PBL model is 52.67, while in the class using the POE model, it is 54.83. Then, the result of the Independent Sample T-Test calculation with the testing criterion is comparing the sig. value (2-tailed) <or> 0.05. The calculation result of the pre-test yields a sig. value of 0.319 > 0.05, indicating that Ha is rejected and Ho is accepted, meaning that there is no significant difference between the pre-test scores of the PBL class and the POE class. The data of students' critical thinking abilities (post-test) in both groups are presented in Table 2.

Tabel 2 Results of Students' Critical Thinking Abilities for Each Indicator

No	Critical Thinking Skill				
	Indicator	PBL	Category	POE	Category
1	Providing a simple explanation	83, 75	Very high	83, 33	Very high
2	Building basic skills	77, 08	High	58, 83	Low
3	Drawing conclusions	71, 67	High	62, 08	Low
4	Providing further	73, 75	High	79, 58	High

explanation					
5	Tactics and strategies	87, 92	Very High	80, 42	High
Mean	79,90	Hig h	71,50	Hig h	

Based on Table 2, it can be seen that the average critical thinking abilities of students in both instructional models fall into the high category. Critical thinking abilities using PBL model are better than POE model across all three indicators: building basic skills, drawing conclusions, and tactics and strategies. This is because students are still unable to consider whether the source can be trusted or not, and in terms of drawing conclusions, students have not been able to provide conclusions effectively.

The results of the t-test for the post-test (critical thinking abilities) can be seen in Table 3.

Tabel 3 Hypothesis Testing for Post-test in PBL and POE Classes

Independent Sampel t-tes					
t-test for Equality of Means					
	t	df	Sig.(2-tailde)	Mean Difference	Std. Error Difference
Equal Variances assumed	3.178	58	0,002	6.0833	1.9144

Based on Table 3, obtained from hypothesis testing results using Independent Sample T-Test with SPSS 23, the testing criterion is comparing the Sig. value (2-tailed) < or > 0.05. The calculation results of the post-test in the PBL class and the POE class using Independent Sample T-Test yield a Sig. value (2-tailed) of 0.002 < 0.05. Therefore, Ho is rejected and Ha is accepted, indicating a significant comparison between the average post-test scores of critical thinking abilities in the PBL class and the POE class.

Normality test of gain is used to determine the extent of improvement in students' learning outcomes before and after treatment. The calculation results of the N-gain test can be seen in Table 3.

Tabel 4 Results of N-Gain Test

Class	Pre-test	Pos-ttest	N-gain	Criteria
PBL	52.67	78.83	0.54	Sedang
POE	54.83	72.75	0.40	Sedang

Based on Table 4, it is evident that the N-Gain value in the PBL model is higher compared to the POE model. However, both fall within the moderate criteria. This indicates that both models are equally effective for developing students' critical thinking abilities.

In classrooms using the PBL model, the learning process can enhance students' critical thinking skills because this model employs everyday problems as contexts to train students in developing critical thinking attitudes and acquiring knowledge (Shoimin, 2014). Students independently solve problems, and this model is student-centered with the teacher acting as a facilitator. This setup has the potential to build concepts independently within students, making learning more meaningful. The PBL learning model has a positive impact on students' critical thinking skills compared to other models like discovery learning (Pasaribu et al., 2020). In PBL, students are grouped to solve problems together. Group discussion processes encourage students to interact with group members, learning to collaborate in problem-solving discussions, indirectly developing students' analytical and critical skills to enhance knowledge (Nafiah, 2014). This aligns with Totten (1991), who stated that critical thinking skills can be honed through cooperation, providing opportunities for students to engage in discussions and take responsibility for learning, thereby becoming critical thinkers. Implementing learning in this model makes students active, starting with teachers presenting problems to students and asking them to analyze them. Then, students determine their own solutions (Nashar, 2015; Scriven, 2007).

Classes using the POE model experienced improvement, albeit lower than those using the PBL model. This is because the POE model inadequately trains students to use reasoning based on a single truth and to draw general conclusions, where students still struggle to make generalizations of knowledge and draw conclusions between initial hypothesis disparities and experimental results from tables and graphs (Amirullah, 2019). This can be observed during the learning process, where only a few students pay attention to the material provided by the teacher, and students lack the willingness and motivation to learn, resulting in low levels of activity and critical thinking abilities. Additionally, some students are unable to explain the taught material, and not all students can provide conclusions effectively. This is consistent with the findings of Islamiyah (2019) that the POE model has not yet had an impact on students' critical thinking abilities, indicating that this model has not yet been able to assist students in critical thinking. The POE model may be applied in learning, but not all students actively participate in discussions or complete exercise problems.

If we consider the indicators of critical thinking abilities, in the first indicator, which is providing further explanation, the PBL model obtains a slightly higher average score of 83.75 compared to POE with a score of 83.33. The difference in scores between the two classes is not significant. This means that students are able to develop the ability to focus on questions, analyze arguments, find relevant information, and formulate new questions as answers to the information provided during the test. One aspect related to this indicator is that students can formulate at least three relevant questions from the discourse given about cells. This is consistent with the findings of Salbiah (2017), which revealed that high scores in this indicator are due to students being trained to identify a problem and solve problems.

In the indicator of building basic skills, the PBL model obtains a significantly higher average score of 77.08, categorized as high, while POE scores 58.83, categorized as low. This indicates that students in the POE model have not yet been able to use their thinking to argue about the credibility of a source. However, they still have limited knowledge and need experience and knowledge as a basis for providing good reasons. This aligns with the opinions of Wijayanti and Suparma (2018), stating that in the learning process, it is necessary to involve students and encourage them to solve problems, develop arguments, and directly engage them, without emphasizing rote memorization that does not support their critical thinking skills.

In the third indicator, which is drawing conclusions, the PBL model obtains a high score of 71.67, while POE scores 62.08, categorized as low. The way students think in conveying information requires experience and good knowledge to draw deep understanding based on facts and reliable sources. According to Supriyati et al. (2018), students experience some difficulty in drawing conclusions because their level of analysis is still relatively moderate and they are not yet trained enough.

In the indicator of providing further explanation, the POE model has a higher score of 79.58, while the PBL class obtains a score of 73.75, categorized as high. The scores obtained from both classes are not significantly different. Consistent with the findings of Ramdani et al. (2020), the indicator of providing further explanation has a high value.

In the fifth indicator, which is strategy and tactics, the PBL model obtains a score of 87.92, categorized as very high, compared to POE

with a score of 80.42, categorized as high. Students are able to decide on a course of action by considering the information and experiences they have gained in their daily lives, enabling them to make sound decisions and be confident in the results obtained. This aligns with Isjoni's (2007) assertion that using strategies encourages students to use their knowledge and experience to solve problems without always relying on others.

CONCLUSION

Based on the results of the conducted research, it can be concluded that there is a significant difference in critical thinking abilities between students taught using the PBL model and those taught using the POE model. However, both models are equally effective in improving students' critical thinking skills. This is evidenced by the improvement in results from the pre-test to the post-test in the PBL class, which experienced an increase after treatment compared to the POE class. The average scores of students' critical thinking abilities in the PBL class increased from 52.87 to 78.83, while in the POE class, they increased from 54.83 to 72.75, with a significance of $0.002 < 0.05$.

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