Department of Mathematics and Statistics

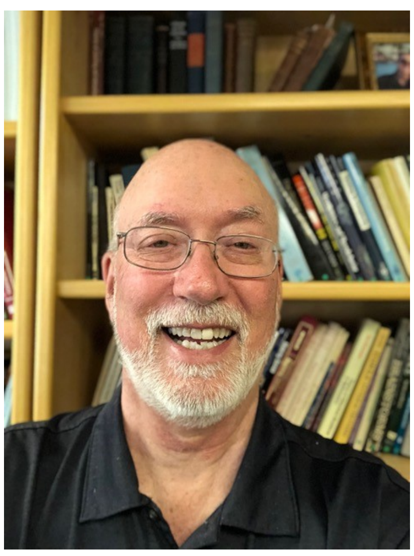
CAL POLY POMONA

Distinguished Lecture

A report of *Developing and Investigating a Rigorous Approach to Conceptual Calculus (DIRACC)*

Professor Pat Thompson

Arizona State University



Pat Thompson is Professor of Mathematics Education in Arizona State University's School of Mathematical and Statistical Sciences. His current project in calculus culminates his research of learning and teaching mathematics from first grade through graduate school. Thompson is a Fellow of the American Educational Research Association, has edited several mathematics education research journals, and has given numerous keynote and plenary addresses around the world.

Thursday May 2, 2019

12:05 - 12:50 pm

Room 3-2870

Reception: 11:30am-12:00 pm

Lunch compliments of the Department of Mathematics and Statistics

Abstract:

Students learn in calculus that derivatives are about slopes of tangent lines and integrals are about areas under curves. When students meet the Fundamental Theorem of Calculus, it is about neither slopes nor areas, and rightly wonder how it can be so fundamental when it occurs so late in the course. In addition, they wonder how an integral, being an area under a curve, can represent any quantity other than area.

I will report on an NSF-funded effort at ASU to develop ideas of calculus coherently across first and second semesters of a three-semester sequence. We do this by framing calculus with two foundational problems:

- You know how fast a quantity varies at every moment; you want to know how much of it there is at every moment.
- You know how much of a quantity there is at every moment; you want to know how fast it varies at every moment.

I will provide an overview of our approach and its foundation in the ideas that values of variables vary, differentials are variables, and that rate of change and accumulation are two sides of a coin. We cast these foundational problems within an instrumentalist perspective—to develop computable open-form definitions of rate of change functions and accumulation functions, thus giving them the same epistemological status in students' minds as closed-form definitions.

We have evaluated DIRACC courses four times in comparison to engineering and traditional calculus—twice with a pre-post comparison of first-semester calculus, once with the Calculus 1 Concept Inventory, and once with the Calculus 2 Concept Inventory. DIRACC students performed significantly better than engineering and traditional calculus students in each comparison.

Additional Information for off-campus visitors available at https://www.cpp.edu/~sci/mathematics-statistics/