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Integration of Interactive Video in Problem-Based Learning on Environmental Change and Conservation Material to Enhance Students' Critical Thinking Skills at SMA Negeri 2 Indramayu

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Abstract

This study aimed to determine the effect of integrating interactive video in problem-based learning (PBL) on students' critical thinking skills in the topic of environmental change and conservation. The research was conducted at SMA Negeri 2 Indramayu during the 2024/2025 academic year using a quasi-experimental design with a non-equivalent control group. Data were collected through a critical thinking test consisting of validated essay questions. The analysis included normality, homogeneity, and independent sample t-tests. The results showed that students taught using PBL integrated with interactive videos achieved higher critical thinking skills than those taught conventionally. The integration of interactive videos improved students' understanding, curiosity, and analytical ability toward environmental issues. Therefore, this approach can effectively foster critical thinking skills in biology learning.

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Keywords: *interactive video, problem-based learning, critical thinking skills, environmental education*.

INTRODUCTION

The Industrial Revolution 4.0 era has transformed perspectives on education. Interestingly, in Indonesian education, there are numerous gaps that actually create a distance between desired competency targets and the results achieved (Halim, 2022). The absence of encouragement from educational patterns to stimulate students to think critically has given rise to a generation of "followers" who spend most of their time standing in line, rather than stepping up to the front and becoming inventors to break deadlocks or halt the flow of unproductivity around them (Waruwu et al., 2024).

The challenge in education is requiring students to develop higher-order thinking (HOTs). In biology, critical thinking skills are essential for students to solve problems encountered during experiments (Hamdani M. et al., 2019). Critical thinking skills generate original ideas and concepts that benefit the learning process and social life. The benefits gained from these skills are crucial for both school and workplace environments, as individuals who think critically tend to be more independent in decision-making and generate more creative ideas (Prasetiyo et al., 2020).

The reality in a study in Palembang shows that students' critical thinking skills on cell material in Palembang high schools are still relatively low (Nawawi. et al., 2019). This low achievement was identified as being related to several factors, including internal and external factors of students, learning behavior, and the learning process that collectively influence learning outcomes. The low achievement of students' cognitive learning outcomes is caused by internal factors from the students themselves due to a lack of enthusiasm in learning during biology lessons. Teachers' inadequate skills in using learning technology that is only filled with theoretical explanations will make students quickly feel bored. Teachers do not use a variety of the latest models and approaches so that students do not participate actively in the biology learning process (Nawawi. et al., 2019). Based on the results of pre-research

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interviews with 10th grade Biology teachers, Biology learning practices at SMAN 2 Indramayu still have room for improvement, where students' critical thinking skills are still relatively low. Although teachers have attempted to facilitate students' conceptual understanding, stimulation of critical thinking skills is still low, and evaluation of biology learning about critical thinking is still rarely carried out. The use of learning media, such as interactive videos and LKPD, is also still rarely/never implemented in biology learning because teachers are still rarely in the use of technology, only more often using PPT and PowerPoint. This indicates the potential to improve the quality of learning through better integration between interactive videos and LKPD in order to stimulate students' critical thinking skills.

In an effort to improve students' critical thinking skills, researchers adopted the Problem-Based Learning (PBL) model. This model was chosen based on the belief that PBL has the potential to facilitate the development of students' critical thinking skills through a problem-solving approach. The advantage of Problem-Based Learning activities is that students can develop critical thinking skills as a step in solving a problem and drawing conclusions based on what they understand (Kusumawati et al., 2022). PBL has a significant influence on high school students' critical thinking skills in biology learning (Azura et al., 2023). In PBL, students are actively involved in solving real-world problems related to biology, enabling them to gain a deeper understanding of concepts. Through this process, students also develop critical thinking skills by identifying problems, analyzing information, and making decisions based on their existing knowledge (Azura et al., 2023). The Problem-Based Learning model is closely related to critical thinking skills. Critical thinking skills will improve students' ability to seek out information essential for the learning process based on accurate facts and data. The Problem-Based Learning model presents real-world problems that require solutions in everyday life. Students are also able to compose and formulate statements accurately, boldly express ideas and concepts, and respect opinions (Rauf. et al., 2022). Although the Problem Based Learning (PBL) model is effective in developing critical thinking skills, applicable biology material will be difficult to understand if it is not supported by visual data that will stimulate the human brain (Sholikha, 2024).

