

The Effect of Problem-Based Learning Assisted by Animated Videos on Students' Critical Thinking Skills

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ARTICLE INFO

Received: 18 August 2026

Revised: 24 September 2026

Accepted: 27 September 2026

Keywords: animated videos, critical thinking, economics learning, problem-based learning

ABSTRACT

Critical thinking is an essential skill in Economics education because students need to analyze problems, evaluate information, and formulate appropriate solutions. This study examined the effect of Problem-Based Learning (PBL) assisted by animated videos on the critical thinking skills of Phase E Economics students at SMA Negeri 4 Padang. A quantitative quasi-experimental study with a pretest-posttest control group design involved 72 students selected purposively from two classes. Class X.E5 (n = 36) was the experimental group and Class X.E1 (n = 36) was the control group. Data were collected using 10 open-ended questions measuring analysis, evaluation, and inference. The instrument was reviewed by experts and demonstrated acceptable reliability (Cronbach's alpha = 0.825). Data were analyzed using ANCOVA, with pretest scores as a covariate, and N-Gain to assess improvement. The ANCOVA results showed a significant difference between the groups after controlling for initial ability ($F = 25.904$, $p < 0.001$, partial $\eta^2 = 0.273$). The adjusted mean was 79.49 for the experimental group and 66.62 for the control group. N-Gain values were 0.67 and 0.47, respectively, both categorized as moderate. These findings indicate that PBL assisted by animated videos can support the development of students' critical thinking skills in Economics learning.

DOI : <https://doi.org/10.24036/ecogen.v9.i3.135>



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INTRODUCTION

Rapid scientific and technological advancements require individuals to possess 21st-century skills, which are essential for adapting to the complex challenges of modern life.

Critical thinking important skill needed by today society. (Öztürk, 2023). cognitive ability encompasses analyzing, generating, and evaluating evidence. (Ennis, 2018), Consequently, the focus of education has shifted from mere knowledge acquisition to the development oh HOTS are crucial for preparing to face the challenges arising from digitalization and globalization.

Critical thinking is a component of higher order cognitive skills; in the revised Bloom's Taxonomy, it encompasses the abilities to analyze (C4), evaluate (C5), and create (C6) (Anderson & Krathwohl, 2001). These skills enable students to understand concepts, contruct arguments, examine relationship, and generate solution. According to (Facione, 2013). Critical thinking is engage in evalution, inference, analysis, explanation, interpretation, and self regulation.

This ability is invaluable in economics study, as students required not merely to understand the material but also to apply it when addressing various economic issues. Topics such as scarcity, needs, priority setting and opportunity cost are directly relevant to situations requiring students to analyze conditions, evaluate choices and their consequences, and make sound decisions (Wolgemuth et al., 2017). Therefore, economics instruction should provide instruction that enable student to apply real world concept, this ensures that learning goes beyond mere comprehension from the topic of discussion and encourages students to think more critically.

In fact, students critical thinking skills of studying economics at SMA Negeri 4 Padang have not yet reached an optimal level. this is evidenced by the order thinking skills (HOTS) involving 269 Grade X Phase E students which showed that 127 students (46.88%) met learning objective mastery criteria (Scoring > 80), whike 142 student (53,12%) failed to achieve such mastery.

Table 1. Result of HOTS assessment for grade X Phase E students

Grade	Number per class	Average	Students Passed (≥80)	Student did'n passed (<80)	Percentage who passed
X. E1	38	67,78	12	26	31,57%
X. E2	40	55,63	2	38	5%
X. E3	39	83,50	29	10	74,35%
X. E5	36	64,86	8	28	22,22%
X. E6	37	73,89	18	19	48,64%
X. E7	39	78,86	22	17	56,41%
X. E8	40	87,27	36	4	90%
Total	269		127	142	46,88%

Source. Grade X Economics Teacher, (2026)

Data indicate that a significant number of students have not yet achieved proficiency in higher order thinking activities. these findings suggest a need to guide students in solving problems relevant to real world situations, enabling them to acquire new knowledge and make better decisions. Preliminary observational data indicate limited development critical thinking skills students may stem from a reliance on lecture-based teaching methods, which offer few opportunities for students to ask questions, analyze information, defend their reasoning, or explore solutions (Kania, 2023). Therefore, students should not merely be required to master concepts, they must also be given opportunities To cultivate problemsolving skills and tackle real-world challenges.

