

The Effect of the Process-Oriented Guided Inquiry Learning (POGIL) Model on Fourth-Grade Students' Critical Thinking Skills Regarding the Topic of Changes in the State of Matter

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Abstract

This research is motivated by the low critical thinking ability of grade IV students of SDN Tembong 2 on the material Changes in Substance Form. The study aims to find out students' critical thinking skills and the influence of the Process Oriented Guided Inquiry Learning (POGIL) learning model on them. The study uses a quantitative approach with a pre-experimental design of one group pretest-posttest, involving 40 students in grade IV (A) who were selected through purposive sampling. Data were collected through a description test based on critical thinking indicators at the cognitive level C4 and C5, then analyzed using descriptive statistics and the Wilcoxon Signed Rank Test assisted by SPSS 25. The results showed that the average pretest score of 12.33 increased to 22.33 in the posttest, with 34 out of 40 students in the medium category and 6 students in the high category. The Wilcoxon test produced an Asymp. Sig. (2-tailed) of 0.000 (< 0.05), so that H_0 is rejected and H_1 is accepted. It was concluded that the POGIL model had a significant effect on the critical thinking ability of grade IV students of SDN Tembong 2 on the material on Substance Form Change.

Keywords

Changes in Substance Forms; Critical Thinking Skills; Elementary; POGIL Model.



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INTRODUCTION

Education is a fundamental need for every individual to develop their potential from birth to adulthood, both through the family, community, and school environment (Irnawan et al., n.d.). The 21st century requires students to have critical thinking skills, namely the ability to reason to understand, analyze, and make appropriate decisions (Syafitri et al., 2021). However, the results of the Programme for International Student Assessment (PISA) 2018 show that the critical thinking skills of Indonesian students are still relatively low (Rahim, 2023). This condition is also seen in grade IV students of SDN Tembong 2 who, based on initial observations and teacher interviews, still have difficulty expressing opinions, analyzing problems, and drawing conclusions. The learning that takes place is still teacher-centered with the lecture method, so students tend to be passive and less trained in critical thinking.

Natural and Social Sciences (IPAS) learning in the Independent Curriculum is designed to be inquiry-based to foster students' curiosity and process skills (Prigita & Basri, 2026). One of the materials for class IV IPAS, namely the change in the form of substances, is classified as abstract and requires a direct learning experience so that it is easy for students to understand (Moda, 2025). In line with the concrete operational stage in Piaget's theory of cognitive development, students aged 9-10 years still need visual representation and real experience to understand abstract concepts, so the selection of the right learning models and media is the key to the success of learning in elementary school (Luh et al., 2025).

The Merdeka Curriculum emphasizes the development of Higher Order Thinking Skills (HOTS), including critical thinking skills that include analyzing arguments, drawing conclusions, and solving problems (Pinasthi et al., 2024). One of the recommended learning models to develop these skills is Process Oriented Guided Inquiry Learning (POGIL), which emphasizes the active involvement of students through the stages of orientation, exploration, concept formation, application, and closing. Previous research has shown that the POGIL model provides a better effect than conventional learning (Elisyah & Listiana, 2023).

Based on the gap between ideal conditions and reality in the field, this study aims to examine the application of the POGIL learning model to the critical thinking skills of grade IV students of SDN Tembong 2 on the material of Substance Form Changes, as well as to measure the extent of the influence of the model on improving students' critical thinking skills.

METHODS

This study uses a quantitative approach with a pre-experimental one group pretest-posttest design, which involves one group without a comparison group and provides treatment before and after learning (Fahrudin et al., 2022). The research design is described as O1-X-O2, with O1 as the pretest, X as the treatment of the POGIL learning model, and O2 as the posttest.

The research population is all grade IV students of SDN Tembong 2, consisting of grades IV (A) and IV (B) (Sugiyono, 2019). The research sample was determined using a purposive sampling technique and involved 40 students in grade IV (A), consisting of 16 male students and 24 female students. Data were collected through a critical thinking ability description test at the cognitive levels C4 (analyzing) and C5 (evaluating) based on Bloom's Taxonomy, which was given at the pretest and posttest stages (Yulianti et al., 2023; Magdalena et al., 2021), as well as documentation techniques to obtain supporting data such as student lists and photos of learning activities.

The treatment of the POGIL model is applied through five stages as described in the following research framework: students are directed to understand the learning objectives (orientation), observe phenomena and discuss in groups (exploration), analyze the results of observations to find concepts (concept formation), apply concepts to new problems (applications), and present the results of discussions accompanied by reflection (closing).

Data were analyzed through the Shapiro-Wilk normality test, the Levene's Test homogeneity test, and the hypothesis test using the Wilcoxon Signed Rank Test with a significance level of 0.05 assisted by SPSS version 25 (Nurhaswinda et al., 2026; Maskhuliah et al., 2025).