Therefore, this study combines PBL with interactive video media to facilitate students' understanding of these concepts. This opinion is in line with (Zulfa & Prastowo, 2023) who explain that the purpose of learning using video media is to cover cognitive, affective, and psychomotor aspects. In the psychomotor domain, it can be produced from what students record in memory based on movement or motor activities in the video so that students can observe and re-evaluate these activities.

Interactive video learning media with small group discussion settings can improve students' critical thinking skills. Critical thinking skills are thinking skills that use the basis of analyzing arguments and generating insights into each meaning and interpretation (Luh Made Indria Dewi & Ni Luh Rimpiati, 2016). This is also shown in the research of (Zulfa & Prastowo, 2023), by using learning media in the form of interactive videos can facilitate the delivery of Integrated Thematic Science learning on the material of human blood circulation with the results of the predicate "Very Good" so that, through interactive video media is effectively implemented in the teaching and learning process (Wardani et al, 2018).

The topic of Environmental Change and Conservation was chosen as the focus of this research because of its applicative nature, requiring more concrete representation. The use of interactive video media is expected to facilitate student understanding of the material. In line with (Fitriana, 2023), the implementation of biology teaching and learning activities generally requires direct field observation to facilitate understanding of a concept. However,

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several applicative concepts were found to be difficult to analogize through field observations. The solution is the need for appropriate learning media to support successful learning.

Based on the description of the research background, the researcher will conduct a study entitled "*Integration of Interactive Video in Learning the Material of Environmental Change and Conservation Through Problem-Based Learning on Critical Thinking Skills of Students at SMA Negeri 2 Indramayu*."

In the field of study of Biology there is material on Environmental Change and Conservation where students are usually required to think critically in finding solutions to assigned problems.

The objectives of this study are:

1. To determine the effect of integrating interactive video into PBL on students' critical thinking skills.
2. To identify the differences in critical thinking skills between students taught using interactive video-based PBL and those taught conventionally.
3. Description of student responses to the application of the Problem Based Learning Model integrated with interactive videos on the material on Environmental Change and Conservation in the experimental class.

METHOD

This research employed a quasi-experimental design with a non-equivalent control group. The study was conducted at SMA Negeri 2 Indramayu with two classes of tenth-grade students as samples. The experimental class was taught using PBL integrated with interactive videos, while the control class used traditional methods.

The instrument was a critical thinking test consisting of five essay items covering indicators such as interpretation, analysis, inference, explanation, and evaluation. The instrument was validated by experts before use.

The data collection involved pre-test and post-test procedures. Data were analyzed through normality and homogeneity tests to verify assumptions, followed by an independent sample t-test using SPSS to determine significant differences between the two groups.

RESULTS AND DISCUSSION

The results of the study are a presentation of data collected during the study at SMAN 2 Indramayu. This study involved two classes, namely class X MIPA 2 as the experimental class and X MIPA 4 as the control class.

Furthermore, student data was processed to answer the research questions. The data obtained include: 1) the value of students' mastery of critical thinking skills taken from the posttest results on the integration of interactive videos in learning the material of environmental change and preservation through Problem Based Learning, and 2) descriptive values of students' critical thinking skills taken from the posttest results on the integration of interactive videos in learning the material of environmental change and preservation through Problem Based Learning. Data collection was carried out on Monday, May 26, 2025 at SMA Negeri 2 Indramayu.

