Casandra Koevoets-Beach

Literature Seminar
When: September 29, 2022
Time: 2:30 pm
Location: CBLL-16

Scaffolding and Lexical Competence: Support for Student Argumentation from NMR Spectroscopic Analysis

Abstract:

NMR spectroscopy is an indispensable tool for chemists. Organic chemists often use NMR spectra as the basis for drawing conclusions about the synthesis and characterization of chemical species. Constructing and critiquing well-informed arguments using data is a critical skill outlined by The National Academy of Science [1]. In chemistry courses, students are expected to analyze spectroscopic traces of molecules, pull information regarding specific spectral features, and utilize that data to make claims regarding their structure. Existing literature has shown that undergraduate students struggle to make correct assumptions based on spectral features and often resort to heuristics to solve these complex problems, making them prime targets for scaffolded instruction. Cooper and Stowe scaffolded individual NMR problems with highly structured, multipart prompts to observe students' ability to analyze and interpret spectroscopic data and construct claims [2]. Students showed competence in analyzing and interpreting data but struggled to construct reasonable claims to their argument regardless of the level of scaffolding. Argumentation in the context of NMR spectroscopy can be challenging for students because of its intersection of visualization, interpretation of data, and integration of spectroscopic terminology. Schultz, et al., developed an instrument (NMR-LRC) that allows instructors to measure students' representational competence in ^{1}H NMR spectroscopy and assist in mastery of the unique and complex lexicon required to make claims based on spectroscopic evidence [3]. Students exhibited novice-like representational competence and item-level scaffolding did not promote more sophisticated claims, which prompted further inspection into intentional scaffolding to explore how textbooks present spectral features. Specifically, this metanalysis evaluated organic chemistry textbooks for frequency and ordering of spectral features in worked examples and practice problems [4]. While NMR spectroscopy is a complex tool for students to conceptualize, researchers have highlighted ways to support students in developing their argumentation skillset using spectroscopic data. Shifting scaffolding from item-level to unit-level and providing instructors with tools to measure students' lexical representational competence can support the spectroscopic solving process and argumentation from spectral data.

References:

1. The National Research Council. A Framework for K−12 Science Education: Practices, Crosscutting Concepts, and Core Ideas; *National Academies Press: Washington, DC,* 2012.
2. Stowe, R. L., & Cooper, M. M. (2019). Arguing from Spectroscopic Evidence. *Journal of Chemical Education*, *96*(10), 2072–2085. https://doi.org/10.1021/acs.jchemed.9b00550
3. Connor, M. C., Glass, B. H., & Shultz, G. v. (2021). Development of the NMR Lexical Representational Competence (NMR-LRC) Instrument As a Formative Assessment of Lexical Ability in 1H NMR Spectroscopy. *Journal of Chemical Education*, *98*(9), 2786–2798. https://doi.org/10.1021/acs.jchemed.1c00332
4. Anderson, S. Y. C., Ong, W. S. Y., & Momsen, J. L. (2020). Support for instructional scaffolding with 1H NMR spectral features in organic chemistry textbook problems. *Chemistry Education Research and Practice*, *21*(3), 749–764. https://doi.org/10.1039/c9rp00252a