Moving from Description to Explanation: Professional Development and Research on Molecular Visualization for High School Chemistry Teachers

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Background
Conceptual understanding in chemistry is at the heart of the Next Generation Science Standards (NGSS). To what extent and in what ways do students’ understanding of chemistry concepts and their ability to apply these concepts to solve problems differ based on their background characteristics, such as socio-economic status or race/ethnicity? How can high school chemistry curricula be improved to better meet the needs of these diverse student populations?

Sampling
- Target teachers of disadvantaged and underrepresented minority students (NCES)
- Target ideal characteristics for change & effectiveness (application)
- Disciplinary Core Ideas
  - motion & stability: forces & energy
  - life
- Minority population (school)
  - 34
- Teachers’ years of experience (teacher)
  - 20
- Teachers are thinking about chemical concepts from the particulate level (molecular visualization)
- Students in PD model work with higher property scores (pre & post), compared to controls
- Students in PD model work with lower median process score with PD
- PD model students report increased understanding of chemistry concepts

VisChem Cognitive Learning Model
Weaving Together PD & Research

Weaving Together PD & Research

Overarching Research Questions
1. How do the VisChem teachers understand chemistry concepts?
2. In what ways do teachers, afford and constrain what is possible, in their implementation of the VisChem approach?
3. To what extent, and in what ways, do students’ ideas about molecular level behavior underpin their understanding of chemical physical phenomena change when they use the VisChem Approach?

Professional Development (PD)
- Professional Development (PD)
  - Professional Development Design
  - Interaction with Advisory Board
  - Project Status

Research
- Teachers will...
  - Emphasize particular level & connections to macroscopic & symbolic levels
  - Focus on limitations inherent within representational models
  - Facilitate learner-centric sensemaking
  - Elicit feedback and respond accordingly

Visualized scores into radar plots
- Organized pedagogical discontentment to promote growth
- Prepared teachers to change their classroom practices
- Elicit learner feedback and respond accordingly
- Improve teacher & student performance
- Organized PD models
- Improved PD model

References
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- VisChem teachers and students for the time and commitment to learning
- Emilia Kamis for her contributions to data analysis
- Advisory board members
- Yanetski & Burt research groups

Project Status
- Recruitment, Sampling, and Selection Methods
- VisChem Cognitive Learning Model
- VisChem Resource Development and Dissemination (e.g., VisChem Channel and Google Drive folders)
- Professional Development Design
- Professional Development Implementation
- Human Resource Development
- Interaction with Advisory Board
- Community of Practice (informal professional gatherings)
- Research on Professional Development
- Research on VisChem Implementation
- Follow Up Simulation Professional Development

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