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Table 1. The results of the test of equality of two means (t-test)

Class	Average	Varians	S_{com}	T_{count}	T_{table}	Conclusion
Eksperiment Class	83.94	Homogen	2.548	13.301	2.000	There is Influence
Control Class	50.04	Homogen				

Based on Table 4.3, the t-count value is 13.301 and the t-table is 2.000 at a significance level of 5% (α = 0.05) with degrees of freedom (df) = 65. Because the t-count > t-table, it can be concluded that there is a significant influence between student learning outcomes in the experimental class and the control class. This shows that the Problem Based Learning model integrated with interactive video has a significant influence on improving student learning outcomes.

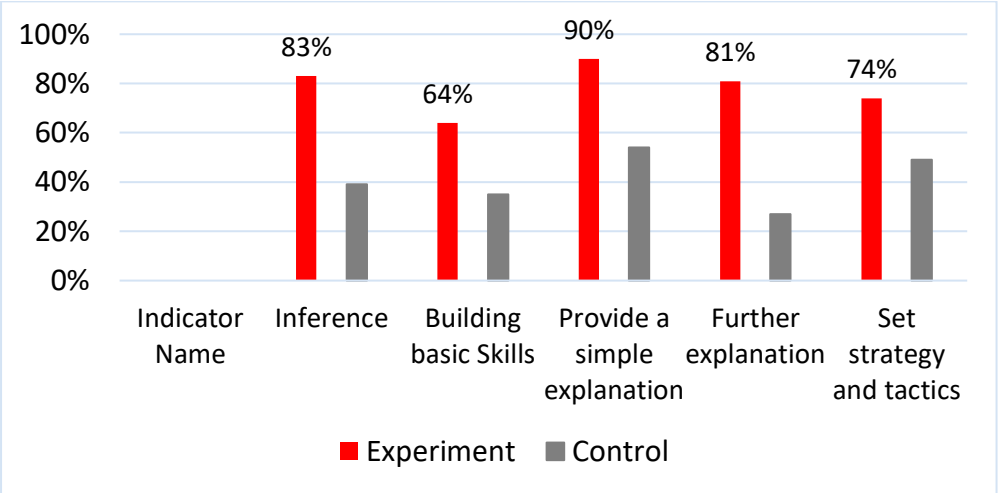

Figure 1. Comparison of the percentage of students' critical thinking skills between the experimental class and the control class

Based on Figure 1. shows that the results of the critical thinking skills test of students between the experimental class and the control class there are differences. This can be seen that the results of the percentage of data obtained in the experimental class and the control class per indicator, in the experimental class the lowest indicator = 64% and the highest = 90% while in the control class it can be seen the lowest indicator percentage = 27% and the highest = 54% it can be concluded that the critical thinking skills of students in the class that uses interactive video integration in learning the material of environmental change and preservation through Problem Based Learning (experimental class) are very high compared to the class that uses the conventional method (Lecture) meaning that the critical thinking skills of the class that uses interactive video integration in learning the material of environmental change and preservation through Problem Based Learning are better than the class that uses the conventional method (lecture).

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Table 2. Student Response Statements to Learning

Indicators	Persentage	Criteria
Actively participating in learning	97%	In general
Reading or listening	91%	In general
Seeing	97%	In general
Arousing/arousing feelings	84%	In general
Observing	97%	In general
Average	93%	In general

Table 2. shows that students' responses to biology learning on environmental conservation changes through Problem Based Learning generally responded well (positively) with a percentage level of 93%.

Table 3. Student Response Statements Regarding Learning Media

Indicators	Persentage	Criteria
Suitability to the material	97%	In general
Ease of use	97%	In general
Attractiveness	94%	In general
Usefulness	92%	In general
Average	95%	In general

Table 3. shows that students' responses to biology learning media on environmental conservation changes using the Problem Based Learning model through interactive videos generally responded well (positively) with a percentage level of 95%.

Based on Table 1, the results of the posttest data analysis, the average score of students' critical thinking skills in the experimental class was 83.94, while in the control class it was 50.04. This means that students' critical thinking skills in the class using the PBL model with interactive video integration were better (33 points higher) than the class using the conventional method (lecture).

