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The Effect of Scaffolded Project Based Learning on Students' Critical Thinking Skills to Support SDG 4

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ABSTRACT

Objective: *To examine the effect of scaffolded Project-Based Learning on junior high school students' critical thinking skills in science learning on the topic of food additives.* ***Method:*** *Employing a quantitative approach using a quasi-experimental pretest-posttest design involving three intact junior high school classes (Classes 8E, 8F, and 8H). Students participated in scaffolded Project-Based Learning activities on the topic of food additives.* ***Results:*** *The findings revealed that scaffolded Project-Based Learning effectively improved students' critical thinking skills across the three participating classes. The mean N-Gain scores reached 0.70 in Class 8E, 0.94 in Class 8F, and 0.91 in Class 8H, all of which were categorized as high. The greatest improvements were consistently observed in the interpretation, inference, and self-regulation indicators, while the explanation and evaluation indicators demonstrated comparatively lower gains in some classes. These findings indicate that integrating structured scaffolding into Project-Based Learning effectively promotes higher-order thinking by supporting students in interpreting information, analyzing contextual problems, drawing evidence-based conclusions, and regulating their own learning processes.* ***Novelty:*** *Extends previous research by integrating structured scaffolding into Project-Based Learning to strengthen junior high school students' critical thinking skills in science learning on the topic of food additives. Furthermore, the study contributes to the implementation of Sustainable Development Goal (SDG) 4 by providing empirical evidence that scaffolded Project-Based Learning promotes meaningful, student-centered, and competency-based science education that develops essential twenty-first-century skills.*

INTRODUCTION

The preliminary study of this research was based on the occurrence of several cases among junior high school students related to the food and beverages they consume. These cases show that students are frequently exposed to food and beverage products without fully understanding their safety, ingredients, and potential effects on health. In daily life, students often consume packaged snacks, instant drinks, and processed foods that may contain preservatives, colorants, sweeteners, and flavor enhancers. This condition indicates the need for science learning that encourages students to think critically about the products they consume. Therefore, the topic of food additives is highly relevant because it is closely related to students' daily experiences and provides opportunities for them to analyze real-life problems, evaluate information, and make rational decisions.

In the 21st century, education is expected not only to transfer knowledge but also to develop higher-order thinking skills, particularly critical thinking. Critical thinking refers to the ability to interpret, analyze, evaluate, infer, explain, and reflect on information rationally in order to solve problems and face real-life challenges (Krajcik & Shin, 2014; Facione, 2015; Belland et al., 2024). These skills are essential for junior high school students because they enable them to examine information, identify problems, evaluate evidence, and make responsible decisions in everyday situations. In the context of food additives, critical thinking