

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

A Qualitative Study of Visualization Skills Used to Understand Chemical Bonding

Theories

By

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Visualization skills and spatial ability are necessary for understanding the 3-dimensional shapes of molecules using Valence Shell Electron Pair Repulsion (VSEPR) theory, hybrid orbital theory and understanding of sigma and pi bonding. Much research has been completed on visualization skills and alternative conceptions in Chemistry Education but there has been little focus on studying these skills for understanding of bonding theory in college Chemistry. The aim of this study is to acquire an understanding of how college Chemistry students visualize in 3D and to collect feedback on their experiences of learning in order to provide information for better assessment tools and teaching strategies.

The method in this study involved interviewing 15 students who were either in the second semester of General Chemistry or taking Organic Chemistry. Data were transcribed and analyzed in conjunction with drawings and molecular models that were constructed and coded for recurring themes and concept understanding. It was found that most participants had a good understanding of molecular polarity and could use VSEPR theory to get the correct shape. Some found that using the Cartesian coordinate axis as a guide helped them to translate between the 2D Lewis structure and the 3D shape. Many had difficulty understanding symmetry, expressing 3-dimensionality in their drawings, determining expanded octet shapes, understanding hybrid orbital theory and understanding how the sigma and pi bonds form. Some of the recurring themes that emerged were the 'value of using models', a 'disconnect' between concepts, a lack of adequate 'time' spent on certain topics and the need to teach the requisite 'terminology'. Alternative conceptions in understanding were identified. Some of these alternative conceptions were consistent with what was found in the literature and some were novel to this study. Recommendations were made on how to address these alternative conceptions and the student concerns that were expressed. Additionally, several concept maps were generated to outline how bonding theories could be learned in a series of steps to solve problems involving 3D structures in Chemistry.

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Time: 2:00 PM

Dissertation Advisor: Keith Sheppard

Place: Location: Virtual Conferencing – Please contact Judy Nimmo, Graduate Program Coordinator, for Zoom access: judith.nimmo@stonybrook.edu.