Mathematics and Science Sensemaking While Developing Equations Representing the North Atlantic Current

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Global warming is often believed to be synonymous with climate change, a misconception which leads individuals to think that climate change entails that every region on Earth warms in a similar fashion (Renert, 2011). However, the North Atlantic Current, for instance, can slow due to rising temperatures and freshwater influxes from melting ice, limiting the flow of warmer water traveling to the polar regions (Stommel, 1961). With less warmer water traveling to polar regions, Earth's polar regions become even colder as the equatorial regions remain warm. Such dynamics of the North Atlantic Current can be represented with mathematical equations that carry scientific meaning. Thus, working with such mathematical equations provides opportunities to deepen students' understanding of mathematics and science.

I studied how college algebra students made sense of the mathematics and science behind a two-box system of the North Atlantic Current. This model accounts for how density differences, determined by the salinity level and temperature of the ocean water, affect the rate of flow of water between the polar and equatorial boxes of the two-box model. Typically, mathematical models representing these dynamics consist of a system of ordinary differential equations, which is typically learned after taking the college calculus series (Kaper & Engler, 2011). Instead, I made these concepts accessible to students who have not taken calculus by requiring students to use recursive equations, which primarily relied on their algebra knowledge.

I analyzed students' *sensemaking*—i.e., making meaning of new situations based on prior experiences and knowledge (Odden & Russ, 2019)—as they developed these equations over the course of three 75-minute class periods. More specifically, I coded instances of students' sensemaking from transcripts of student discourse as they worked on the mathematical model, according to the *Sci-Math Sensemaking Framework* (Zhao & Schuchardt, 2021). Preliminarily, I have found that students used a variety of mathematics and science sensemaking types to justify the choices they made in the mathematical structure of their equations. Students used science mechanisms such as heat transfer to justify the structure of equations, as well as making qualitative predictions to describe what they think will occur in the system over time and how this is reflected in their equations. Students also discussed mathematical concepts related to limits and changing rates of change. Overall, students made sense of mathematical relationships and concepts, alongside justifications from science, to translate the complexities of the North Atlantic Current into mathematical equations.

Students also reflected on the broader implications of their mathematical model in the real world. When considering the impacts of a slowed North Atlantic Current, students reflected on the multitude of significant impacts this would have on humans and other living organisms. Some students also recognized that models of the real world are imperfect and require assumptions and simplifications. Thus, not only did students make sense of the mathematics and science behind the mathematical model, but they also gained insight into the limitations of mathematical models, as well as a deeper understanding of the role of ocean circulation on Earth's climate, ecosystems, and society.

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