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The Effect of Paul-Elder Framework-Based Video-Assisted LKPD in PBL on Students' Critical Thinking Skills

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Abstract

Developments in the 21st century require high-quality human resources who have several abilities, one of which is critical thinking. This experimental research was conducted to determine whether or not there was an influence of video-assisted LKPD based on the Paul-Elder framework on students' critical thinking skills in green chemistry material. This research method uses quasi-experiment with one experimental class and two control classes. The population is 108 class X students at SMA Teuku Umar Semarang. Samples were obtained using cluster random sampling. The experimental class was given LKPD assisted by 2 source videos while the control class was given LKPD assisted by 1 source video. Hypothesis testing uses one way anova with a significance level of 5%. The results of the research show that there is a significant influence between 2-source video media and 1-source video media on students' critical thinking skills in green chemistry material at a significance level of 0.05 with a significance value of 0.00 or less than 0.05. Improving critical thinking skills can be achieved by utilizing video-assisted LKPD based on the Paul-Elder framework which has been proven to be influential in chemistry learning. To get better results of students' critical thinking skills and Paul-Elder performance, it is best to use LKPD assisted by 2 source video media.

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INTRODUCTION

Education plays a crucial role in various aspects of life. The 4.0 Revolution era, also known as the 21st century learning era, is a turbulent time in the world of education (Suciono et al., 2021). In this era, life continues to develop and the emergence of increasingly complex problems, so that the ability for students to solve various problems that occur is needed. In this case, an ability called 21st century ability is needed (Warda, 2018). The development of the 21st century requires high-quality human resources who have several abilities, one of which is higher-order thinking (Perdani et al., 2019).

High-level thinking includes critical thinking, creative thinking, problem solving, and metacognition. Critical thinking is closely related to the cognitive abilities of students. Critical thinking skills begin to develop at the formal operational stage based on Piaget's cognitive development theory. According to Piaget's cognitive development theory, after the age of 12 years, students should have begun to be trained to think critically. thus, high school children with the age of 15 years should also have begun to think critically (Hewi & Shaleh, 2020).

Critical thinking is the art of analyzing and evaluating thoughts with the intention of improving them (Paul & Elder, 2014). According to Ennis (2011) critical thinking is a mental activity that is reflective and based on reasoning to determine what to believe and do. Students who are able to think critically will be able to make logical reasoning, analyze arguments, interpret information coherently and logically, make conclusions make decisions based on evidence (Fitriani et al., 2022). Critical thinking skills can help students express their ideas fluently. Students who are able to think critically will be able to make logical reasoning, analyze arguments, interpret information coherently and logically, make conclusions, and make decisions based on evidence using appropriate concepts, methods, and contexts (Fitriani et al., 2022). The results of interviews conducted with chemistry teachers are still limited learning media needed during learning activities, especially in green chemistry material. The learning process that is carried out occurs in one direction. Students are not accustomed to receiving alternatives, students are not asked to discuss from various sources, so the sources used by students are limited to teachers and school textbooks. In addition, the learning applied at school is more dominant in using conventional lecture learning models with textbooks and textbooks alone, which media have not been able to hone students' critical thinking skills. Critical thinking skills can be developed and trained by applying the appropriate learning model.

One of the learning models that is considered effective is to use a problem-based learning model. The application of Problem Based Learning (PBL) will be more interesting when supported by the use of visualization through media. One of the media that can help improve the effectiveness of the learning process is through the use of video or audio visual (Supriyono et al., 2022). Video media is a form of electronic media that combines sound and image technology so that interesting and dynamic impressions are obtained (Nurwahidah et al., 2021). The use of video-assisted worksheets is expected to reduce the weaknesses of problem-based learning and at the same time help improve students' critical thinking skills in the context of everyday life.

Previous research conducted by Yarmalinda (2020) explained that the problem-based learning model had a significant effect on students' critical thinking skills. Relevant research is supported by Supriyono (2022) who stated that the application of the problem-based learning model with video media in the classroom effectively improves students' critical thinking skills.

This research uses the Paul-Elder framework for its critical thinking model. The framework will be applied to the learning media in the problem-based learning model. The Paul & Elder critical thinking framework is one of the frameworks used by several researchers to analyze critical thinking because this critical thinking framework is general for engineering, natural sciences, social sciences, and linguistics (Mutakinati et al., 2018). The Paul-Elder framework is a level of stages that are considered easier to adopt into syntax in learning. Critical thinking skills can be measured through Paul-Elder's elements of reasoning and intellectual standards, which then from these

elements can be used as indicators to identify the extent to which students use critical thinking (Santi et al., 2018).

