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THE INFLUENCE OF THE USE OF LEARNING MEDIA ON THE MATERIAL ON THE PROPERTIES OF LIGHT ON THE LEARNING OUTCOMES

Meirita Sari^{1*}, Elvida Sari Yunilarosi², Intan Apriani³, Lionita Dewi Hardila⁴, Sigit Surya Pratama⁵

^{1,2,3,4,5}Program Studi Tadris Ilmu Pengetahuan Alam, UIN Fatmawati Sukarno Bengkulu, Indonesia

*Correspondence E-mail: meiritasari@mail.uinfabengkulu.ac.id

Abstract: This study examined the effect of using learning media in teaching the properties of light on junior high school students' learning outcomes and critical thinking skills in science. A quantitative approach was employed using a one-group pre-test–post-test design. The sample was selected randomly, and data were collected through a critical thinking test administered before and after the treatment. The findings revealed that the use of learning media had a positive and significant impact on students' performance. Students' mean score increased from 54.81 on the pre-test to 82.90 on the post-test, indicating substantial improvement in learning outcomes. In addition, students' critical thinking skills showed marked development, improving from a low category to an excellent level after the implementation of the learning media. Statistical analysis using the t-test further confirmed that the treatment significantly enhanced students' critical thinking abilities. These results suggest that integrating learning media into science instruction, particularly in the topic of the properties of light, effectively supports students' understanding and promotes higher-order thinking. Overall, the study concludes that the use of learning media not only improves academic achievement but also fosters critical thinking skills, which are essential for students' success in science learning.

Keywords: Critical Thinking, Properties of Light, Learning Outcomes, Learning Media

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INTRODUCTION

According to Prasasti and Anas (2023), students must be adequately prepared to face global challenges in the coming century. Through strong reasoning, students are able to seek accurate evidence, evaluate critical thinking, and convey the consequences of their actions and statements. Critical thinking, as explained by Ennis (2016), focuses on deciding what to believe or what actions to take. According to Afdillah et al. (2023), critical thinking is a deliberate thinking process that integrates various skills to solve problems effectively.

However, students' critical thinking skills in Indonesia are still relatively low. This is reflected in the results of the Programme for International Student Assessment (PISA) 2018, which show that Indonesian students' achievement in science remains below the OECD average (Fitriani et al., 2021). One of the causes of this low achievement is the underdevelopment of critical thinking skills in the learning process (Sa'adah et al., 2020). In addition, learning processes that are still dominated by lecture methods and the limited use of interactive learning media result in low student engagement and difficulties in understanding concepts deeply.

Based on observations conducted in schools, students also demonstrate low conceptual understanding and critical thinking skills, particularly in science subjects. Many students have not yet achieved the Minimum Mastery Criteria (KKM), indicating that the learning process has not been optimal. This condition is supported by Anas and Syafitri (2019), who state that science is one of the subjects that is less favored by students, which in turn affects their learning outcomes.

To address these problems, the use of learning media is considered one of the possible solutions. Learning media can help students transform abstract concepts into more concrete forms. One type of media that can be used is the light properties box (KOSICA), a teaching aid designed to demonstrate various properties of light such as reflection, refraction, and the propagation of light (Fadhilah et al., 2022).

Although several previous studies have examined the use of learning media in teaching the properties of light, such as those conducted by Faradhita (2022) and Isti et al. (2022), these studies still have limitations. The identified research gap is that most studies focus primarily on improving learning outcomes or conceptual understanding, without deeply examining the effect of the light properties box media on students' critical thinking skills. Furthermore, previous studies were mostly conducted in limited learning settings or used different types of media, thus not providing a comprehensive understanding of the effectiveness of KOSICA in direct face-to-face learning.

Based on this gap, this study is important to conduct. The urgency of this research lies in the need to develop students' critical thinking skills as one of the essential competencies of the 21st century, which are crucial for facing global challenges. Without strong critical thinking skills, students will struggle to analyze information, solve problems, and make appropriate decisions, both in academic contexts and in everyday life. Therefore, innovation in learning is needed not only to improve learning outcomes but also to enhance students' critical thinking skills.

The selection of the topic of light properties in this study is based on the nature of the material, which is abstract and requires concrete visualization to be easily understood by students. Concepts such as reflection, refraction, and the propagation of light are difficult to comprehend if delivered only verbally. Therefore, the use of media such as the light properties box is highly relevant in helping students directly observe these phenomena. In addition, the topic of light properties is closely related to everyday life, which can encourage students to think critically in connecting concepts with real-world phenomena.