A real example in the results of research by (Wardani et al., 2018) shows that the average percentage of students' critical thinking skills in the class using the conventional model is in the low category (<60%). Findings from (Masek & Yamin, 2012) revealed that the conventional approach was also proven to be less effective in improving critical thinking skills. Then, based on the results of the hypothesis test in Table 4.5, there was a significant influence between student learning outcomes in the experimental class and the control class. This shows that the Problem Based Learning model integrated with interactive video has a significant effect on improving student learning outcomes. In line with the findings of (I Made Dandi Suardika, 2024) who showed a significant increase in students' critical thinking skills after using PBL-based interactive videos.

These findings indicate that the integration of interactive video and the Problem Based Learning model not only increases student engagement in the learning process but also has a real impact on the development of critical thinking skills.

The use of interactive video allows students to obtain a more concrete visualization of the problem, while the PBL approach encourages students to be actively involved in the

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problem-solving process. As stated by (Achmad Ramadhan & Sutrisnawati Mardin, 2023), the PBL approach enriched with interactive media makes students more active in observing, analyzing, and concluding concepts through direct experience. This opinion is also supported by (Imansyah & Hasanah, 2024), who stated that interactive video improves students' critical thinking skills. In line with these findings, (Abdulah, 2023), PBL assisted by interactive video was proven to significantly improve critical thinking scores (average posttest 79.94 vs. 68.28). These results are in line with research by (Nulhakim et al., 2020) which found that PBL-based interactive multimedia is effective in improving students' critical thinking skills.

In addition to testing the effect, this study also describes students' critical thinking skills. Table 4.6 shows that the average percentage of each critical thinking skill indicator for students in classes using the problem-based learning model integrated with interactive video was 78.4%, which falls into the high category. A similar trend was observed for classes using the conventional model, where the average percentage was also 40.8%, falling into the Very Low category. These results can be described in detail regarding students' critical thinking skills in biology learning on environmental change and preservation as follows.

The first indicator, namely "compiling simple explanations," the experimental class scored 90%, which is categorized as very high, while the control class scored only 54%, which is categorized as low. In this case, students were asked to analyze arguments about solid waste management. Students in the experimental class were able to differentiate between domestic waste and non-domestic solid waste based on their definitions, sources, and examples, demonstrating the ability to compile simple explanations. These results are in line with research by (Han et al., 2024) which stated that students are able to analyze arguments and identify the reasons put forward in a problem. Support for this skill is also evident in student responses that show active participation after watching the interactive video. They are encouraged to discuss, ask questions, and answer questions in learning. This is supported by (Almuslamani et al., 2020) which shows that the use of videos has a direct influence in encouraging student activeness through discussion and interaction.

The second indicator, "conclusion," showed a score of 83% for the experimental class (very high category), while the control class only achieved 39% (low category). In this indicator, students were asked to create and determine the results of considerations in the form of a flowchart of the compost-making stages. Students in the experimental class were able to perform well because they were accustomed to similar question patterns during the learning process. This is supported by the findings of (Fetricia et al., 2023) that students who had been given practice questions with a similar approach tended to be able to conclude correctly in the evaluation. Student responses also supported this result; they listened attentively to the narrator's voice explanation in the video, demonstrating concentration on the information needed to conclude the material's content. This aligns with (Palaigeorgiou & Papadopoulou, 2019) who emphasized that interactive videos can focus students' attention on listening and understanding learning content.

The third indicator, "further explanation," scored 81% in the experimental class (very high category) and 27% in the control class (low category). During the lesson, students were asked to define appropriate terms related to how to minimize solid waste. These results indicate that students in the experimental class were able to provide further explanations by assessing definitions and identifying relevant assumptions in the given context. This finding aligns with research by (Nurhasanah, 2020), which states that trained students are able to provide further critical explanations of a problem. Student responses reinforced this achievement, as they were drawn to the visuals in the video, including images, colors, and

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designs, making it easier for them to understand and explain the material. This aligns with research by (Tseng, 2021), which states that visual guidance in videos increases student engagement and helps them develop critical explanations through keen observation.

