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Theories of Mathematics Education: Seeking New Frontiers.

Bharath Sriraman and Lyn English, Editors. Springer 2010.

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I like this book!! It is the flagship book announcing a new Springer series *Advances in Mathematics Education*, and as such it does a wonderful job introducing readers to the field, at the same time laying it out clearly and extending it in many different directions. It provides a valuable perspective on the field. All the same, it may strike one as a scrappy pastiche of mathematics education ideas and research paradigms, but I think you will find that it will provide lots of food for thought for those who have been working in this area for a few decades. It also serves as a formidable introduction for the new researcher. It is over 660 pages long. Think of it as a frisky young colt on a sunny day.

I tend to read books linearly, start to finish, and that's just what I started to do with this one. Quite quickly, I became bogged down in the preface, where a debate raged over whether or not it was possible, or even desirable, to develop some grand unified theory of mathematics education. Not that this isn't worthy of debate, but I found it difficult to begin here. I eventually abandoned my linear reading and dove into the chapters at random. After having had a chance to think about whether I believed in a grand unified theory or not, I came back to their introductory words and found them illuminating. The problem is, however, that the wrong question is being debated by scholars. On page 14, Sriraman and English point out that some scholars are asking "are we [as a field] replacing one particular theoretical perspective with another that is more valid ...?" The editors have laid out the many voices of pluralism in the mathematics education field. They have indeed shown that there are many voices that complement rather than compete with one another.

My recommendation is to just dive in and start reading. You will not be disappointed unless you want to find laid out for you THE one approved approach to mathematics education research. The idea that mathematics education can and does have many flavors and that there are many different paths for the research, does not sit well with some of my mathematician colleagues. This idea tends to leave them with the feeling that the field is in total disarray and does not know what it's doing or where it's going. This is true to some extent in the finer points, but I don't find that depressing or disturbing. There will always be debates about appropriate and relevant research methodologies. It IS a young field, and the research paradigms for mathematics education research are very different from those used in mathematics research. They are rich, varied and vibrant. There are many ways to research any given problem, and it is often essential to bring to bear more than one lens or approach to any problem. And the field IS moving forward.

In the introduction, Sriraman and English claim that the book “takes an avant garde look at theories of mathematics education ... synthesizes the past and orients towards new frontiers by synergizing areas that have been developing rapidly in the last five years.” (p. ix). They go on to claim that they “present a good case that theory development is indeed progressing and our field has indeed consolidated and synthesized previous work and moved forward in unimagined and productive ways.” (p. x). I certainly agree and I think they have made their case admirably.

The book is laid out in nineteen parts each with its own preface. The general (but not uniformly adhered to) organizational structure is for each section to begin with a preface, followed by a survey article describing some aspect of the mathematics education field, and for many (though not all) sections, there follows one or more commentaries by other notable researchers in the field. I like this way of laying out the material; it reminds me of the classical Greek commentaries of mathematical works. The list of contributors is impressive, extensive, international, and reads like a “Who’s Who” of mathematics education. This makes it a valuable resource for anyone interested in learning about the many facets of the field.

Several of the chapters are revisions and/or updates of earlier articles. It paints an informative picture of where the field as a whole has come, and in particular how the original authors interpret that advancement. For example, in the preface to Pegg and Tall’s section (Part VI), entitled *The fundamental cycle of concept construction underlying various theoretical frameworks*, Hegedus writes “...be ready for a thorough, detailed and rich adventure in comparing multiple theoretical frameworks drawing on concept formation and more generally, epistemology.” He goes on to recommend that graduate students in particular use this as a springboard into different theories in cognitive development of mathematical concepts. The original paper was written in 2005. The chapter elaborates and contrasts Piaget Stages, van Hiele levels, SOLO model (Structure of the Observed Learning Outcome) which addresses the global growth of knowledge through successive modes of operation, and Bruner modes of cognitive development. These provide a taxonomy for describing cycles of development of knowledge. For the young (or old!) researcher there are sections on theories of learning, on the conceptual and philosophical foundations for mathematics education research. There is a discussion of the paradigm of design science, and of the use of symbols and mediation in mathematics education to name just a few.

Taking apart just one section at random, I will choose the section *Problem Solving Heuristics, Affect, and Discrete Mathematics: A Representational Discussion* by Gerry Goldin (originally published in ZDM in Volume 36, Number 2, 2004). He reminds us of the vision of Debellis and Resenstien (2004) of discrete mathematics holding a central place in the school curriculum in the US, particularly for students who have been otherwise turned off to mathematics. Goldin examines the particular math competencies that discrete math problems evoke in students, asks why they are evoked, how one can structure activities to ensure they are evoked and developed, and how one can assess the effectiveness of such activities on student performance. He uses a specific example to illustrate his ideas, and clearly builds on a previously reported heuristic process, suggesting that discrete mathematics evokes a “model the general on the particular” heuristic process.

In the commentary, Jinfa Cai summarizes the research in problem solving over the past 40 years and laments the fact that such research is in decline. He suggests that Goldin’s chapter suggests “one future direction of problem solving in school mathematics.” (p. 252). At the same time, Cai takes Goldin to task for using a dichotomy that contrasts traditional mathematics topics with discrete mathematics in making his argument. He suggests that this is an unnecessary and unproductive. But, nevertheless, he suggests that Goldin’s message is clear – that the kinds of problems used in the classroom matter, and influence

the learning that takes place. Cai ends his commentary with a plea for a renewed effort in problem solving research, and provides seven questions to get eager researchers started.

The next section in the book addresses the topic of mathematical problem solving for the 21st century, in which the editors present the field as it looks now, and make suggestions as to its future directions, with an argument that we should focus on modeling. The synthesis is commented on by Grootenboer who agrees with their assessment by suggesting that “[a]n emphasis on mathematical modeling in the curriculum will provide students with more authentic mathematical experiences and promote deeper thinking and problem solving, and this seems as important as it ever has been given our data-dense society.” (p. 295). I hope this close-up look at just one section of the book provides a clear example of what one can expect to find in any of the 59 prefaces, chapters and commentaries of this indispensable book. I highly recommend it for the library of any serious mathematics education researcher.