REAL-WORLD CONNECTIONS TO SUSTAINABILITY: USING AUTHENTIC LEARNING ACTIVITIES TO INTRODUCE STUDENTS TO SYSTEMS THINKING THROUGH GREEN CHEMISTRY

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Systems thinking refers to approaches to learning that emphasise the interdependence of components in dynamic systems and how they interact and influence one another (Mahaffy et al., 2019). Applying systems thinking to green chemistry teaching and learning can create a molecular basis for sustainability (Mahaffy et al., 2019) that is able to enhance undergraduate chemistry students' multidimensional understanding of complex sustainability challenges (Smith, 2011). However, efforts to introduce sustainable systems thinking – specifically within first-year introductory chemistry courses – are particularly challenging, and past approaches have produced mixed success (Mahaffy et al., 2019; An et al., 2021). Consequently, this indicates an opportune space within undergraduate chemistry education research to explore alternative and multidisciplinary approaches towards teaching green chemistry and sustainability (Wissinger et al., 2021).

In this research, we present the preliminary results of a trimester-long intervention using authentic learning activities to introduce first-year chemistry students to systems thinking, through the application of green chemistry concepts. To determine the effectiveness of the intervention, we are using a mixed-methods research design to assess the impact of the learning activities on students' development of systems thinking skills. Student motivations and attitudes towards the subject of chemistry will also be evaluated via validated survey instruments (Guay et al., 2000; Liu et al., 2017). The learning activities have been designed and developed successfully, though the delivery of the intervention is currently ongoing. Preliminary results indicate that students are excited to learn about how chemistry can be more sustainable, and that they are engaging with the learning activities.

The aim of this research is to provide rigorous evidence for using systems thinking as a tool to teach students about green chemistry, 'future-proofing' chemistry in a way that is relevant, meaningful, and authentic for today's chemistry students. Outcomes from our data analysis will help inform the development of new undergraduate chemistry education curricula that align with contemporary sustainable challenges.

REFERENCES

An, J., Loppnow, G.R., & Holme, T. A. (2021). Measuring the impact of incorporating systems thinking into general chemistry on affective components of student learning. *Canadian Journal of Chemistry*, *99*(8), 698–705.

Fisher, M.A. (2019). Systems thinking and educating the heads, hands, and hearts of chemistry majors. *Journal of Chemical Education*, *96*(12), 2715–2719.

Guay, F., Vallerand, R. J., & Blanchard, C. (2000). On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS). *Motivation and emotion*, *24*(3), 175–213.

Liu, Y., Ferrell, B., Barbera, J., & Lewis, J. E. (2017). Development and evaluation of a chemistry-specific version of the academic motivation scale (AMS-Chemistry). *Chemistry Education Research and Practice*, *18*(1), 191–213.

Mahaffy, P. G., Matlin, S. A., Holme, T. A., & MacKellar, J. (2019). Systems thinking for education about the molecular basis of sustainability. *Nature Sustainability*, *2*(5), 362–370.

Smith, T. (2011). Using critical systems thinking to foster an integrated approach to sustainability: A proposal for development practitioners. *Environment, development and sustainability*, *13*, 1–17.

Wissinger, J. E., Visa, A., Saha, B. B., Matlin, S. A., Mahaffy, P. G., Kümmerer, K., & Cornell, S. (2021). Integrating sustainability into learning in chemistry. *Journal of Chemical Education*, *98*(4), 1061–1063.

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