

CONTEMPORARY HYBRID LABORATORY PEDAGOGY: CONSTRUCTION OF A SIMPLE SPECTROPHOTOMETER WITH STEM PROJECT-BASED LEARNING TO INTRODUCE SYSTEMS THINKING SKILLS

Ari Syahidul Shidiq^{1*}, Anna Permanasari², Hernani³ and Sumar Hendayana³

¹Chemistry Education Study Program, Universitas Sebelas Maret, Surakarta, Indonesia

²Science Education, Universitas Pakuan, Bogor, Indonesia

³Chemistry Education Department, Universitas Pendidikan Indonesia, Bandung, Indonesia

*Corresponding author: arishidiq@staff.uns.ac.id

Abstract: Hands-on laboratory activities are a vital aspect of chemistry education that can help students strengthen their understanding of chemistry's core concepts and applications. Nevertheless, during the COVID-19 pandemic, students and teachers could not access laboratories. Thus, innovative pedagogical approaches are required to meet these challenges. The current study, therefore, examines the use of contemporary hybrid laboratory pedagogy to construct a simple spectrophotometer by implementing Science, Technology, Engineering, and Mathematics (STEM) project-based learning to introduce systems thinking skills and measure the effectiveness of improving attitude. A quantitative approach, with one group pre-post design, was employed in this study. The subjects were 33 chemistry students from a state university in Bandung, Indonesia. A simple Atomic Absorption Spectrophotometer (AAS) was chosen as the topic of an engineering project given to students. The project was implemented over fourteen meetings designed in a hybrid laboratory activity. The students' worksheets, questionnaires on students' attitudes toward systems thinking skills, and a questionnaire on student attitudes toward STEM-project-based learning were used as research instruments. Additionally, interviews with selected students further supported the quantitative data. Following the intervention, a RASCH: racking and stacking analysis revealed that two of the eight systems thinking skills indicators showed noticeable results. Other results uncovered that the student-made simple AAS had an accuracy of 95.3% compared to commercial AAS. This study also demonstrated that students had a negative attitude toward implementing STEM project-based learning. In contrast, students' attitudes towards systems thinking skills indicated positive results. Challenges and opportunities for further research are also discussed in this paper.

Keywords: Hybrid laboratory pedagogy, STEM learning, system thinking skills, simple AAS