Based on this description, research has been carried out with the aim of knowing how the effect of video-assisted LKPD based on the Paul-Elder framework in problem-based learning on students' critical thinking skills in green chemistry material.

METHODS

The type of research used is quantitative research with a quasi experiment approach. The research design used used posttest only control design. In this study, the population is class X Teuku Umar Semarang High School with the sampling technique is cluster random sampling. Sampling is done when the sample has been said to be homogeneous by testing the homogeneity of the daily test data of the sample class students in the previous chapter. Based on the sampling technique, the samples were X-4 class students with 36 people as the experimental class, X-5 class students totaling 36 people as control class 1 and X-1 class totaling 36 people as control class 2. The independent variable in this study is learning media with variations in the treatment of experimental1 groups using video media 2 sources while control group 1 uses video media source 1 and control group 2 uses video media source 2, while for the dependent variable is the critical thinking ability of students.

Table 1. Posttest Only Control Group Design

No	Kelompok	Perlakuan	*Posttest*
1	Eksperimen	X1	O
2	Kontrol 1	X2	
3	Kontrol 2	X3	

The data collection method consists of tests using posttest question instruments in the form of essays and student worksheets. To analyze the data, one-way anova hypothesis test was used with a significant level of $\alpha = 0.05$. The requirements that must be met for hypothesis testing using one-way anova are normality and homogeneity of variance tests. The normality test was carried out with the Kolmogorov- Smirnov test, while for the variance homogeneity test, the Levene's Test was used.

RESULT AND DISCUSSION

In Paul-Elder's critical thinking model, there is the concept of Three Kinds of Questions consisting of one system questions, no system questions, and multisystem questions that can help students improve the quality of thinking and develop their critical thinking skills. Each class sample was given a different treatment, in which the two control classes were given a problem video that

came from one source that adhered to the concept of one system question. The experimental classes were given problem videos from two sources that embraced the concept of multysystem questions. The concept involves more than one system of thinking and requires complex thinking to answer. Students in the experimental class will consider various points of view and understand the relationship between several concepts, in which case experimental class students will receive from two or more different points of view from the two video sources that have been given to experimental class students.

The results of this study are in the form of critical thinking skills analyzed from worksheet data and green chemistry posttests. Data analysis includes posttest data analysis and critical thinking ability analysis. Researchers proved that the three classes had the same average by testing the homogeneity of the previous chapter's daily test scores as initial data. Analysis of critical thinking skills was then carried out to determine the level and distribution of students' critical thinking skills. Posttest data analysis includes normality test, homogeneity test, one-way anava test and post-anava test using Tukey test.

Analysis of Critical Thinking Skills

The data on students' critical thinking skills were obtained from worksheets and essay-based post-tests. These were designed to cover various aspects or indicators of critical thinking based on the Paul-Elder model. The worksheet data were used to assess students' Paul-Elder performance in each session. The summary of students' Paul-Elder performance results for each meeting is presented in Figures 1 and 2.

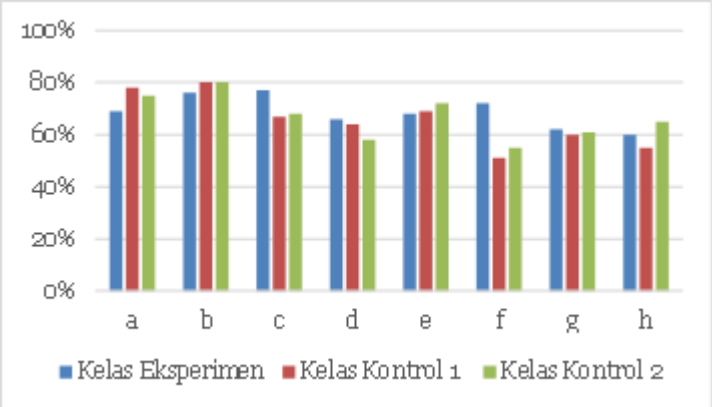

Figure 1. Recapitulation Results of Paul-Elder Performance in Meeting I by Indicator

