Mathematical Knowledge for Teaching in Chemistry

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Abstract

The Mathematical Knowledge for Teaching (MKT) theoretical framework describes effective mathematics teaching in a way that relies on an instructor's subject matter knowledge (SMK) and on their pedagogical content knowledge (PCK). This proposal reports our initial effort to understand MKT within chemistry instruction, namely what MKT could support chemistry instructors' efforts to help students develop a deeper understanding of the mathematics used in general chemistry. Coding of several types of general chemistry problems involving ratios and proportions and covariation are provided as examples.
Keywords: Mathematical Knowledge for Teaching; Chemistry Instruction

Students' challenges with the mathematics used in general chemistry are long-standing (Kotnik, 1974) and persistent (Muzyka, 2018). Efforts to address the deficiencies in mathematics preparation that impact outcomes in general chemistry have largely focused on providing students with more practice of procedures. Simply giving students more practice without building understanding of the underlying mathematics is unlikely to have long-term benefit and will not prepare students to address novel problems.

Suppose that the focus was shifted to building chemistry instructors' ability to anticipate, identify, adapt, and respond to students' difficulties with mathematics in chemistry. We propose that building chemistry instructors' mathematical knowledge for teaching (MKT) (Ball, Thames, & Phelps, 2008), which combines subject matter knowledge with pedagogical content knowledge (PCK) (Shulman, 1986), would equip them to address the challenges faced by their students and support students in building a deeper understanding of the mathematics used in chemistry.

This poster reports our efforts to characterize mathematical knowledge for teaching applied to the context of chemistry instruction, specifically common content knowledge (CCK) and PCK. We used the *Common Core State Standards for Mathematics* (National Governors Association, 2010) to systematically code the CCK required for general chemistry instruction. In addition, our framework identifies PCK into the categories of known difficulty, pedagogical opportunity, anticipated gaps in prior knowledge, and areas of difference between chemistry applications and mathematics instruction. Our results show the particular importance of chemistry instructors' PCK of ratio and proportional reasoning and covariation, as this content surfaces throughout general chemistry.

References

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