IN THEIR OWN WORDS: EXPLANATIONS OF STEM STUDENTS' REASONING DURING MATHEMATICAL MODELLING

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Teaching mathematics through mathematical modelling means moving beyond dressing up mathematical procedures with real-world terminology. It involves interacting with students' representational systems and ways of thinking about and with those systems – and those ways of thinking are often non-normative, incomplete, and self-contradictory to an objective observer, like a teacher or a researcher. Thus, one question the field has posed is *How should the observer respond to students' work?* There is a strong temptation to attend to accuracy and to correct students' modelling work because it does not match the intended solution. However, we know that consistent negative feedback dismissing students' real-world experiences teaches them to ignore their own intuitions and hinders them in learning to use mathematics to solve realistic problems.

In this talk, I start from the position that it is not possible to answer the question *How should the observer respond?* without understanding *Why did the students model the way they did?* This second question is partially answered. The field already has a number of high-level, descriptive answers to this second question. For example, interpretations of students' work might point towards metacognitive fault (the student was "not paying attention" to or "did not notice" some feature the observer thought was important), implicate obstacles to knowledge transfer (the student did not activate target mathematics content), or even indicate blockages to phases of a modelling cycle (the student did not include/ignore variables). I argue that descriptive framings, even when couched in suitable theories, fall short of explaining what the student might have been thinking that led them to their modelling decisions which limits our capacity to design contingent responses to students' modelling work. To enhance the field's ability to address students' patterns of reasoning, I argue we ought to be asking *What were they thinking?* A simple analogy is that a doctor should seek the underlying cause of symptoms to prescribe a proper treatment.

Awareness of the typical ways students think about mathematical content while modelling and the kinds of explanations that are sensible to students is an essential step towards equipping instructors with the pedagogical skills they need to contingently interpret student thinking and respond constructively to students' reasoning patterns. Using STEM students' own words, I will share some archetypal ways students think about mathematical content while modelling including: their desire for precision, accuracy and authenticity, the mathematical structures they anticipate, and the rationales they use to justify the mathematics selected for their models. My goal is to increase the sophistication we attribute to students' modelling decisions by deepening the field's understanding of students' mathematics – as they use it in modelling – as an alternative to focusing exclusively on accuracy of solutions to modelling problems.