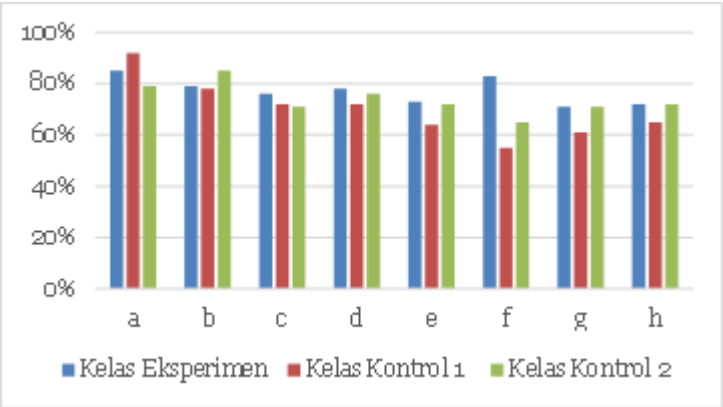

Figure 2. Recapitulation Results of Paul-Elder Performance in Meeting II by Indicator
Description: Indicators (a) purpose, (b) questions, (c) assumptions, (d) point of view, (e) information, (f) concepts, (g) conclusions, (h) implications.

Based on the recapitulation results from both meetings, there was an overall percentage increase in indicators from Meeting I to Meeting II. This indicates that students' critical thinking skills improved across all indicators. The critical thinking performance in each session was also compared with the criteria for critical thinking development based on the six stages of the Paul-Elder model. The results of students' critical thinking skill categories for each meeting are presented in Figure 3.

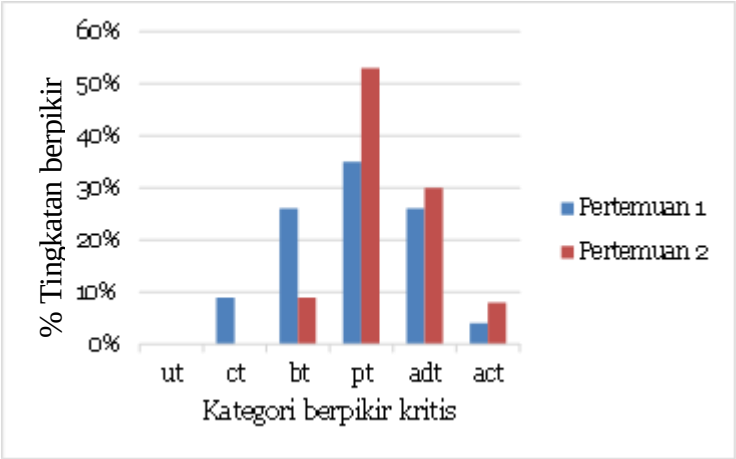

Figure 3. The Results of Students' Critical Thinking Skill Categories
Description: Critical Thinking Categories (UT) Unreflective Thinker, (CT) Challenged Thinker, (BT) Beginning Thinker, (PT) Practicing Thinker, (ADT) Advanced Thinker, (ACT) Accomplished Thinker.

The results of the critical thinking skill categories from the three classes based on the worksheets show that, in both Meeting 1 and Meeting 2, no students were classified in the

unreflective thinker category, indicating a complete absence of students with very low critical thinking skills.

In the low critical thinking category at the challenged thinker level, 10 students (9%) were identified in Meeting 1. These students faced significant limitations in their thinking processes. In the medium critical thinking category at the beginning thinker level, 28 students (26%) were identified in Meeting 1, and 10 students (9%) in Meeting 2. Although students at this level still had limitations in thinking, they began to improve certain aspects of their thinking abilities. At the practicing thinker level, 38 students (35%) were identified in Meeting 1, and this increased to 57 students (53%) in Meeting 2.

In the high critical thinking category at the advanced thinker level, 28 students (26%) were found in Meeting 1 and 32 students (30%) in Meeting 2. Meanwhile, in the accomplished thinker category, there were 4 students (4%) in Meeting 1 and 9 students (8%) in Meeting 2. To simplify, this study categorized unreflective thinker and challenged thinker as low (lower) thinkers, beginning thinker and practicing thinker as average (medium) thinkers, and advanced thinker and accomplished thinker as high thinkers.

Posttest Data Analisys

The analysis of the collected data includes the posttest scores of critical thinking skills from the three sample classes. To test the hypothesis using one-way ANOVA, the data has been tested for normality and homogeneity of variances. These tests were conducted as preliminary tests before the ANOVA. The normality test is used to determine whether the distribution of scores in the experimental class, control class 1, and control class 2 is normal or not. This normality test was conducted with a 95% confidence level, or a 5% significance level. The results of the normality test are shown in Table 2, with a significance value of 0.138 (> 0.05) for the experimental class, while the posttest scores for both control classes, control class 1 and control class 2, had significance values of 0.200 (> 0.05). Therefore, it can be concluded that the data from the three classes are normally distributed.

