

Investigation of the Influence of Project-Based Learning-STEAM with Visual Simulation Media on Students' Critical Thinking Skills in Optics

Optics is closely related to everyday technology but is often difficult for students to understand because of its abstract nature. This difficulty is caused by students' low critical thinking skills, which include the ability to interpret, analyze, infer, evaluate, and explain, which are important skills in the 21st century. This study aims to improve students' critical thinking skills in optics by applying the Project-Based Learning model with the STEAM approach and Visual Simulation Media (PjBL-STEAM-MSV). This study used a mixed method with an untreated control group design with pretest-and-posttest. The study subjects were 54 students of SMAN 1 WOHA, Indonesia, who were distributed into an experimental class taught through the PjBL-STEAM-MSV model, and a control class taught through a conventional model. The research instrument was a critical thinking ability test consisting of 5 essay questions with a reliability of 0.636, and an interview guide. Quantitative data were analyzed using the T-test, N-gain, and effect size, while qualitative data were analyzed through data reduction, coding, and concluding. The results showed that the implementation of PjBL-STEAM-MSV had a significant effect on improving students' critical thinking skills in optics material ($\alpha = 0.01$). This result was supported by the N-gain of the experimental class of 0.48 (medium category) higher than the control class of 0.20 (low category). The highest and lowest increases in the experimental class occurred in the evaluation and explanation indicators, while in the control class the analysis and explanation indicators. Experimental class students still had difficulty developing explanation skills in presentation activities due to limited time, while control class students had difficulty in almost all indicators because they focused on memorization. Recommendations for further research are further development of learning media and support for student mentoring so that the results are more optimal.

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