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Cover Page Footnote

Papageorgiou, G., Markos, A., & Zarkadis, N. (2016). Students' representations of the atomic structure-the effect of some individual differences in particular task contexts. Chemistry Education Research and Practice, 17(1), 209–219. https://doi.org/10.1039/c5rp00201j Roche Allred, Z. D., & Bretz, S. L. (2019). University chemistry students' interpretations of multiple representations of the helium atom. Chemistry Education Research and Practice, 20(2), 358–368. https://doi.org/10.1039/C8RP00296G Zarkadis, N., Papageorgiou, G., & Stamovlasis, D. (2017). Studying the consistency between and within the student mental models for atomic structure. Chemistry Education Research and Practice, 18(4), 893–902. https://doi.org/10.1039/c7rp00135e

Exploring Students' Epistemological Understanding of Atomic Structure Models

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ABSTRACT

Developing a robust understanding of atomic structure and the nature of matter is foundational across chemistry and STEM courses. The development of this concept is challenging because it relies on models to illustrate something not directly observable. Scientific models are important tools used to explain phenomena, particularly phenomena that are not directly observable. In general chemistry, students are typically asked to consider four different models: (1) the particle model, (2) the nuclear model, (3) the Bohr model, and (4) the Quantum model. Each depiction has its own advantages and limitations, where instructors introduce each model to explain specific parts of an atom. However, little evaluation is done by instructors on students' epistemological understanding of the nature of models which could impact how they interact directly with atomic models.

Previous research indicates that students ranging from general chemistry to physical chemistry struggle to explain and apply atomic structure (Papageorgiou et al., 2016; Roche Allred & Bretz, 2019; Zarkadis et al., 2017). Students are most comfortable with the Bohr model as it shows electrons orbiting the nucleus (Roche Allred & Bretz, 2019). Students have found it difficult to connect probability to the depiction of an electron cloud and tend to rely on classical ideas (Papageorgiou et al., 2016; Roche Allred & Bretz, 2019; Zarkadis et al., 2017). By relying on the classical and simplistic Bohr model, students may struggle to explain more complex concepts in future courses, such as resonance.

In this study, students' understanding of the nature of models and how they applied that understanding in the context of atomic models was investigated. Semi-structured interviews were used to elicit students' epistemological understanding of models and their general understanding of atomic structure. For instance, students were asked to explain how scientists generate models and identify the characteristics of a good scientific model. Subsequently, students were asked to explain ideas such as nuclear attraction and probability using the four different models described above (1 - 4) to investigate which features students attend to for specific concepts.

Results from this qualitative study include the variety of ways students understand and conceptualize models of an atom as well as how their general notions of the nature of models play a role in their conceptualization. The implications for introducing atomic structure models and promoting an epistemological understanding of models in general chemistry will be discussed.

KEYWORDS: chemistry, atomic structure, atomic structure models, stem, learning, undergraduate, general chemistry, models, education, science, modeling

REFERENCES: Papageorgiou, G., Markos, A., & Zarkadis, N. (2016). Students' representations of the atomic structure-the effect of some individual differences in particular task contexts. *Chemistry Education Research and Practice,* 17(1), 209–219. https://doi.org/10.1039/c5rp00201j

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