Table 2. Normality Test for Posttest Data

Score	Group	Kolmogorov-Smirnov			Desc
		Statistic	df	Sig.	
Posttest	Experiment	0,129	36	0,138	Normal
	Control 1	0,116	36	0,200	
	Control 2	0,116	36	0,200	

The hypothesis test is conducted after the normality test is performed when the data is normally distributed and the variance test is performed when the data has the same or homogeneous variance. This hypothesis testing is conducted to see the difference in the effects of two-source video media and one-source video media on students' critical thinking skills in green chemistry material. The hypothesis testing uses one-way ANOVA, and after testing, the results presented in Table 4 show that F calculated > F table, which is 13.881 > 3.08, with a significance of 0.00 (< 0.05). Therefore, H0 is rejected, and Ha is accepted. This means that there is a significant effect between the two-source video media and the one-source video media based on the Paul-Elder framework on critical thinking skills in green chemistry material.

Table 4. One-Way ANOVA Test on Posttest Scores

Nilai	df	Fhitung	Ftabel	Sig.
Between Groups	2	13,881	3,08	0,000
Within Groups	105			
Total	107			

Since there was a significant difference in the results of the one-way ANOVA test, a post-ANOVA test was conducted using the Tukey test. The purpose of this test was to identify the groups that showed differences or to evaluate the extent of the differences between each class or treatment group. The results of the Tukey test are shown in Table 5. It can be seen from the Tukey test results that there is no significant difference between control class 1 and control class 2, as both control classes used one-source video-assisted LKPD. This is also reflected in the average scores of students in control class 1 and control class 2, which are grouped in subset 1, indicating no significant difference. However, significant differences were observed between the experimental class and both control class 1 and control class 2. The experimental class, which used two-source video media, had higher average scores compared to the two control classes that used one-source video media. Therefore, it can be concluded that the LKPD with two-source video media, based on the Paul-Elder framework, is more effective than the LKPD with one-source video media in improving students' critical thinking skills.

Table 5. Tukey Test on Posttest Scores

Category	**N**	**Subset**	
		1	**2**
Control 1	36	74,4750	
Control 2	36	78,0056	
Experiment	36		86,0722
Sig.		0,266	1,000

The critical thinking skill scores based on the posttest results were obtained after the learning process took place. The test results for students can be seen in Table 6. Based on the posttest scores, it is clear that the average critical thinking skills of students in the experimental class, which used two-source

video media, had a higher average score than the two control classes, with an average of 86.07. The average critical thinking skill score for students in the class using one-source video media (control class 1) was lower than the experimental class, at 74.48, and the class using video media from source 2 (control class 2) had an average of 78.01. Therefore, it can be concluded that the LKPD with two-source video media, based on the Paul-Elder framework, is more effective than the LKPD with one-source video media in improving students' critical thinking skills.

Table 6. Student Posttest Results

No	Class	Maximum	Minimum	Mean
1	Experiment (Video sources 2)	98	66	86,07
2	Control 1 (Video source 1)	89	61	74,48
3	Control 2 (Video source 2)	95	52	78,01

The results of this study align with research conducted by Dewandaru (2015), which stated that there is a significant effect of video media on students' critical thinking skills. The use of video media helps teachers present material and makes it easier for students to stimulate their critical thinking. After conducting the one-way ANOVA test, data on the average critical thinking scores for the experimental and control classes were obtained. The hypothesis analysis using the one-way ANOVA test found significant differences between the use of two-source video media and one-source video media in improving critical thinking skills between the experimental class and both control classes on the topic of green chemistry. This is because students in the experimental class were exposed to problems from more than one source during their learning process. As a result, experimental class students received more information, concepts, ideas, questions, drew conclusions, and found solutions to various problems, while considering different viewpoints and assumptions from different sources. On the other hand, both control classes were only given problems from one source during their learning. Students in the control classes typically received information, concepts, and viewed problems from just one perspective — that of the video provided by the teacher.

The findings of this study are consistent with research by Wang et al. (2006), which stated that individuals who can engage with multiple perspectives and apply a multi-system approach in their critical thinking tend to be more effective in problem-solving because they can consider a broader range of viewpoints and generate more solutions.

CONCLUSION

There is a significant effect between two-source video media and one-source video media on students' critical thinking skills in green chemistry material at a 0.05 significance level, with a significance value of 0.00 (< 0.05) and Fcount > Ftable. The improvement in critical thinking skills can be achieved by using LKPD (Student Worksheet) assisted by video media based on the Paul-Elder framework, which has proven to be effective in chemistry learning. To achieve better critical thinking skills and Paul-Elder performance in students, it is recommended to use LKPD assisted by two-source video media.

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