Melanie M. Cooper

Evidence-based Approaches to Improving Chemistry Education

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and

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B.S., 1975,
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Selected Publications

Developing computational resources to automate analysis of students' London Dispersion force explanations, Noyes, K.N. Cooper, M.M., *J. Chem. Educ.* **2020**, *97*, 11, 3923–3936. *https://doi.org/10.1021/acs.jchemed.0c00445*

Arrows on the Page Are Not a Good Gauge: Evidence for the Importance of Causal Mechanistic Explanations about Nucleophilic Substitution in Organic Chemistry, Crandell, O.M.; Lockhart, M.A.; Cooper, M.M., *J. Chem. Educ.* **2020**, *97 (2)*, 313–327. *https://doi.org/10.1021/acs.jchemed.9b00815.*

Organic Chemistry, Life, the Universe and Everything (OCLUE): A Transformed Organic Chemistry Curriculum, Cooper, M.M.; Stowe, R.L.; Crandell, O.M.; Klymkowsky, M.W., *J. Chem. Educ.* **2019**, *96 (9)*, 1858–1872. *https://doi.org/10.1021/acs.jchemed.9b00401.* **ACS Editors Choice**

Investigating Student Understanding of London Dispersion Forces: A Longitudinal Study, Noyes, K.; Cooper, M.M., *J. Chem. Educ.* **2019**, *96 (9)*, 1821–1832. *https://doi.org/10.1021/acs.jchemed.9b00455.*

Chemistry Education Research—From Personal Empiricism to Evidence, Theory, and Informed Practice, Cooper, M.M.; Stowe, R.L., *Chem. Rev.* **2018**, *118 (12)*, 6053–6087. *https://doi.org/10.1021/acs.chemrev.8b00020* **ACS Editors Choice**

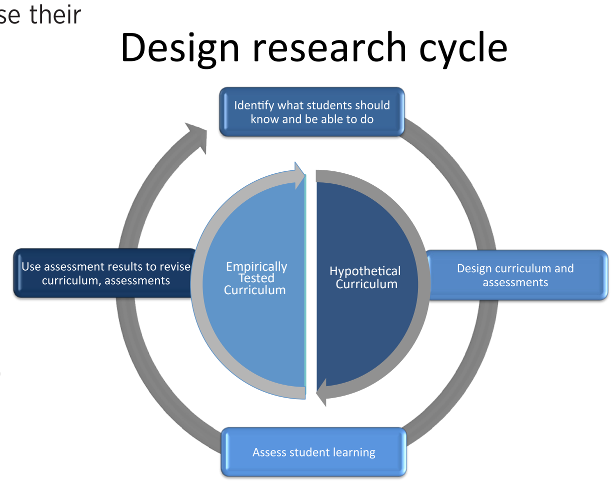
Evaluating the Extent of a Large-Scale Transformation in Gateway Science Courses, Matz, R.L.; Fata-Hartley, C.L.; Posey, L.A.; Laverty, J.T.; Underwood, S.M.; Carmel, J.H.; Herrington, D.G.; Stowe, R.L.; Caballero, M.D.; Ebert-May, D.; Cooper, M.M., *Sci. Advances* **2018**, *4 (10)*, eaau0554. *https://doi.org/10.1126/sciadv.aau0554.*

The focus of our research is to develop evidence-based approaches to teaching, learning and assessment. Our work involves a wide range of activities and methods including designing ways to assess both what students know and how they use their knowledge, developing curriculum materials, and evaluating the effects of transformation efforts both within and across disciplines.

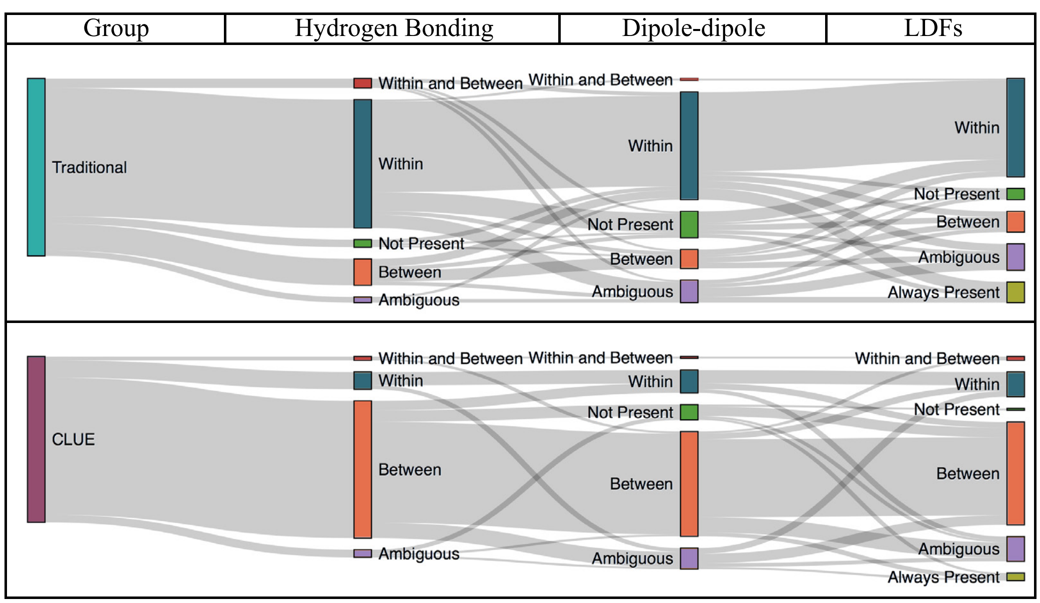
Our approach to curriculum transformation uses a design-based research cycle in which we identify what students should know and be able to do, design and implement a curriculum that would meet these goals, assess student achievement, and use the results of the assessments to revise the curriculum and accompanying assessment materials These assessments require students to construct (free form) structures, diagrams, and models, and to develop explanations for phenomena. Our formative assessment system, beSocratic (*http://besocratic.com*), is designed to recognize and respond to student input.

Examples of this process are ***Chemistry, Life, the Universe and Everything (CLUE)***, an NSF supported general chemistry curriculum, and ***Organic Chemistry, Life, the Universe and Everything (OCLUE)*** (both developed in collaboration with Mike Klymkowsky, University of Colorado at Boulder).

Using this system, we have evaluated how students in both traditional and CLUE curricula understand a range of chemical ideas and phenomena. For example, we have shown that both CLUE and OCLUE students are more likely to construct causal mechanistic explanations for phenomena such as acid-base reactions, nucleophilic substitutions and how London dispersion forces arise.



Current research projects include investigations of the impact of classroom culture on student learning, how students learn to use mechanistic arrows to predict and explain reactions, how energy ideas are used across disciplines, how mechanistic reasoning emerges across disciplines.



Sankey diagram showing how CLUE and traditional students represent intermolecular forces as within or between molecules.