

# MODELING AND TECHNOLOGY

Helen M. Doerr  
Syracuse University

Dave Pratt  
University of Warwick

Michal Yerushalmy  
University of Haifa

The words "mathematical modeling" cover a broad range of theoretical and practical orientations to the teaching and learning of mathematics. Equally broad are the approaches researchers have taken to understand the role of technology in the teaching and learning of mathematics. In this session, we propose to bring these two major strands of work together by examining some of the issues and some of the approaches that have emerged over recent years. The main purpose of this group will be to discuss the nature of the learning activity when students engage in modeling with various technological tools. The discussion group will begin by discussing some epistemological and psychological perspectives on modeling. Then we will shift the discussion to examine the issues that are raised by some examples of research on modeling and technology.

*Epistemological and Psychological Perspectives:* There are two epistemological underpinnings to mathematical modeling: first, the model is separate from the world to be modeled and, second, modeling is a cyclic, iterative process. The essence of this epistemological stance is that the world of phenomena and the model world co-construct each other. A psychological perspective on modeling and technology more directly addresses issues related to the role of the learner and learning. A distinction we have found useful is that between the learner's activity in using existing model created by an expert and in building a model that reflects the learner's own emerging understandings of the phenomena. In the first case, the learner's task is to explore the consequences of actions taken within the boundaries of a content domain model. In the second case, the learner's task is to express their own concepts by making explicit the relationships among objects and variables and then to examine, interpret and validate the consequences of their idea.

*Exploratory modeling through microworlds:* Environments such as Cabri Geometry, probability microworlds and spreadsheets have all been used to provide environments for students to explore models that have been designed by experts. After presenting a brief example of some work by students in a probabilistic microworld, we will engage in discussion on questions such as: How do such tools mediate between reality and mathematics? How is it that learners come to understand the explored world?

*Expressive modeling through function toolkits:* Tools such as graphing calculators, spreadsheets, and qualitative function graphers have all been used to provide students with the opportunity to express their understandings of some experienced phenomena. Again, we will present a brief example from the Visual Mathematics project showing some work done by students as they strive to make sense of experience. We will discuss such questions as: How do the available tools support or constrain the expression of students' ideas? What is the nature of effective modeling tasks with particular tools? What is the role of the teacher in such expressive environments?