The fourth indicator, "managing strategies and tactics," showed a score of 74% in the experimental class (high category) and 49% in the control class (low category). In this indicator, students were asked to create a pamphlet containing information on solid waste management. During the process, they were encouraged to discuss and collaborate in developing strategies for conveying information. This is consistent with the findings of (Mauludah et al., 2019) who stated that in group discussions, students are trained to use their knowledge and experience in developing problem-solving strategies. Student responses after watching the video also indicated that they felt more motivated and emotional in expressing their opinions. Interactive videos have been shown to arouse students' interest in the material and increase their courage to actively participate. This is reinforced by (Han et al., 2024), who stated that interactive video content arouses students' emotions and significantly increases their motivation and engagement in the learning process.

The final indicator, "building basic skills," scored 64% in the experimental class (medium category) and 35% in the control class (low category). In this context, students were asked to provide solutions to waste problems accompanied by relevant reasons. Although still considered moderate, the experimental class's performance demonstrated a better ability to build a foundation for critical thinking compared to the control class. This aligns with research by (Suharyani et al., 2023), which reported that students are expected to be able to connect information in the text with logical and contextual solutions. Student responses indicated that they were able to observe the video in depth, particularly in recognizing the negative impacts of waste and the stages of waste management. They stated that the video helped them understand the content and relate it to real life. Research by (Fadilah & Nandiyanto, 2022) supports this, stating that the visuals in the video facilitated understanding and raised students' awareness of environmental issues, thereby encouraging them to think critically in finding solutions.

Based on observations and data analysis on each critical thinking skill indicator, it can be concluded that the learning conditions in the experimental class demonstrated significantly superior quality compared to the control class. This superiority was evident in the high scores achieved on each indicator, reflecting students' ability to formulate explanations, draw conclusions, provide further explanations, organize strategies, and develop basic problem-solving skills. In depth, learning in the experimental class was more dynamic and interactive. Students appeared more enthusiastic in participating in the learning process, actively engaged in discussions, and were able to convey arguments and ideas in a structured manner. Several key factors influencing this improved learning quality included the use of interactive videos designed with quizzes, narratives, dynamic visuals, and material contexts close to students' real-life situations. These media served not only as a means of information but also as a catalyst for discussion, conceptual reinforcement, and logical thinking training. Another factor was the implementation of the Problem-Based Learning model, which encouraged students to examine real-world problems, find alternative solutions, and communicate their findings independently and collaboratively. Emotional student engagement is also an influential aspect, where the visuals and narrative in the video can arouse students' attention and empathy for the environmental issues being studied. On the other hand, the control class that only used conventional media such as PowerPoint and LKPD tended to produce passive learning interactions. The lack of visual stimulation, emotional

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engagement, and opportunities for exploration made it difficult for students to understand the context of the problem in depth, resulting in low critical thinking skill outcomes. Thus, it can be concluded that learning effectiveness is greatly influenced by the quality of the media and the learning approach used, where the integration of interactive video and the PBL model proved to be an optimal combination in improving the quality of the process and student learning outcomes. This statement is supported by the results of research by (Febliza et al., 2023), who concluded that the use of interactive video was significantly superior in improving critical thinking skills compared to conventional media (the effect obtained reached approximately one-third of the total variance contribution). (Suseno et al., 2020)also reported an increase in critical thinking through PBL + video.

Overall, the use of interactive video media in PBL is highly recommended to improve students' critical thinking skills, especially on the material of environmental change and preservation at SMA Negeri 2 Indramayu.

CONCLUSION

Based on the data processing, analysis, and discussion, the following conclusions can be drawn from this study:

1. The application of the Problem-Based Learning Model integrated with interactive video to the topic of Environmental Change and Conservation has an impact on students' critical thinking skills.
2. The results of the description of students' critical thinking skills after implementing the Problem-Based Learning Model integrated with interactive video are classified as high.

3. The description of student responses to the application of the Problem-Based Learning Model integrated with interactive video to the topic of Environmental Change and Conservation in the experimental class showed a generally positive response.

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