

Spring 2018 Colloquium

Department of Physics & Astronomy, TAMU-Commerce

Feb 15, Thursday, 4-5 PM in Science Building 127

(coffee and cookies will be served at 3:50 PM)

Physics Education

Embedding physics concepts in mathematical formalism

Dr. Scott Franklin

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Dr. Scott Franklin is Professor of Physics at Rochester Institute of Technology. He received his Ph.D. in physics from the University of Texas at Austin in 1997 and then held a National Science Foundation Postdoctoral Fellowship in Science, Mathematics, Engineering and Technology Education at Dickinson College from 1997-2000. This postdoctoral position introduced him to physics education research (PER), activity-based classrooms, and quantitative and qualitative methodologies. He has conducted research in a variety of PER topics, including the negligible impact of matching learning environment to expressed learning style preferences, writing as a lens into student conceptual reasoning, how physicists embed physical meaning in mathematical symbolism and, most recently, case-studies of large-scale institutional change. Dr. Franklin is Director of RIT's CASTLE Center for Advancing STEM Teaching, Learning & Evaluation and also the Institute's Learning Assistant and IMPRESS programs. As Director, he has mentored students and faculty in developing Discipline Based Education Research (DBER) projects. With Dr. Eleanor Sayre, he has recently been formalizing these mentoring experiences, expanding the number of faculty that become part of the growing DBER community. More information about Dr. Franklin can be found at

<https://people.rit.edu/svfps/>

Abstract

To the physicist, the distinction between concept and mathematical formalism seems arbitrary. As one faculty colleague likes to say, "the concepts are the math and the math are the concepts." in this talk, I present two studies on how physicists embed conceptual meaning in complex mathematical formalism. The first study involves an analysis of faculty

classroom discourse, which involves manipulating mathematical equations to illuminate physical principles. Observations of an upper-level fluid mechanics and junior-level “Vibrations & Waves” courses are interpreted using the concept of symbolic forms, conceptual and contextual meanings that are embedded in equations. When an equation is manipulated (e.g. bringing terms to one side or another), different forms are emphasized, changing the meaning of the equation. I'll argue that this framework can make explicit the faculty motivations for the moves, e.g. changing the context from a physics to a mathematical frame. The second project studies how textbooks use the “=” sign to imply causality, to define new physical quantities, and to assign numerical or variational values to symbols. These meanings are context-dependent, and can change within presented derivations. Both studies unpack the rich meaning physicists associate with math, meaning that is often hidden from students.