Volume 17
Number 1
June 2025

Journal of
The Indonesian Society of Integrated Chemistry
Published by Jambi University, Chemistry Education Study Program

P-ISSN 2085-1715 & E-ISSN 2621-5543

JISIC

Implementation of POE Learning Model to Improve Students' Critical Thinking Abilities on the Material of Ion Equilibrium and pH of Buffer Solutions

Nurfazela[1*], Jimmi Copriady[1], Sri Wilda Albeta[1]

[1] Universitas Riau - Indonesia

ABSTRACT

This study was motivated by the low level of students' critical thinking skills, which is evident from their difficulties in solving complex problems. Students tend to rely on memorized formulas rather than analyzing the problems beforehand. The objective of this study was to investigate the improvement of students' critical thinking skills on the topic of ionic equilibrium and buffer solution pH in Grade XI at SMAN 2 Tambang, through the implementation of the Predict-Observe-Explain (POE) learning model. The research was conducted in the even semester of the 2024/2025 academic year using a randomized control group pretest-posttest design, involving two classes: class XI-1 as the experimental group and class XI-4 as the control group. Data collection was carried out using pretest scores as baseline data for normality and homogeneity tests, and the difference between pretest and posttest scores was used for hypothesis testing. Data analysis techniques included normality tests, homogeneity tests, and hypothesis testing. The results indicated that students' critical thinking skills improved significantly after the application of the POE model. This improvement was confirmed by the hypothesis test, where the significance value was $0.000 < 0.05$, indicating that H_0 was rejected and H_a was accepted. Therefore, the implementation of the POE learning model is recommended as an effective alternative to enhance students' critical thinking skills, particularly in learning materials related to ionic equilibrium and buffer solution pH.

Keyword: Critical thinking skills, Ionic equilibrium, buffer solution, POE model.

Received: May, 21 2025;
Revised: June, 10 2025;
Accepted: June, 15 2025

* coresponding author: nurfazela4780@student.unri.ac.id
DOI: https://doi.org/10.22437/jisic.v17i1.45223

INTRODUCTION

Education is one of the fundamental pillars in shaping high-quality and competitive human resources in the 21st-century globalized era. Education functions not only as a means of transferring knowledge but also as a platform for developing thinking skills, including critical thinking, which is essential in addressing future challenges. According to PISA, critical thinking is one of the most emphasized and essential skills required in the 21st century (Nursidrati et al., 2022).

To realize high-quality education, continuous efforts to reform the learning system are being made. One of the most

Copyright © 2025, by its Author(s)
This work is licensed under a Creative Commons Attribution 4.0 International Licence CC-BY

crucial changes is the paradigm shift from teacher-centered learning to student-centered learning, alongside a focus on mastering 21st-century skills such as critical thinking, creativity, communication, and collaboration. The success of the teaching and learning process in education is influenced by several factors, including teachers, students, subject matter, learning environment, and learning resources used (Panggabean et al., 2021).

Critical thinking is an essential skill that encourages students to analyze information deeply, evaluate various possible solutions, and make logical and responsible decisions. In the context of education in Indonesia, the lack of students' critical thinking skills remains a major challenge, particularly in chemistry education.

Interviews with chemistry teachers at SMAN 2 Tambang revealed that many students struggle to understand and solve chemistry problems, especially those of a complex nature. Students tend to memorize formulas without grasping the underlying concepts, relying solely on teacher-provided examples. The continued use of conventional teaching approaches with minimal conceptual exploration has contributed to students' weak critical thinking skills. Teachers often still employ traditional models, focusing merely on solving mathematical problems, rather than building a comprehensive understanding of the subject and cultivating students' critical thinking abilities in problem-solving (Azizah et al., 2015; Elisa, E. et al., 2019).

One solution to address this issue is the use of innovative and interactive learning models, such as the Predict-Observe-Explain (POE) model. This model integrates prediction, observation, and explanation into a unified learning process, actively engaging students in critical thinking through experiments, group discussions, and reflective learning. This aligns with the findings of Arini et al. (2017), who reported that problem-solving discussions offer students opportunities to demonstrate their critical thinking skills. The POE model emphasizes not only content mastery but also encourages students to explore the connection between theory and real-world phenomena.