METHOD

This study is a field research conducted directly in the school to obtain accurate and factual data (Simanjuntak & Sosrodiharjo, 2014). It employs a quantitative approach based on the positivist paradigm, in which data are collected through research instruments and analyzed statistically to test the proposed hypotheses (Sugiyono, 2015). The research uses a quasi-experimental method with a *Pretest-Posttest Control Group Design*, involving two groups: an experimental group and a control group. The experimental group is taught using the light properties box (KOSICA) as a learning medium, while the control group receives conventional instruction without the media.

The population of this study consists of all eighth-grade students, with the sample taken from two classes, namely Class VIII A as the experimental group and Class VIII B as the control group, selected through purposive sampling based on specific considerations such as initial ability and teacher recommendation. The research instrument used is a critical thinking test in the form of essay questions administered as pretest and posttest. Prior to its use, the instrument is tested for validity using the Product Moment correlation and for reliability using Cronbach's Alpha, along with item difficulty and discrimination index analysis. The data are analyzed using descriptive statistics (mean, maximum, minimum, and standard deviation), followed by normality and homogeneity tests, hypothesis testing using the *t-test*, and N-Gain analysis to determine the improvement in students' critical thinking skills after the treatment.

In this study, the KOSICA learning media is used to facilitate students' understanding of abstract concepts related to the properties of light. The media consists of components such as a light source, lenses, and supporting materials that enable students to observe phenomena such as reflection, refraction, and light propagation directly.



Figure 1. Media

Figure 1 illustrates the KOSICA learning media used in this study. The media is designed to provide a concrete representation of abstract scientific concepts, allowing students to observe light behavior directly through experimentation. During the implementation phase, students in the experimental group actively engaged in group-based experiments using the KOSICA media. They observed, discussed, and analyzed the results of the experiments to construct their understanding of the concepts.



Figure 2. Examples Of The Properties Of Light

Figure 2 shows students conducting experiments using the KOSICA media in the classroom. Through this activity, students actively participated in observing and analyzing light phenomena. This hands-on learning process supports the development of students' critical thinking skills by encouraging them to draw conclusions based on direct observation.

FINDING AND DISCUSSION

This review aims to examine the influence of light properties on the critical thinking skills of junior high school students. Researchers used pre-test and post-test results to process the data. The accompanying researcher is expected to present the results based on the collected data as follows:

Validity and Reliability

This study used pre-test and post-test instruments containing questions (papers) to assess students' critical reasoning. The instrument's validity was tested using content validity, and the results were deemed substantial. Furthermore, the test's reliability was evaluated using Cronbach's Alpha. The findings from the reliability assessment used in the review are presented below:

Table 1. Reliability Test Results

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.746	.749	5

Based on the estimation using SPSS 29 above, it can be seen that the test value is 0.746. Cronbach's Alpha (α) > 0.60 indicates that the test is solid.

Normality Test

The paired sample t-test was used to analyze the data collected by the researcher. The analyst previously looked at the generality of the information before conducting the investigation. This study used the Shapiro-Wilk strategy because the number of tests was less than 50. The generality results showed that the significance value of the variable V1 was 0.228 and the significance value of the variable and X1 was 0.092. In addition, a premetric paired sample t-test can be conducted to determine whether elective speculation is recognized or the significance value (2- followed) is equal to or less than 0.05. This shows a significant difference between the pre-test and post-test mean scores, indicating the success of the treatment.

Table 2. Normality Test

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
V1	.185	21	.059	.941	21	.228
X1	.220	21	.009	.921	21	.092

a. Lilliefors Significance Correction

Average Pre-test and Post-test Scores The light prop box media significantly impacted students' critical thinking when solving problems, according to the review. Table 3 below shows the average pre- and post-test scores:

Table 3. Average Pre-test and Post-test Scores

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	V1	54.81	21	10.884	2.375
	X1	82.90	21	8.252	1.801

Based on the information presented in table 3, it can be seen that the average value of students' critical reasoning performance in (pre-test) V1 was 54.81, while in (post-test) X1 it increased to 82.90. This indicates a significant increase in the average score after using the light property box media as an appropriate medium in the learning experience. In addition, the researcher used a suitable pattern t-test to decide whether there was a significant difference between the pre-test and post-test scores in working on students' critical reasoning after using the light property box media.

Paired Sample T-Test

The following table presents the results obtained from the t-test analysis.