FINDINGS AND DISCUSSION

Findings

The research was carried out at SDN Tembong 2, Cipocok Jaya District, Serang City, Banten Province, through three face-to-face meetings: the first meeting for the pretest, the second meeting for the application of the PONDIL model, and the third meeting for the posttest. The students' critical thinking ability was measured using a description test instrument adjusted to critical thinking indicators at the C4 and C5 cognitive levels. The results of descriptive statistical analysis are shown in Table 1.

Table 1. Descriptive Critical Thinking Ability Test Results

Data	N	Minimum	Maximum	Red	Std. Deviation
Pretest	40	10	21	12,33	3,647
Posttest	40	19	29	22,33	2,401

Source: primary data processed, 2026

Table 1 shows that the average posttest score (22.33) is higher than the average pretest score (12.33), with a smaller standard posttest deviation, indicating a more homogeneous distribution of student scores after learning using the PIGIL model.

The normality test using Shapiro-Wilk showed a significance value of 0.000 for the pretest and a posttest value of 0.002 (both < 0.05), so the data was declared to be abnormally distributed. The homogeneity test using the Levene's Test yielded a significance value of 0.004 (< 0.05), indicating that the variance of the pretest and posttest data was inhomogeneous. Since the data were not normally distributed, hypothesis testing was performed using the non-parametric Wilcoxon Signed Rank Test, as presented in Table 2.

Table 2. Wilcoxon Signed Rank Test Test Results (Posttest - Pretest)

Test Statistics	Value
Z	-5,526
Asymp. Sig. (2-tailed)	0,000

Source: SPSS output version 25, 2026

Based on Table 2, a Z value of -5.526 and Asymp. Sig. (2-tailed) of 0.000 (< 0.05), so that H_0 is rejected and H_1 is accepted. These results show that there is a significant difference between students' critical thinking skills before and after the application of the PIGIL learning model.

Based on the critical thinking ability score category (maximum score of 40), of the 40 students who were the research sample, as many as 34 students (85%) were in the medium

category and 6 students (15%) were in the high category after the application of the PONGIL model, as presented in Table 3.

Table 3. Distribution of Students' Critical Thinking Ability Categories After the Implementation of the POGIL Model

Category	Score Interval	Number of Students	Percentage
Very High	33-40	0	0%
Height	25-32	6	15%
Medium	17-24	34	85%
Low	9-16	0	0%
Very Low	0-8	0	0%

Source: primary data processed, 2026

Discussion

The results of the study showed that the critical thinking skills of grade IV students of SDN Tembong 2 improved after participating in learning using the Process Oriented Guided Inquiry Learning (POGIL) model on the Substance Forms Change material. This improvement can be seen from the students' ability to recognize assumptions, analyze arguments, use information, make deductions, and draw conclusions, which are indicators of critical thinking used in this study.

This improvement is inseparable from the characteristics of the POGIL model which actively involves students through the stages of orientation, exploration, concept formation, application, and closing. In the exploration and concept formation stage, students are trained to observe phenomena, gather information, and analyze them through group discussions, while in the application stage, students apply concepts that have been understood to solve new problems. The series of activities trains students to think logically and systematically, in line with the concrete operational cognitive development stage, where students aged 9-10 years need hands-on learning experience to understand abstract concepts.

The results of hypothesis testing using the Wilcoxon Signed Rank Test showed an Asymp value. Sig. (2-tailed) of 0.000 (< 0.05), so it can be concluded that the POGIL learning model has a significant effect on students' critical thinking skills. This finding is in line with the research of Wijaya and Handayani (2021) which shows that the POGIL model has a positive effect on the critical thinking skills of elementary school students. This research is also in line with Elisyah and Listiana (2023) who found that guided inquiry-based learning can improve students' ability to solve problems systematically.

During the learning process, students showed high enthusiasm, actively discussed, and were more courageous to express their opinions than before the implementation of the POGIL model. This change in learning attitude indicates that the POGIL model not only affects the cognitive aspect, but also on the scientific attitude and confidence of students, which is in line with the demands of the student profile in the Independent Curriculum.

Thus, the POGIL learning model can be an alternative to the science learning strategy in elementary schools, especially in abstract materials such as changes in the form of substances, because it is able to encourage active student involvement and develop high-level thinking skills needed in the 21st century.

CONCLUSION

Based on the results of the study, it can be concluded that the critical thinking skills of grade IV students of SDN Tembong 2 in the material Changes in the Shape of Substances show good results after using the Process Oriented Guided Inquiry Learning (POGIL) learning model, which is reflected in the students' ability to recognize assumptions, analyze arguments, use information, make deductions, and draw conclusions. The results of the Wilcoxon Signed Rank Test test showed an Asymp value. Sig. (2-tailed) of 0.000 (< 0.05), so that H_0 was rejected and H_1 was accepted, which means that there is a significant influence of the POGIL learning model on students' critical thinking skills.

These findings provide implications that the POGIL model can be used as an alternative to student-centered learning strategies in elementary schools. Teachers are advised to apply this model consistently accompanied by student worksheets (LKPD) that support each stage of inquiry. Further research is suggested to examine critical thinking indicators more deeply, use different learning materials, or apply the POGIL model to other levels of education to obtain broader findings.

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