The topic of ionic equilibrium and buffer solution pH in grade XI chemistry is considered complex, as it demands both deep conceptual understanding and calculation skills. According to Putra et al. (2023), this topic requires students to comprehend key concepts, be proficient in calculations, and think critically when solving related problems. Furthermore, it is highly applicable to real-life contexts, making it a relevant medium for fostering students' critical thinking. Learning processes involving experimentation, data analysis, and group discussion can help students develop logical, systematic, and evidence-based thinking patterns.

Based on the description above, this study aims to examine whether the implementation of the POE learning model can enhance students' critical thinking skills on the topic of ionic equilibrium and buffer solution pH in grade XI at SMAN 2 Tambang.

METHODS

The type of research conducted was an experimental study using a randomized control group pretest-posttest design, involving two classes: a control group and an experimental group. The design of the randomized control group pretest-posttest study is presented in the table 1.

Table 1. Research Design

Group	Pretest	Treatment	Posttest
Experimental	T_0	X	T_1
Control	T_0	–	T_1

The population of this study consisted of all Grade XI students, with the science program (MIPA) comprising four classes: XI-1, XI-2, XI-3, and XI-4. The sample was selected with class XI-1 assigned as the experimental group and class XI-4 as the control group.

The data collection method used in this study was testing, in which data were obtained from pretest and posttest scores. The data analysis techniques employed included normality testing, homogeneity testing, and hypothesis testing.

RESULTS AND DISCUSSION

Research Findings

The results of this study are presented in the form of quantitative data, which were analyzed in two stages: the initial stage and the final stage. The initial stage included normality testing and homogeneity testing, while the final stage involved hypothesis testing.

Normality Test

The initial data analysis aimed to examine the normality and homogeneity of the data. Based on the analysis using IBM SPSS Statistics 26, the results of the normality test are presented in Table 2.

Table 2. Test of Normality (Kolmogorov-Smirnov)

Class	Statistic	df	Sig.	Interpretation
XI-1	0.125	34	0.165	Normal
XI-4	0.138	34	0.079	Normal

Table 2 shows that the pretest data for both class XI-1 and class XI-4 have significance values greater than 0.05, indicating that the data in both classes are normally distributed.

Homogeneity Test

At this initial stage, a homogeneity test was also conducted for both pretest and posttest scores using IBM SPSS Statistics 26. The results of the homogeneity test are shown in Table 3.

Table 3. Test of Homogeneity of Variances

Data Set	Test Based On	Liliefors	Sig.	Interpretation
Pretest	Mean	0.001	0.979	Homogeneous

Table 3 presents the results of the homogeneity test for the pretest scores of students in class XI-1 and XI-4. The analysis revealed that both classes are considered homogeneous, as the significance value is greater than 0.05.

Hypothesis Testing

The hypothesis test was conducted using a one-tailed t-test. The data used for this test were the differences between posttest and pretest scores, as these differences reflect the extent of improvement in students' critical thinking skills before and after learning the topic of ionic equilibrium and buffer solution pH, with or without the implementation of the POE (Predict, Observe, Explain) learning model. The hypothesis testing results are shown in Table 4.

Table 4. Independent Samples Test

Data Set	Levene's Test F	Mean	t	Sig. (2-tailed)	Interpretation
Pretest–Posttest	3.66	54.58	5.3	0	H_a accepted (Significant)

As shown in Table 4, the significance value obtained from the hypothesis test is 0.000, which is less than 0.05 ($p < 0.05$). This indicates that the alternative hypothesis (H_a) is accepted. Thus, it can be concluded that the application of the POE learning model significantly improves students' critical thinking skills on the topic of ionic equilibrium and buffer solution pH.

