The effect of the predict observe and explain learning model on critical thinking ability of junior high school students on environmental pollution

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Article Information	Abstract

Learning models that emphasize life skills provide opportunities for students to be actively involved in exploring and applying science concepts in everyday life are needed, one of which is POE (Predict-Observe-Explain). Learners are invited to make predictions first about an experiment related to everyday life, observe the results of the experiment, and finally explain what they learned using this model. This model also aims to develop critical and analytical skills that are useful in various situations. This study aims to determine the effect of the POE learning model on the critical thinking skills of junior high school students on environmental pollution material. This type of research is a quasi-experiment in the form of non-equivalent control group design. The population in this study included all VII grade students of Al-Azhar Paron Junior High School, while the samples included VII A (control class) using scientific learning and VII B (experimental class) using the POE model. Indicators of critical thinking skills measured in this study are the ability to provide simple explanations and the ability to conclude. Based on the results of the study, it is known that the POE model has an influence on the critical thinking skills of seventh grade students at Al-Azhar Paron Junior High School. The test results show that the significance value (2-tailed) is 0.002, which is smaller than the significance level of 0.05, so the null hypothesis (H0) is rejected and the alternative hypothesis (H1) is accepted. The use of the POE model can be used as an alternative in the variation of learning models in schools to develop students' critical thinking skills.

Abstrak. *Model pembelajaran yang menekankan pada kecakapan hidup memberikan kesempatan kepada peserta didik untuk terlibat aktif dalam mengeksplorasi dan mengaplikasikan konsep-konsep IPA (Ilmu Pengetahuan Alam) di kehidupan sehari-hari diperlukan, salah satunya POE (Predict-Observe-Explain). Peserta didik diajak untuk melakukan prediksi terlebih dahulu tentang suatu eksperimen yang berkaitan dengan kehidupan sehari-hari, mengamati hasil dari eksperimen, dan akhirnya menjelaskan apa yang mereka pelajari menggunakan model ini. Model ini juga bertujuan mengembangkan keterampilan kritis dan analitis yang berguna dalam berbagai situasi. Penelitian ini bertujuan untuk mengetahui pengaruh model pembelajaran POE terhadap kemampuan berpikir kritis peserta didik Sekolah Menengah Pertama (SMP) pada materi pencemaran lingkungan. Jenis penelitian ini merupakan quasi-experiment dalam bentuk non-equivalent control group design. Populasi dalam penelitian ini meliputi seluruh peserta didik kelas VII SMP Al-Azhar Paron, sedangkan sampelnya meliputi kelas VII A (kelas kontrol) menggunakan pembelajaran saintifik dan VII B (kelas eksperimen) menggunakan model POE. Indikator kemampuan berpikir kritis yang diukur dalam penelitian ini yaitu kemampuan memberikan penjelasan sederhana dan kemampuan menyimpulkan. Berdasarkan hasil penelitian diketahui bahwa model POE memiliki pengaruh terhadap kemampuan berpikir kritis peserta didik kelas VII di SMP Al-Azhar Paron. Hasil uji menunjukkan bahwa nilai signifikansi (2-tailed) sebesar 0,002, yang lebih kecil dari tingkat signifikansi 0,05, sehingga hipotesis nol (H0) ditolak dan hipotesis alternatif (H1) diterima. Penggunaan model POE dapat dijadikan sebagai alternatif dalam variasi model pembelajaran di sekolah untuk mengembangkan kemampuan berpikir kritis peserta didik.*

A. Introduction

Learning involves educational interactions that occur with a specific purpose (Azahro & Agnafia, 2022). This interaction is carried out by educators in structured learning activities through several stages. Educators provide facilities to students to achieve good learning. Scientific learning encourages learners to observe everyday phenomena. Critical thinking is an important ability in improving the quality of education (Rachmanto, 2019). Permendikbud Number 81A of 2013 implements the curriculum by emphasizing process skills, including observing, questioning, gathering information, associating, and communicating.

A developed nation is determined by quality resources. Human resources as actors, who determine the quality of the nation, must have the ability to face challenges according to the times. This ability is obtained from the education process. The ability of human resources is improved through education, meaning that education is prepared as a provision in improving the quality of the nation. Education can also improve the dignity of the nation. Human resource development cannot be separated from the role of education. The government seeks to organize quality education and can realize the process of improving the quality of students in accordance with Law Number 20 of 2003 concerning the National Education System. The quality in question is in the form of processes and results in education (Agnafia et al., 2022). Indonesia's participation in the Program for International Students Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) shows attention to the development of global education. However, Indonesia's rankings and achievements in both surveys are still low.

