



# The Effect of The Generative Learning Model Based on Cognitive Conflict Assisted by Learning Videos on The Critical Thinking Skills of Grade XI Senior High School Students

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## ABSTRACT

Students' critical thinking skills in high school physics learning remain relatively low despite the implementation of various innovative learning models such as problem-based learning and inquiry. One contributing factor is the limited use of learning media that can visually present anomalous phenomena to trigger cognitive conflict and stimulate students' curiosity. This study aims to examine the effect of a cognitive conflict-based generative learning model assisted by instructional videos on students' critical thinking skills in static fluid topics. A quasi-experimental design with a posttest-only control group was employed. The results indicate that students who learned through the cognitive conflict-based generative model supported by video learning demonstrated higher critical thinking skills than those who learned using the models and media commonly applied by teachers in schools. These findings suggest that integrating videos into a generative learning framework effectively enhances students' critical thinking skills by facilitating the connection between prior knowledge and new concepts. Therefore, this learning model can be considered a promising alternative for improving critical thinking skills in physics education.

**Keywords:** Generative Learning Model, Critical Thinking.



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## I. INTRODUCTION

Physics learning requires higher-order thinking skills to enable students to understand and explain natural phenomena scientifically [1]. Therefore, physics education should not only focus on conceptual mastery but also on the development of critical thinking skills that allow students to analyze, interpret, and evaluate information based on scientific evidence [2], [3]. Critical thinking plays a crucial role in helping students connect abstract concepts with real-world phenomena, leading to meaningful and coherent conceptual understanding [4].

However, the implementation of innovative learning models such as Problem-Based Learning (PBL) and Inquiry has not yet optimally improved students' critical thinking skills [5], [6]. In classroom practice, students often struggle to link prior knowledge with newly learned concepts, resulting in fragmented and superficial understanding [7]. This indicates that existing learning models do not sufficiently challenge students' initial conceptions or stimulate deeper cognitive processes required for critical thinking development.

Generative learning is grounded in constructivist theory and emphasizes students' active involvement in constructing knowledge by integrating new information with prior understanding [8]. Previous studies have reported that generative learning can enhance students' critical thinking skills and conceptual understanding [9], [10]. Nevertheless, the effectiveness of this model largely depends on the presence of learning experiences that explicitly encourage students to re-evaluate and reconstruct their initial conceptions. Without strong cognitive stimulation, the generative learning process may not fully activate critical thinking [11].

Cognitive conflict is a learning strategy that deliberately exposes discrepancies between students' prior knowledge and observed phenomena, creating a state of cognitive disequilibrium that promotes conceptual change [12]. When students encounter phenomena that contradict their expectations, they are encouraged to reflect, question, and test their initial ideas processes that are essential for the development of critical thinking

skills [13]. Therefore, integrating cognitive conflict strategies into generative learning is expected to strengthen students' ability to meaningfully connect prior and new knowledge.

In this context, anomaly-based instructional videos offer a promising approach. Such videos can visually present counterintuitive and real-world phenomena that are difficult to observe directly in the classroom, making cognitive conflict more explicit and impactful [14]. Embedding anomaly-based videos within a cognitive conflict-based generative learning framework provides concrete experiences that challenge students' initial understanding and support deeper conceptual reconstruction [15].

Accordingly, this study aims to examine the effect of a cognitive conflict-based generative learning model assisted by anomaly-based instructional videos on students' critical thinking skills in static fluid topics. The novelty of this research lies in the intentional use of anomaly-based videos as a source of cognitive conflict within a generative learning framework, offering a more effective alternative for enhancing students' critical thinking skills in physics education.

## II. METHOD

This study employed a quasi-experimental method with a *posttest-only control group* design. The research subjects consisted of 60 eleventh-grade students divided into two intact classes, namely an experimental class and a control class. A *total sampling* technique was applied, in which all students in the population were included without individual randomization. The experimental class was taught using a cognitive conflict-based generative learning model assisted by instructional videos, while the control class received instruction using the learning models and media commonly implemented by teachers at school. The research design is presented in Table 1.

**Table 1.** Research design

Class	Treatment	Posttest
Experiment	X	T1
Control	-	T2

(Source: Ref [16])

Explanation:

X : Treatment given to the experimental group

- : Treatment given to the control group

T1 : Posttest (final test) for the experimental class

T2 : Posttest (final test) for the control class

The research instrument was a critical thinking skills test comprising 16 essay items developed based on Ennis's critical thinking indicators, simple explanations, basic skills, inferences, and further explanations. Each indicator was represented by four items to ensure balanced measurement of students' critical thinking skills.

The instructional videos used in the experimental class contained anomaly-based phenomena related to static fluid concepts that commonly lead to student misconceptions. These anomalies were selected to create discrepancies between students' initial predictions and observed outcomes, thereby triggering cognitive conflict and encouraging students to re-evaluate and reconstruct their prior understanding through the stages of generative learning.

Posttest data were analyzed using an *independent samples t-test* to examine differences in critical thinking skills between the experimental and control groups.

## III. RESULTS AND DISCUSSION

### A. Results

Student critical thinking skills data were obtained thru posttest results administered after instruction in the experimental and control groups. The average critical thinking skills scores of students from both classes are presented in Table 2

**Table 2.** Average Posttest Critical Thinking Skills

Class	Average Critical Thinking Skills	Category
Experimental	81.46	Very high
Control	74.69	High

As shown in Table 2, the average critical thinking skills score of students in the experimental class (81.46) is higher than that of the control class (74.69). This result indicates that students who learned through the

cognitive conflict-based generative learning model assisted by video achieved better critical thinking performance than those who learned using the models and media commonly applied by teachers.

