Chemical equilibrium: an evaluation of a new type of instruction.

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Chemical equilibrium is a central theme in introductory chemistry and lays the groundwork for later units in acid base chemistry and oxidation/reduction reactions as well as other domains such as environmental chemistry and molecular biology. However, the core concepts and strategies required to reason about chemical equilibrium problems are difficult for students to acquire, and many students fail to master this material.

Over the past year and a half, we have conducted an extensive analysis of the underlying cognitive processes and representations required to fully understand chemical equilibrium. Our analysis has revealed that most introductory texts focus on mathematical procedures, and fail to fully explicate several fundamental concepts – concepts that instead are typically left implicit. Through a series of studies, we have investigated the role of visual diagrams and new modes of instruction on chemistry learning and have conducted a systematic analysis of conceptual understanding and misunderstanding in this domain.

Based on our prior work, we developed a new lecture format for chemical equilibrium that makes explicit the progress of reaction using visual diagrams and qualitative (as well as mathematical) explanations. Forward and backward reactions occur simultaneously and the stoichiometric coefficients restrict the possible states of a system to lie on a single dimension we refer to as the progress of reaction.

In our study, students in a college level introductory chemistry class were randomly assigned to view either the new type of lecture (described above) or a traditional lecture (based on the same professor's lecture notes from prior years). We will discuss student understanding of chemical equilibrium in the two conditions, as measured by open-ended questions, in class "clicker" participation and follow-up quiz responses. By collecting and systematically analyzing a rich set of student data, we hope to further understand the conceptual development of equilibrium concepts and determine which types of instructional interventions produce a flexible understanding of this domain in chemistry.