The development of technology has brought great changes in human life (Julianti et al., 2022). Critical thinking, teamwork, and problem-solving skills are essential in facing competition (Erviana, 2016). Science and technology also play an important role in today's on life (Suryandari et al., 2022). Merdeka Curriculum is a new curriculum introduced in 2021 to produce graduates who are creative, innovative, and ready to face global challenges. However, its implementation has not been evenly distributed throughout schools due to limited human resources and infrastructure (Hardanie et al., 2021).

Curriculum changes are also an obstacle in the implementation of Merdeka Curriculum. Socialization and education regarding the benefits and objectives of the curriculum need to be carried out (Wanti & Chastanti, 2023). Improving the quality of human resources and infrastructure is also important for the success of the Merdeka curriculum. The POE learning model can be a solution to these problems. This model emphasizes student learning activities through investigations related to the material being studied (Yusrizal, 2020). Critical thinking skills can be developed through this learning model. The importance of critical thinking, problem solving, collaboration, and communication skills in 21st century education. The POE learning model can develop these skills. Research was conducted to analyze the effect of the POE learning model on students' critical thinking skills on environmental pollution material. According to Qing et al. (2010) using task-based learning in teaching chemistry experiments, there was a significant difference in the level of student confidence in the two classes tested afterwards. This finding shows that the learning method successfully improves students' ability to think critically in middle school.

Based on observations of interviews and questionnaire sheets at Al-Azhar Paron Junior High School, a problem was found, namely the lack of appropriate strategies or scientific K13 learning models, so that cognitive learning has not been created in HOTS C4, C5, and C6 (analyze, evaluate, and create), making critical thinking skills still relatively low with an average percentage of 45% of the pre-test results conducted (Nuzul et al., 2022). Learning activities are teacher activities to make students' learning conditions take place well and get good learning results too.

This study aims to analyze the effect of POE learning model on critical thinking skills of seventh grade students on environmental pollution material at Al-Azhar Paron Junior High School. Through the POE model, it is expected that students can develop critical thinking skills in expressing opinions, drawing conclusions, and understanding concepts better. This research wants to know the extent of the influence of the POE learning model on students' critical thinking skills, as well as how the application of this model can enrich science learning and its relevance in students' daily lives.

Research by Islamiyah et al. (2019) found that the selection of the POE learning model affects students' critical thinking skills. Astuti et al. (2023) in his research that the POE learning model affects students' critical thinking skills. Nuramelia (2016) stated in her thesis that the use of the POE model greatly affects students' critical thinking skills. Thus, this research is expected to provide a better understanding of the effect of the POE learning model on students' critical thinking skills. To reinforce the conclusion, this research makes a significant contribution by providing an in-depth view of the potential of the POE learning model in improving students' critical thinking skills.

The POE learning strategy has been shown to be effective in improving students' understanding of redox reactions (Treagust et al., 2014). This study showed that students experienced improved understanding and showed a positive attitude towards the use of POE in facilitating learning.

Nonetheless, some students still had difficulties in differentiating certain concepts.

In this study, the POE learning model was evaluated using a simple and controlled experimental method on science process skills, metacognition, and learning style. The results showed that POE with controlled experiment method was more effective in improving science process skills. No significant effect of metacognitive level or learning style on science process skills was found (Budiati et al., 2012; Narut & Supradi, 2019).

Therefore, these findings can be used as valuable guidance for teachers and other stakeholders in designing and improving learning strategies that encourage mastery of higher order thinking skills.

B. Material and method

This research uses the Quasi-Experimental Design method Nuramelia (2016) to test whether the POE learning model can affect students' critical thinking skills. The research design used was non-equivalent control group design. The research was conducted at Al-Azhar Paron Junior High School in class VII even semester of the 2022/2023 academic year. Class VII A became the control group using the scientific learning model, while class VII B became the experimental group using the POE learning model.

The population of this study were all seventh grade students of Al-Azhar Paron Junior High School. The research sample consisted of VII A and VII B classes selected using purposive sampling technique. Each class consisted of 25 students. The variables studied in this research are the independent variable (X), namely the POE learning model, and the dependent variable (Y), namely students' critical thinking skills in environmental pollution material. The data used is quantitative data in the form of essay test scores that measure students' critical thinking skills after learning using the POE model. The research instrument used is an essay test, which is designed according to Ennis' critical thinking concepts, including students' ability to formulate arguments, assess other people's arguments, identify assumptions underlying a statement, and conclude logically.