One strategy taught can employ to foster Students' critical thinking can be developed through the use of innovative models that encourage active student participation (Kwangmuang et al., 2021), such models provide opportunities fo students to enhance higher order thinking skills while simultaneously boosting motivation, engagement, and learning autonomy.

PBL model that centers learning process on specific problems, enabling student participate actively in understanding the issues and determining appropriate solutions based in the situation at hand (Chigbu et al., 2023). In a PBL environment, Students do not merely receive instructions one-way from the teacher they actively participate in the learning process, while the teacher as a guiding them toward a deeper understanding. these characteristics make PBL an approach capable of developing HOTS, as students challenged in analyze real world problem a process that demands a deep understanding of information, the consideration of evidence and the evaluation and creation of solutions. The PBL framework encompasses presenting problems to students, organizing students for learning, preparing for group and individual work, presenting developed result, and evaluating and guiding the learning process (Moghadam, 2023). Implementation of PBL has been extensively examined in prior research. A meta-analysis by (Liu & Pásztor, 2022), encompassing 50 empirical studies and 5,210 participants, The use of PBL leads to better critical thinking skills. Research by (Ghani et al., 2021) further indicates that PBL fosters student engagement in the problemsolving process and encourages the growth of higher-order thinking skills. These findings suggest that PBL is particularly suitable when the learning process aims not only for content mastery but also for developing students' ability utilizing knowledge to solve problems.

However, the implementation of PBL becomes more effective when students receive stimuli that help them comprehend the presented problems. Animated videos serve as one such medium. They can visually depict situations or problems, thereby providing students with a more concrete understanding before they embark on inquiry activities (Pimdeet et al., 2024). Integrating visual and verbal elements into instruction also assists students in organizing information and connecting it to their existing knowledge (Mayer, 2024). In this study, the animated video functions as an initial stimulus rather than a substitute for the learning activities themselves. After viewing the video, students are guided to identify the problem and proceed with the problemsolving process through worksheets, discussions, and presentations.

The use of animated videos aligns well with the characteristics of the Economics topics addressed in this study. Concepts such as scarcity and needs involve situations where individuals must determine which needs are more pressing. Meanwhile, concepts like priority scales and opportunity costs require decision making and the consideration of consequences. Such issues can easily be related to students' daily lives. Animated videos enable the visualization of these situations, allowing students to grasp the context of the discussion rather than merely reading about the problem in text format. Furthermore, these issues can serve as a starting point for inquiry activities and discussions within the PBL framework.

Previous studies have also highlighted the benefits of using media in PBL. (Maulina et al., 2024) demonstrated that video-assisted PBL supports the learning process. Similarly, (Abdulah et al., 2021) found that multimedia-supported PBL facilitates learning and the development of students' thinking skills. Meanwhile, (Arviani et al., 2023) showed that instruction providing opportunities for students to engage actively in learning activities can foster critical thinking skills. These findings reinforce the rationale for using media to support the implementation of PBL, particularly when the media serves to provide a stimulus followed by activities involving critical thinking and problemsolving skills.

Research conducted by (Munawaroh & Sholikhah, 2022), also involved the development of PBL-based student worksheets utilizing interactive videos and Google Sites to stimulate critical thinking skills in Economics instruction. The study found the developed materials to be valid, practical, and effective in stimulating critical thinking abilities. Additionally, (Widia & Syamwil, 2023) implemented PBL by integrating "4C" competencies into Economics instruction and observed differences in learning outcomes between the PBL group and the control group. Both studies demonstrate that PBL and instructional media hold significant potential for application in Economics education.

Nevertheless, there remains an opportunity for further research in different contexts. Previous studies have largely focused on the impact of PBL on learning outcomes or the use of media as a component of instructional materials. Research specifically integrating PBL with animated videos serving as problem stimuli in Phase E Economics instruction and examining critical thinking skills through the aspects of analysis, evaluation, and inference remains limited. Furthermore, the relationship between animated videos and PBL stages should be viewed as an integrated learning sequence; the videos serve not merely to convey content but also as stimuli that direct students toward a problem, prompting them to conduct inquiries, engage in discussions, consider solutions, and draw conclusions.