CONCLUSION

Based on the results of data analysis and interpretation, it can be concluded that the POE (Predict, Observe, Explain) learning model is effective in enhancing students' critical thinking skills on the topic of ionic equilibrium and buffer solution pH in Grade XI at SMAN 2 Tambang.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the principal, teachers, and Grade XI students of SMAN 2 Tambang for their support and cooperation, which enabled the successful implementation of this research. Special thanks are also extended to JISIC for providing the necessary support and facilities to complete this article.

REFERENCES

Alfiyanti, I. F., Jatmiko, B., & Wasis. (2020). The Effectiveness of Predict Observe Explain (POE) Model with PhET to Improve Critical Thinking Skills of Senior High School Students. *Studies in Learning and Teaching*, 1(2), 76–85.

Arini, S., Hayono, dan Saputro, S. (2017). Upaya Peningkatan Kemampuan Berpikir Kritis dan Prestasi Belajar Siswa dengan Menggunakan Model Pembelajaran Learning Cycle 5E pada Materi Pokok Hidrolisis Garam. *Jurnal Pendidikan Kimia*, 6(2), 161-170.

Azizah, Rismatul., Yuliati, Lia., dan Latifah, Eny. (2015). Kesulitan Pemecahan Masalah Fisika Pada Siswa SMA. *Jurnal Penelitian Fisika dan Aplikasinya (JPFA*) 5, 2: 44-50.

Fitrianingsih, E., Mulyani, H., & Lepiyanto, A. (2021). Pengaruh Model Pembelajaran Poe (*Predict-Observe-Explain*) Terhadap Keterampilan Berpikir Kritis Di Sman Rawajitu Selatan. *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *12*(2), 147.

Elisa, E., & Wiratmaja, I. (2019). Augmented reality: Analisis Pengembangan Media Pembelajaran Kimia untuk Meningkatkan Keterampilan 4C Mahasiswa. *Journal of The Indonesian Society of Integrated Chemistry*, *11*(2), 73–81. https://doi.org/10.22437/jisic.v11i2.8124

Hikmah, A. (2019). Pengaruh Model Pembelajaran Poe (*Predict-Observe-Explain*) Terhadap Kemampuan Berpikir Kritis Siswa Kelas III SD N Pisangan 02 Pada Materi Wujud Dan Sifat Benda. *JKPM (Jurnal Kajian Pendidikan Matematika)*, *4*(1), 11 -30.

Nursidrati, Komalasari, L. I., & Syamratulangi, S. (2022). Analisis Penyajian Konsep Fungsi pada Buku Teks Matematika Singapura dalam Mengembangkan Berpikir Kritis. *Jurnal Lentera.* 4(1), 1-14.

Okta Nurfiyani, I., Suharsono, S., & Faisal Mustofa, R. (2019). Pengaruh Model Pembelajaran Poe (Predict-Observe-Explain) Terhadap Hasil Belajar Dan Kemampuan Berpikir Kritispeserta Didik Pada Konsep Keanekaragaman Hayati. *BIOSFER: Jurnal Biologi Dan Pendidikan Biologi*, *4*(2), 67–72.

Panggabean, F., Simanjuntak, M. P., Florenza, M., Sinaga, L., & Rahmadani, S. (2021). Analisis Peran Media Video Pembelajaran Dalam Meningkatkan Hasil Belajar IPA SMP. *Jurnal Pendidikan Pembelajaran Ipa Indonesia (JPPII)*, 2(1), 7-12.

Putra, T. P., Erna, M., & Anwa, L. (2023). Blended Learning Berbantuan Google Classroom Peserta Didik Pada Materi Kesetimbangan Ion Dan pH. *Jurnal Manajemen Pendidikan Penelitian Kualitatif*, *7*(1), 21–29.

Rosidah, A., Puspitasari, W. D., & Dewi, A. F. (2021). Pentingnya Model Pembelajaran Poe (*Predict* , *Observe* , *Explain*) Dalam Pembelajaran Ipa. *In Prosiding Seminar Nasional Pendidikan*, *03*, 166–169.