The validity of the test instrument was tested through logical validity (content validity and construct validity) by consulting expert practitioners. Empirical validity was tested by trying the test to students who were not research subjects. Test reliability was calculated using the K-R 20 formula (Arikunto, 2013). The results of this study are expected to provide information about the effect of the POE learning model on students' critical thinking skills in environmental pollution material.

C. Results and discussion

The data collected in this study consisted of quantitative data obtained through the test method, namely the critical thinking ability test. The pre-test data collection was conducted to assess the initial ability of students' critical thinking in science learning before applying POE learning in the experimental class, and scientific model learning in the control class. In contrast, post-test data collection was conducted to evaluate students' critical thinking skills after receiving the treatment, both in experimental and control classes. The distribution of students' critical thinking skills can be seen in Figure 1.
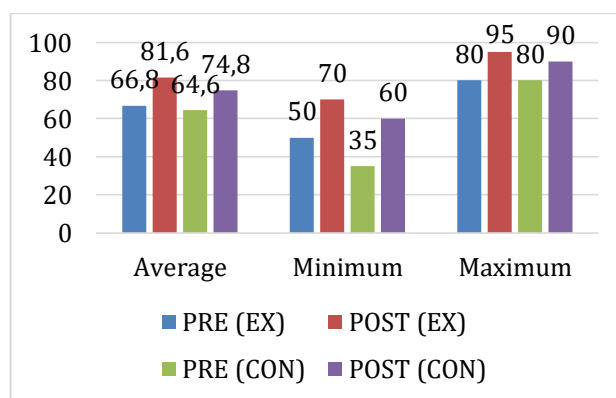

Figure 1
Distribution of pre-test and post-test results of students' critical thinking skills

Information:
Pre (ex)   = Pre-test experiment class
Pre (con)   = Pre-test control class
Post (ex)   = Post-test experiment class
Post (con)   = Post-test control class

The pre-test results of students' critical thinking skills in the experimental class had an average score of 66.8 with a minimum score of 50 and a maximum score of 80. In contrast to the control class, the pre-test results of students' critical thinking skills had an average score of 64.6 with a minimum value of 35 and a maximum value of 60. The table also shows that the post-test results of students' critical thinking skills in the experimental class had an average score of 81.6 with a minimum value of 70 and a maximum value of 95. While in the control class, the post-test results of students' critical thinking skills have an average value of 74.80, with a minimum value of 60 and a maximum value of 90. As explained above, it can be seen that there is an average difference between the pre-test and post-test scores for each experimental and control class. In the experimental class, it can be seen that the average post-test score has increased by 14.8 from the average pre-test score. In contrast to the control class, it can be seen that the average post-test value has increased by 10.2 from the average pre-test value.

The data from the research results were then tested for normality and homogeneity as a prerequisite test. The test can be done with the SPSS 25 program. In the implementation of the normality test, if the significance value> 0.05 means that the data is normally distributed, otherwise if the significance value <0.05 means that the data is not normally distributed. The results of the normality test through Kolmogorov-Smirnov can be seen in Table 1.

Based on Table 1, the significance value of each pre-test and post-test data for the experimental class is 0.315 and 0.109, which both significance values are greater than 0.05, so it meets the requirements if the data is normally distributed. The significance value of the pre-test and post-test data for the control class is 0.057 and 0.353 respectively, which means that the significance value of both is greater than 0.05, so both also qualify if the data is normally distributed.

In addition to the normality test, the research data also needs to be tested for homogeneity. If the significance value <0.05 means the data is not homogeneous, otherwise if the significance value> 0.05 then the data is homogeneous. The results of the homogeneity test can be seen in Table 2.