Against this backdrop, this study applies animation-assisted Problem-Based Learning (PBL) in Phase E Economics instruction to improve students' critical thinking skills, particularly in the aspects of analysis, evaluation, and inference. Animated videos are employed as initial stimuli, followed by problem-solving activities aligned with the stages of PBL. The study also accounts for variations in students' prior abilities by using pretest scores as a covariate in the ANCOVA analysis. Consequently, differences in post-instructional abilities are analyzed while controlling for the students' initial conditions in both groups. The novelty of this study lies in integrating animated videos as problem

stimuli within the PBL stages in Phase E Economics learning, rather than using videos solely as instructional content. This study specifically examines students' critical thinking through analysis, evaluation, and inference while controlling for differences in initial ability using ANCOVA. Therefore, This study aims to compare critical thinking skills among students. participating in animation-assisted PBL and those undergoing conventional instruction in the Phase E Economics subject at SMA Negeri 4 Padang.

METHOD

This study adopts a quantitative approach using a quasi-experimental method and a pretest-posttest control group design, involving two groups an experimental class and a control class (Sugiyono, 2018). The research was conducted during the 2026/2027 academic year with 10th-grade students (Phase E) at SMA Negeri 4 Padang. A purposive sampling method was used to select the participants: class X.E5 (36 students) was designated as the experimental group, and class X.E1 (36 students) as the control group. These classes were selected because their learning environments and student competency characteristics met the study's requirements. To minimize instructor-related bias, the same researcher conducted all learning activities in both classes.

Prior to instruction, students in both classes took a pre-test to assess their baseline critical thinking skills. The mean pre-test scores were 40.03 for the experimental group and 34.64 for the control group, a difference of 5.39 points. Since the baseline abilities of the two classes were not identical, pretest point were used as a covariate and posttest point as the variable dependent in an analysis of covariance (ANCOVA). This approach allowed for an analysis of the differences in final outcomes between the classes while accounting for the students' initial abilities.

Critical thinking skills were measured using 10 open-ended questions covering indicators of analysis, evaluation, and inference. Before use, the instrument underwent expert review by an economics education instructor and economics teachers from SMA Negeri 4 Padang. Subsequently, a pilot test was conducted with 34 10th-grade students (class E.9) at SMA Negeri 14 Padang. Based on the results of the reliability test, the Cronbach's alpha coefficient is 0.825. Regarding item discrimination, 6 of the 10 questions were categorized as "good" or "fair."

Instruction for the experimental group was delivered over three sessions using PBL incorporating animated videos. The topics covered included scarcity, needs, priorities, and opportunity costs. The implementation of PBL (Problem-Based Learning) followed a process comprising problem presentation, student grouping, research, results presentation, and evaluation problemsolving process. In the experimental class, animated videos served as an introduction to help students understand the problem before engaging in activities and discussions using worksheets. In the first session on July 28, 2026, students learned about scarcity and needs using the animated video "Yu Darmi Ingin Membeli Kulkas" (Yu Darmi Wants to Buy a Refrigerator) from the anime series *Keluarga Somat*. In the second session on August 4, 2026, students discussed priorities and opportunity costs using the animated video "Berhutang atau Tidak" (To Borrow or Not to Borrow) from the anime series **Nussa dan Rara**. The third session on

August 5, 2026, was dedicated to reinforcing the learning content covered in these videos, followed by a post-test.

Control class utilized the same materials and number of sessions but employed a traditional classroom teaching method. The first session (July 30, 2026) and second session (July 31, 2026) involved lectures using PowerPoint, question-and-answer sessions, and practice exercises. The third session on August 6, 2026, focused on reinforcing learning content through a lecture format without PowerPoint, followed by a final test. Both classes shared the same materials, learning objectives, number of sessions, test questions, and instructor. The only difference in instruction was the teaching model: the experimental class used PBL utilizing videos," while the control class used "traditional teaching."

The research data were analyzed in several stages. The initial stage involved descriptive analysis. Subsequently, assumption tests were conducted, specifically the Shapiro-Wilk test for normality and Levene's test for homogeneity. Hypothesis testing was performed using ANCOVA, with the learning group as the independent variable, the post-test as the dependent variable, and the pre-test as the covariate. Prior to this, the homogeneity of regression slopes was verified. Next, the improvement in critical thinking skills was assessed using N-gain scores. Finally, to determine the magnitude of the difference in results between the two groups, effect size calculations based on (Cohen et al., n.d.) were employed.

RESULT AND DISCUSSION

RESULTS

Data regarding critical thinking skills were obtained through the administration of pretests and posttests. The sample was divided into an experimental group and a control group. The experimental group utilized the Problem-Based Learning model with animated video media, while the control group underwent conventional instruction. As a preliminary step prior to hypothesis testing, normality and homogeneity tests were conducted on the data.

