

Public Abstract

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Title:The role of mental-modeling ability, content knowledge, and mental models in general chemistry students' understanding about molecular polarity

This study explored general chemistry students' thinking processes about molecular polarity and related concepts. The study employed a mixed-method design to reveal how general chemistry students use their conceptual frameworks and mental models to solve problems about molecular polarity. The quantitative phase collected students' background information, scores of course exams, as well as understanding and misconceptions about concepts of molecular geometry, polarity, and prerequisite concepts for a large sample size. The qualitative phase was guided by a theoretical framework of personal constructivism and a case study methodology. The primary data sources were video-taped interviews to document students' explanations and thinking processes. The secondary data sources were students' constructed artifacts and their responses to the items on the three diagnostic instruments. Grounded theory approach, employing a comparative method, was used for data analysis.

Findings of the quantitative study indicated results of inferential statistics and identified students' misconceptions associated with concepts of electronegativity, chemical bonding, bond polarity, molecular shape, polarity of molecules, intermolecular force, and ionic lattices. For qualitative findings, I characterized high-, moderate-, and low-scoring students' mental-modeling ability, conceptual frameworks, and features of mental models while solving problems about molecular geometry and polarity. The major findings include that there is a positive interaction between an individual's level of content knowledge and mental-modeling ability, where one may facilitate or hinder the other. In addition, three prerequisite concepts were identified that may explain students' failure for learning about molecular geometry and polarity. I also found that metacognitive ability plays a significant role in a successful mental-modeling process.

This study provides empirical evidence for how students' content knowledge, mental-modeling ability, and construction and use of mental models influence their understanding about molecular polarity. The findings have implications for college chemistry education for teaching concepts of molecular polarity.