Table 4. Paired sample test

Paired Samples Test									
		Paired Differences				Significance			
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	t		df	
					Lower	Upper		One-Sided p	Two-Sided p
Pair 1	V1 - X1	-28.095	7.224	1.576	-31.384	-24.807	-17.822	20	<.001

The significance value (2-followed) is $0.001 < 0.05$ as found in table 4 of the t-test results (matched sample T-test). These results indicate that the light property box media overall improves students' critical thinking skills after treatment. Students' critical thinking skills are reported to increase by using the light property box media (kosica).

This study aims to analyze the effect of using the light properties box (KOSICA) as a learning medium on students' critical thinking skills in science learning. Critical thinking

skills include activities such as analyzing, evaluating, drawing conclusions, and solving problems. Conceptually, these skills are categorized as higher order thinking skills (HOTS), which are essential in 21st-century learning (Hamidah et al., 2023; Dinah et al., 2023).

The results of the study indicate that students' critical thinking skills before the treatment were still relatively low. This suggests that students were not yet able to optimally relate concepts to real-life phenomena. This finding is consistent with the OECD report through PISA 2018, which states that Indonesian students' scientific literacy is still below the international average (Fitriani et al., 2021). This low level of ability is also influenced by teacher-centered learning practices (Sa'adah et al., 2020).

After the treatment was implemented, there was a significant improvement in students' critical thinking skills, as indicated by the increase in the average score from 54.81 to 82.90 and a significance value of $0.000 < 0.05$. This improvement shows that the use of the KOSICA learning medium is effective in helping students understand concepts while also enhancing their critical thinking skills.

Theoretically, these findings are supported by constructivist theory proposed by Jean Piaget (1952), which states that knowledge is actively constructed through interaction with the environment. In a modern context, this theory remains relevant and is reinforced by recent studies showing that experiential learning can improve conceptual understanding and critical thinking skills (Wandini et al., 2022).

In addition, the results of this study are supported by the social constructivist theory of Lev Vygotsky (1978), which emphasizes the importance of social interaction in learning. Group discussions and collaborative activities using the KOSICA medium allow students to exchange ideas and build shared understanding. This is in line with recent research indicating that collaborative learning can enhance students' critical thinking skills (Dinah et al., 2023).

Furthermore, this study is also consistent with experiential learning theory by David Kolb (1984), which states that effective learning occurs through a cycle of concrete experience, reflection, conceptualization, and experimentation. The use of the KOSICA medium provides students with direct experience in observing the properties of light, making learning more meaningful. Recent studies also show that experiential learning significantly improves both critical thinking skills and learning outcomes (Hamidah et al., 2023).

Hamidah et al. (2023) state that experiment-based learning media can enhance students' critical thinking skills. Prasetya and Muhroji (2022) found that the use of concrete media in science learning can improve student engagement and learning outcomes. Fadhillah et al. (2022) also demonstrated that the light properties box is effective in helping students

understand abstract concepts through direct visualization. In addition, Isti et al. (2022) emphasized that the appropriate use of learning media according to the characteristics of the material can improve learning outcomes and students' thinking skills.

From an implementation perspective, the use of the KOSICA medium increases student engagement in the learning process. Students become more active, enthusiastic, and able to collaborate in groups. This is in line with the concept of student engagement, which states that active participation contributes to the improvement of critical thinking skills (Dinah et al., 2023).

However, the use of the KOSICA medium also has limitations, such as requiring more time and careful preparation. This is consistent with the findings of Fadhilah et al. (2022), which state that experiment-based learning requires effective time management and classroom organization.

CONCLUSION

Considering the potential impact of expert assessments on the use of the light properties box (kosica) in developing clear thinking skills, it presents an opportunity to improve students' understanding of the properties of light in junior high school.

This is because some students still lack the ability to think naturally to understand the properties of light and various other branches of science. Therefore, educators should employ learning strategies that emphasize imagination and creativity, including the use of media.

Media aims to provide students with understanding through real-world experiences so they can grasp the material. The potential impact of the t-test indicates that the scores of students seeking treatment were higher than the average. This is evidenced by the average score increasing from 54.81 to 82.90, which aligns with the research results and findings presented in the previous section.

The results of the t-test of the fitted model, which had a p-value of 0.000 0.05, revealed a significant increase in students' unambiguous thinking skills after treatment provided by subject matter experts. This tracking provides very meaningful assistance because the use of light box media (kosica) as a classroom performance aid affects students' unambiguous thinking skills. In this way, it is recommended that experts examine the use of standard light box media (kosica) at various different cutoff points.

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