Table 2. Shapiro–Wilk Normality Test Results for Pretest and Posttest Scores

Class		Shapiro-Wilk		
		Statistic	df	Sig.
Result	<i>PreTest A (control)</i>	.894	36	.002
	<i>Post test A (control)</i>	.979	36	.696
	<i>PreTest B (exprimen)</i>	.943	36	.064
	<i>Post test B (exprimen)</i>	.947	36	.081

Source. Data processed in 2026

Table 2 It can be seen that the posttest data for the control and experimental groups. are normally distributed, with Sig. values of 0.696 and 0.081 (>0.05), respectively. Regarding the pretest, the experimental group had a Sig. value of 0.064 (>0.05), whereas the control group had a Sig. value of 0.002 (<0.05); thus, the control group's pretest data were not

normally distributed. Due to the difference in initial ability between the two groups, the analysis proceeded using ANCOVA, with the pretest serving as a covariate to control for this difference.

Table 2. Tests of ANCOVA Assumptions

Test	F	Sig.	Decision
Homogeneity of regression slopes	0.358	0.552	Met
Levene's test	1.279	0.262	Met

Source. Data Processed in 2026

The test for homogeneity of regression slopes yielded $F = 0.358$ and $\text{Sig.} = 0.552 (>0.05)$, indicating no interaction between the group and the pretest; consequently, the assumption of homogeneity of regression slopes was met. The test for homogeneity of variance also showed $F = 1.279$ and $\text{Sig.} = 0.262 (>0.05)$, confirming that the variances of the two groups were homogeneous.

Table 3. Test Ancova

Class	Adjusted Mean	F	Sig.	Partial Eta Squared
Experimental	79,494	25,904	<0,001	0,273
Control	66,617			

Source. Data processed in 2026

Table 4 presents the ANCOVA results. After controlling for initial (pre-test) scores, a significant difference was found between the post-test scores of the experimental and control groups; the F-value was 25.904 ($p < 0.001$). Adjusted mean score for the experimental group was 79.49, whereas that of the control group was 66.62 a difference of 12.88 points. Furthermore, the partial eta squared value was 0.273, indicating a substantial effect of the PBL plus animated video intervention. In short, even after controlling for the groups' initial abilities, the critical thinking skills of the students in the experimental group remained superior to those in the control group.

Table 4. Test N-Gain

Group	Pretest Mean	Posttest Mean	N-Gain	Category
Experimens	40,03	80,58	0,67	Moderate
Control	34,64	65,53	0,47	Moderate

Source. Data Processed in 2026

Table 5 shows that the N-Gain value for the experimental group was 0.67, which is higher than the 0.47 recorded for the control group. Based on (Hake, 1998) criteria, both groups fell into the medium category. Although both groups showed improvement, the

experimental group demonstrated a greater increase in critical thinking skills compared to the control group.

In addition to the N-Gain, the effect size calculation using Cohen's *d* yielded a value of 1.17, indicating a large effect size. These results reinforce the ANCOVA findings, confirming a substantial difference in critical thinking skills between the group participating in animation-assisted PBL and the group undergoing conventional instruction.

DISCUSSION

Analysis indicates that students in classes implementing PBL with animated videos demonstrated higher critical thinking skills compared to those in classes using traditional teaching methods. After adjusting for initial ability using analysis of covariance ANCOVA, the adjusted mean for the experimental class was 79.49, surpassing the control class mean of 66.62. This 12.88-point difference was statistically significant ($F = 25.904$, $p < 0.001$). A partial eta-squared value of 0.273 represents the group effect size within the ANCOVA model. Thus, the difference in critical thinking skills persisted even after accounting for the students' initial standing in both classes.

These findings align with the characteristics of PBL, which positions a problem as the starting point for learning. Students do not merely listen to teacher explanations; they engage in activities such as comprehending the problem, gathering information, discussing, considering various options, and deciding on a solution. These activities provide students with opportunities to apply knowledge to solve problems rather than simply memorizing material. (Moallem et al., 2019) and (Ghani et al., 2021) also explain that PBL fosters student engagement through processes of inquiry and problemsolving. Each implemented stage of PBL supports the critical thinking indicators examined in this study. Students employ analytical skills when comprehending and breaking down the problem. They engage in evaluation when comparing information and alternatives. Furthermore, inference skills come into play as they use the results of these discussions to determine solutions and draw conclusions. This sequence is consistent with (Facione, 2013) view that analysis, evaluation, and inference are components of critical thinking. Animated videos serve as a trigger before students begin problem-solving activities, thereby supporting the process. The use of the videos extends beyond mere viewing; it continues with the completion of student worksheets, discussions, and inquiry activities. Presenting information using both visual and linguistic elements helps students comprehend and organize new information (Mayer, 2024). Furthermore, presenting economic issues via video adds a sense of concreteness, making the material more suitable as a basis for discussion. These findings align with research by (Abdulah et al., 2021; Maulina et al., 2024), which demonstrates that video and multimedia can support the implementation PBL and facilitate students' thinking processes.