Before conducting hypothesis testing, normality and homogeneity tests were performed to ensure that the data met the assumptions for parametric analysis. The results of the normality test using the Liliefors test are presented in Table 3.

**Table 3** Results of Posttest Normality Test Calculation

Class	N	$\alpha$	$L_h$	$L_t$	Description
Experimental	30	0.05	0.09762	0.161	Normal
Control	30		0.14452		Normal

The results of the Posttest Normality Test calculation in Table 3 show that the calculated "L" value for both sample classes is smaller than the table "L" value, namely:  $0.14452 < 0.161$  for the control class and  $0.09762 < 0.161$  for the experimental class. This indicates that the critical thinking skills data for both classes are normally distributed at a significance level of 0.05. Next, the results of the homogeneity test are presented in Table 4.

**Table 4.** Results of Posttest Homogeneity Test Calculation

Class	N	$\bar{X}$	S	$S^2$	$F_h$	$F_t$	dk	Ket
Experimental	30	81.46	7.93	62.94	1.452	1.861	$\frac{29}{29}$	Homogen
Control	30	74.693	6.584	43.36				

Table 4 shows that the calculated F value of 1.452 is smaller than the table F value of 1.861 at a significance level of 0.05 with numerator and denominator degrees of freedom of 29 each. This indicates that the data from both groups have homogeneous variances. After both prerequisite tests are met, a two-sample t-test is conducted to determine if there is a difference in critical thinking skills between the two classes. Table 6 presents the complete calculation results for the two-sample hypothesis test.

**Table 6.** Results of the Two-Mean Posttest Equality Test Calculation

Class	N	$\bar{X}$	S	$S^2$	$t_h$	$t_t$
Experimental	30	81.46	7.93	62.94	3.59	2.0003
Control	30	74.693	6.584	43.36		

At a significance level of 0.05, the calculated t value (3.59) exceeds the critical t value (2.0003), indicating a statistically significant difference in students' critical thinking skills between the experimental and control groups. Since both classes received similar instructional conditions except for the learning model and media used, this difference can be attributed to the implementation of the video-assisted cognitive conflict-based generative learning model.

To strengthen the interpretation of the results, an effect size analysis was conducted using Cohen's d. The analysis yielded a Cohen's d value of 0.94, which is categorized as a large effect size. This result indicates that the applied learning model has a strong practical impact on improving students' critical thinking skills.

Further analysis was conducted based on critical thinking skill indicators. The comparison of average scores for each indicator is presented in Table 7.

**Table 7.** Comparison of Average Scores for Students' Critical Thinking Skills

Critical thinking skills indicators	Experimental Class	Control Class
Simple explanation	88.96	80.6
Basic skills	84.58	75.8
Inference	80.21	74.2
Further explanation	72.08	68.13

Based on Table 7 shows that the experimental class consistently achieved higher average scores across all critical thinking indicators compared to the control class. These results indicate that the video-assisted cognitive conflict-based generative learning model effectively enhances multiple dimensions of students' critical thinking skills, including explanation, analysis, inference, and reasoning.

## B. Discussion

The results indicate that the implementation of a cognitive conflict-based generative learning model assisted by instructional video has a significant effect on students' critical thinking skills. This finding is consistent with previous studies reporting that generative learning is effective in enhancing critical thinking by actively engaging students in constructing knowledge through the integration of new concepts with prior knowledge [12], [13]. Such knowledge construction enables students to develop deeper conceptual understanding, which is essential for higher-order thinking in physics learning [14].

The effectiveness of this model can be explained by conceptual change theory, which posits that meaningful learning occurs when students experience a discrepancy between their initial conceptions and observed phenomena, leading to the restructuring of their understanding. In this study, cognitive conflict was induced through video-based contextual phenomena, such as a needle floating on the water surface, which contradicted students' initial predictions. In line with previous findings [17], [18], these discrepant events encouraged students to analyze evidence, question their assumptions, and formulate explanations based on scientific reasoning, thereby strengthening their critical thinking skills.

The use of instructional video further enhanced the impact of cognitive conflict by aligning with multimedia learning principles. The integration of visual and auditory representations facilitated students' understanding of abstract physics concepts, such as surface tension, while reducing cognitive load. This result supports prior research indicating that multimedia-assisted instruction is more effective than conventional instruction in promoting conceptual understanding and critical thinking skills [17], [18].

In contrast, students in the control group, who were taught using instructional models and media commonly applied in schools, had limited opportunities to experience explicit cognitive conflict. Consequently, the stimulation of analytical and evaluative thinking was less optimal. This finding is consistent with previous research showing that learning environments with low cognitive challenge tend to produce lower levels of critical thinking skills [20].

Overall, this study confirms that a cognitive conflict-based generative learning model supported by instructional video is more effective in improving students' critical thinking skills. The teacher's role as a facilitator who designs cognitively challenging learning situations and guides students in reconstructing concepts independently is crucial for optimizing the development of higher-order thinking skills in physics learning.

## IV. CONCLUSION

Based on the results of this study, it can be concluded that the cognitive conflict-based generative learning model assisted by instructional videos significantly improves students' critical thinking skills in high school physics learning, particularly on static fluid topics. Students who participated in this learning model demonstrated higher critical thinking skills compared to those taught using conventional instructional models and media, indicating that the observed differences were due to the treatment applied. These findings suggest that physics teachers can implement this model in regular classroom instruction by presenting contextual phenomena through videos to trigger cognitive conflict and guide students in actively constructing scientific understanding. This study is limited by its relatively small sample size, the narrow scope of material, and the use of a posttest-only design. Therefore, future research is recommended to involve larger samples, apply the model to various physics topics, and use a pretest-posttest design to obtain a more comprehensive assessment of students' critical thinking development.

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