Integrating Environmental Justice into Selected Organic Chemistry Topics: Development and Validation of an Innovative Learning Packet

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Abstract

This study examined the impact of an environmental justice-integrated learning packet on student engagement and academic performance in organic chemistry. The instructional material was evaluated using a multi-dimensional framework, assessing its accuracy, inclusivity, instructional effectiveness, usability, and its ability to promote skills development and civic responsibility. Results showed high mean ratings across all categories, with the highest scores recorded in cognitive and emotional engagement dimensions. Students demonstrated strong metacognitive strategies, persistence, and interest in applying chemistry concepts to real-world contexts. Academic achievement data indicated a significant improvement from pre-test to post-test scores, supported by a Wilcoxon Signed Rank Test ($Z = -2.94$, $p = 0.003$), with a large effect size ($r = 0.849$), confirming the effectiveness of the intervention. The learning packet's interdisciplinary design, alignment with environmental justice principles, and emphasis on relevance and critical thinking contributed to these outcomes. The findings affirm the importance of context-based and socially conscious science instruction in enhancing student understanding and motivation. The study provides empirical support for integrating environmental justice themes into science curricula to achieve both cognitive and affective learning gains.

Keywords: environmental justice; organic chemistry education; systems thinking; student engagement; interdisciplinary learning; academic performance