Integrating these elements is crucial in experience based learning. While video serves to present the background and context of a problem, each stage of the PBL process offers students the opportunity to actively engage with the issue. After watching the video, students identify the problem, discuss the information provided on worksheets,

consider potential solutions, and finally present their findings. In other words, critical thinking skills are developed not merely through the medium itself, but primarily through student activities following this initial stimulation. This is why the use of animated video in this study is not positioned solely as a means of content delivery.

Themes such as scarcity, needs, priorities, and opportunity costs encourage the implementation of this learning approach because they are closely relevant to students' lives. Students can relate the instructional materials to situations where they must assess needs, establish priorities, and consider choices that entail trade-offs. Such issues provide opportunities for students to understand the rationale behind and consequences of their decisions. Learning based on real-life problems also effectively motivates students to actively seek solutions and make decisions (Moallem et al., 2019).

Discussion and presentation activities further reinforce this process. Students are required to explain the reasoning behind their chosen answers, while responses from other groups offer opportunities to consider diverse viewpoints. This process fosters the ability to communicate information and draw persuasive conclusions. These findings align with meta analyses by (Arviani et al., 2023; Liu & Pásztor, 2022), which demonstrated a positive correlation between the implementation of PBL and students' critical thinking skills.

Improvements in critical thinking skills were observed in the control group as well. The N-gain values were 0.67 for the experimental class and 0.47 for the control class; both fell within the moderate range. This indicates that learning continued and students' abilities improved during the second lesson. In the control class, students received explanations of the material, participated in Q&A sessions, and solved practice problems. However, opportunities for inquiry-based activities, discussions, and independently deriving solutions were more limited compared to the experimental class. These differences in activities are considered the reason for the greater degree of improvement seen in the experimental class (Sheffield, 2018; Shpeizer, 2018).

The difference between the two groups is further supported by a Cohen's *d* value of 1.17. This is a large effect size, indicating that the difference in outcomes between the groups is not only statistically significant but also substantial. However, given that the sample was purposively selected and the study employed a quasi-experimental design, the results must be interpreted within the specific context of the research. Consequently, the findings cannot be broadly generalized to diverse school environments or student populations.

This study contributes to the field by applying PBL incorporating animated videos as problem stimuli to economics instruction at the "Phase E" level. Beyond merely using videos to convey instructional content, the study integrated them with inquiry activities, discussions, presentations, and problem-solving tasks. Furthermore, it specifically examined critical thinking skills focusing on analysis, evaluation, and inference and utilized Analysis of Covariance (ANCOVA) to account for students' initial proficiency levels. Thus, PBL utilizing animated videos offers a viable alternative approach to economics education, providing contextualized learning materials that stimulate student thinking. Limitations of the study include the use of purposive sampling and

the brief duration of the intervention, which spanned only three sessions. Future research could involve longer intervention periods and samples with more diverse characteristics.

CONCLUSIONS

The results of this study, obtained through Analysis of Covariance (ANCOVA) after controlling for initial ability, revealed a significant difference in students' critical thinking skills following the application of a PBL model incorporating animated videos in Phase E economics classes at SMA Negeri 4 Padang. The adjusted post-test mean scores were 79.49 for the experimental class and 66.62 for the control class ($F = 25.904$, $p < 0.001$). N-gain scores were 0.67 for the experimental class and 0.47 for the control class, with both falling into the moderate category. The effect size was 1.17, indicating the magnitude of the difference. Therefore, the PBL model using animated videos serves as an effective alternative for economics instruction, as it fosters students' critical thinking skills through problem-solving activities, discussions, and the use of videos as learning stimuli.

AUTHOR CONTRIBUTION

Vivin Aulia Putri : Conceptualization, methodology, investigation, data management, data analysis, and writing the initial draft.

Oknaryana : Supervision, validation, review and editing of the manuscript.

CONFLICT OF INTEREST

"The authors declare no conflict of interest."

SIMILARITY STATEMENT

The manuscript has been checked using plagiarism detection software and meets the similarity level requirements of the Ecogen Journal.

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