Table 1 Normality test results of critical thinking ability data

N. Sig.	Experiment class		Control class	
	Pre-test	Post-test	Pre-test	Post-test
	.315	.109	.057	.353
Information	normal	normal	Normal	normal

Table 2 Results of homogeneity test of pre-test and post-test data of critical thinking ability

		Levene Statistic	df1	df2	Sig.
Learning activities	Based on Mean	.023	1	48	.881
	Based on Median	.026	1	48	.872
	Based on Median and with adjusted df	.026	1	47.265	.872
	Based on trimmed mean	.021	1	48	.884

Table 3 Independent sample test results

		t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.
Learning activities	E.v. assumed	3200	48	,002	6,8	2,125
	E.v. not assumed	3,2	47.633	,002	6,8	2,125

Based on Table 2, the homogeneity test results for pre-test data in the experimental and control classes are the significance value of 0.372, so it is qualified if the data is homogeneous because the value is greater than 0.05. The result of the homogeneity test for post-test data in the experimental and control classes is a significance value of 0.462, thus qualifying if the data is also homogeneous because the value is greater than 0.05.

After the critical thinking ability is declared normally distributed and also homogeneous, then the test data continued for hypothesis testing. Basically, hypothesis testing is carried out to test the null hypothesis (H0) and the alternative hypothesis (H1). Hypothesis testing in this study used the t test, namely the independent sample t test through the SPSS 25 program. This test was conducted on experimental class post-test data with control class post-test data. By doing this test, it can be seen the effect of the POE model on students' critical thinking skills. The basis for decision making for this test is if the significance value (2-tailed) > 0.05, meaning H0 is accepted and H1 is rejected, otherwise if the significance value (2-tailed) < 0.05, meaning H0 is rejected and H1 is accepted. The independent sample t test results can be seen in Table 3.

Based on Table 3, the independent sample t test result show that the significance value (2-tailed) obtained is 0.002, which is smaller than 0.05, so the result shows that H0 is rejected and H1 is accepted. From the test results, it can be interpreted that there is an effect of the POE model on the critical thinking ability of seventh grade science students at Al-Azhar Paron Junior High School.

Through the results of this study, we can understand that the POE learning model has a significant positive impact on students' critical thinking skills, especially in the context of environmental pollution material. This finding is consistent with previous studies, such as those conducted by Yulianto et al. (2014); Islamiyah et al. (2019); Astuti et al. (2023), which also highlighted the positive influence of the POE learning model. However, while these results provide an optimistic outlook, this research provides a challenge to go further in understanding the 'why' and 'how'. There is still a need to explain more concretely why the POE learning model elicits such positive impacts. Questions about the mechanisms underlying these positive effects need to be answered to ensure that the research results can make a more substantial contribution to curriculum and learning development.

Therefore, to complete this understanding, future research is expected to focus on a more detailed explanation of the factors that mediate or moderate the effect of the POE learning model on students' critical thinking level.

Through the application of the POE model, the increase in the average critical thinking skills of students in the experimental class can occur because in the POE model there are stages of activity or syntax that are in accordance with science learning activities and can provide direct learning experience to students. The three stages or syntax in the POE model predict, observe or data collection, and explain or present. A series of stages of activities carried out in the POE model encourages students to actively participate so that learning is more student-centered and supports students to develop their critical thinking skills and actively seek information to solve existing problems (Rikmasari et al., 2022). In contrast to the control class, the application of the scientific learning model is teacher-centered and students' knowledge is still entirely derived from the teacher, as a result students tend to be passive and less critical of the learning material presented.

Based on a study conducted by Zulaeha et al. (2014), POE learning involving experimental or practicum activities has the ability to teach students to actively seek and find solutions to various problems faced. POE learning strategy with Learning Journals method has been proven effective in improving concept understanding and science process skills of students. The results of research conducted Rahayu et al. (2015) showed that the experimental group that applied the POE strategy showed a significant increase in understanding compared to the control group.

In a study conducted Yuliani et al. (2019), the POE demonstration method was used to strengthen students' metacognitive abilities. The results showed a significant increase in students' metacognitive abilities after applying this method, which was reinforced by statistical analysis showing clear differences before and after treatment. This study reinforces the findings of Kearney (2004), that the use of multimedia-based POE tasks supports students' peer learning conversations, especially at the prediction, reasoning, and observation stages.

D. Conclusion

Based on the results of data analysis and hypothesis testing conducted, it can be concluded that the POE model has an influence on the critical thinking skills of seventh grade students at Al-Azhar Paron Junior High School. This is evident from the results of the independent sample t test between the experimental and control class post-test data. The test results show that the significance value (2-tailed) is 0.002, which is smaller than the significance level of 005. Therefore, the null hypothesis (H0) is rejected and the

alternative hypothesis (H1) is accepted. Thus, the use of the POE model can be used as an alternative in the variation of learning models in schools to develop students' critical thinking skills.

E. Acknowledgement

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