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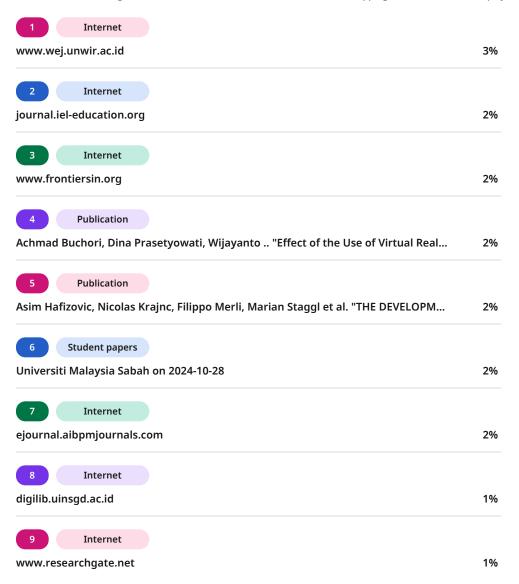
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Effectiveness of Learning With PBL Model Based on E-Modules To Improve Critical Thinking Skills

Aulia Betha Novianti^{1*}, Budi Jatmiko¹, Binar Kurnia Prahani¹, Riski Ramadani¹, Noer Risky Ramadhani²

¹State University of Surabaya, Surabaya City, Indonesia ²Universität <mark>für Weiterbildung Krems, Krems an der Donau, Austria</mark>



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Objective: This study aims to examine the effectiveness of physics e-modules based













ABSTRACT

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1st-Century Learning;
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on the Problem-Based Learning (PBL) model in improving students' critical thinking skills on static fluid concepts. The focus is to evaluate the implementation of learning, measure the improvement of students' critical thinking ability, and analyze student responses after applying the PBL-based e-modules. Method: The research employed a proper experimental design with a pre-test and post-test control group, conducted at MA Ma'arif Bangil, Pasuruan, Indonesia. A total sampling technique was used, with class XA as the experimental group and class XB as the control group. Data were collected using observation sheets, pre-test and post-test instruments, and student response questionnaires. Data analysis included N-Gain scores, normality and homogeneity tests, t-tests, and descriptive analysis for student responses. Results: The findings showed that the implementation of PBL-based e-modules reached an average of 91.8% categorized as very good. Students in the experimental class demonstrated a significant improvement in critical thinking skills, with an average N-Gain of 0.512 (moderate), compared to 0.212 (low) in the control group. Furthermore, student responses were predominantly in the "good" and "very good" categories, indicating positive perceptions of the learning approach. Novelty: This study highlights the integration of PBL with interactive e-modules as an innovative

learning strategy that not only enhances students' critical thinking skills but also addresses the limitations of conventional print modules. It provides empirical evidence that digital-based problem-oriented instruction is highly relevant to fostering 21st-

INTRODUCTION

Twenty first century education requires students not only to master knowledge but also to possess higher-order thinking skills, including critical thinking skills (Lombardi, 2023). These skills are considered essential in preparing young people to face global challenges, rapid technological developments, and increasingly complex societal needs (Kennedy, 2025). Critical thinking skills help students analyse information in depth, evaluate perspectives objectively, and make appropriate decisions in solving real-life problems (Calma & Davies, 2025). However, various international studies, such as the Programme for International Student Assessment (PISA), indicate that Indonesian students' science and problem-solving abilities remain below the OECD average, suggesting that their critical thinking skills have not developed optimally (OECD, 2019). This finding aligns with national research indicating that the average critical thinking ability of students is approximately 35.41%, which is classified as low (Marisda et al., 2024). To address this challenge, a learning strategy is needed that can increase student active engagement and hone their critical thinking skills. One model that has proven effective is Problem-Based

century competencies in science learning.