Research on Student Model Formation and Development in Physics

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Abstract

The research literature on modeling in science education is rapidly growing. This literature asks such questions as: How can scientific models and modeling be used to enhance science learning? and How and why do student models change? Answers to these questions may hold the key to new and powerful learning environments in science.

The goal of this Scholarship of Teaching and Learning (SoTL) study is to achieve a better understanding of student modeling in my college-level Physical Science 101 course. Physical Science 101 is a general-education "hands-on science" course for pre-service elementary school teachers and other non-science majors.

My research approach is to engage students in a modeling task involving a two-way trip of a fan cart. The fan (propeller) is a source of nearly constant force on the cart. For the two-way trip, the cart is pushed opposite the fan thrust. The cart subsequently slows down to rest and then speeds up on the return trip. The two-way trip is analogous to a vertical ball toss. To conduct this study, students are placed in pairs (N=20 pairs) and asked to develop and articulate a consensus "draft" model of the two-way trip. Following a peer scientific debate, student pairs articulate their "final model". Responses to the modeling task, before and after the debate, are used to answer such important questions as: What rational factors determine the likelihood that a particular model will be cued or retained? What roles do classroom technology and social discourse play? What path of development is followed?

Surprisingly, only 3 of 20 student pairs provided a Newtonian model of the two-way trip, despite full acceptance of the Newtonian model for the one-way trip. Alternative (pre-Newtonian) student models fell into four (4) main classes: Long Decay (LD), Truncated Decay (TD), Short Decay (SD) and Newtonian Decay (ND). Many student pairs (12 of 20) had difficulties articulating their model consistently across representations (writing, diagrams, and graphs). Students were unexpectedly resistant to changing their models. Of the eight (8) pairs that provided an internally consistent model, only one (1) pair changed their views. Given the (effective) sample size, student model formation and evolution is difficult to assess. However, initial results suggest a few interesting, competing models of learning. New research tools are needed to support and measure student modeling.