

## Theories of mathematics education: European perspectives, commentaries and viable research directions

Bharath Sriraman (USA)  
Lyn D. English (Australia)

**Abstract:** We briefly comment on different perspectives on (1) the role of mathematics education theories; (2) the issue of plurality and healthy heterogeneity versus consolidation; (3) underlying inquiry systems or the implicit role of philosophy in theories of mathematics education. This paper also outlines developments within the European research scene on theory usage in mathematics education research, which complement the discussion at the 29th PME research forum in Melbourne.

**ZDM-Classification:** D20, C30

The second issue on theories of mathematics education extends the discussion presented in vol37.no.6. Theory development is by no means only of interest to the Anglo-American research community and this issue presents several European perspectives on theories of mathematics education. The oft invoked word, constructivism, in the research literature has been criticized by some researchers as having evolved into a dogma, as opposed to the original intention of the word to connote a philosophy of learning. Nearly ten years after the heated dialogue between the social constructivist and radical constructivist camps, Paul Ernest contrasts the positions of 'simple' constructivism, radical constructivism, enactivism and social constructivism. In doing so, Ernest makes use of metaphors which explain these positions today.

One of the issues we thought worthy of discussion by the community at the 29<sup>th</sup> PME was the presence of multiple and diverging theories. Steve Lerman examines this issue by developing his contribution to the discussion in Melbourne. Lerman points out that the mathematics education research community has adapted theories from the fields of cultural psychology, situated cognition, ethnomathematics, sociology, sociology of education, poststructuralism, hermeneutics, critical theory, social linguistics and semiotics, among others. His empirical analysis of PME research reports from 1985-2005 provides evidence of this social turn and explains the plurality of theories used in mathematics education. In this developed contribution, Lerman draws on the sociological theories of Basil Bernstein to argue that the multiplicity and divergence are neither surprising nor necessarily damaging to the field.

Törner & Sriraman present a historical paper which contrasts the mathematics education histories of the U.S and Germany. The authors point to common tendencies and shifts in U.S and Germany and show that certain

trends seem to have re-occured across time and location. In particular, they spell out periodic shifts in focus of mathematics education over the last 100 years and in this process unravel common focal points in the parallel development of the field in these two countries. One of their major criticisms of the field is the constant re-invention of the wheel, or repetitive research which is a detriment to pushing the field forward, something which can be now avoided with the presence of technology, easy communication between researchers and facilitating access to published research.

Given the criticism of the absence of European perspectives, this issue includes a substantial summary and discussion of theory usage in Europe based on the analysis of research reports of European participants at the 4th European Congress of Mathematics Education (CERME4) held in February 2005 in Spain. Sriraman & Kaiser discuss trends seen within CERME4 reports on theory usage by European researchers in seven of the fourteen working groups. Based on their analysis of theoretical frameworks employed by researchers in the working groups on (WG1) Metaphors and embodied cognition; (WG2) Affect and Beliefs; (WG3) Structures; (WG4) Argumentation and Proof; (WG6) Algebraic Thinking; (WG7) Geometric Thinking and (WG13) Modelling and Applications, Sriraman & Kaiser take a stance on possible common questions which could further theory development as well as ways in which researchers from different traditions could understand each other within these domains of inquiry. They also point to tendencies of researchers from certain European traditions to make use of "home-grown" frameworks.

Bikner-Ahsbabs & Prediger also address the issue of multiplicity and richness of existing theories and propose the idea of networking theories instead of integrating them. The networking model contains elements of Lester's ideas on paying attention to researcher's underlying inquiry systems when trying to understand reported research, as well as Lerman's observations of the numerous sociological fields from which mathematics education researchers adapt theories for their work, which are not necessarily damaging to the field. Their paper is based on the discussions of the working group on Theories at CERME4 led by Tommy Dreyfus.

As mentioned in the previous issue, we have included critical commentaries of papers published in vol.37,no.6. Guershon Harel reacts to Frank Lester's paper and offers possible reasons apart from political ideology for the emergence of forces within the U.S to define scientific research in education rigidly. Harel also interprets Lester's paper as a call to the MER community to respond to the current political forces that (inappropriately) shape our field, as well as addresses the role of the mathematical context in MER.

Bettina Dahl's commentary to John Pegg and David Tall's paper discusses their fundamental cycle model of conceptual construction from action to object and its relationship to other theories. Dahl compares Pegg &

Tall's SOLO model to a different model called the CULTIS model as a possible means of intergrating the SOLO model or serve as a complement.

Gerald Goldin critiques and comments on the global ideas presented by Moreno-Armella & Sriraman on the development of representational systems drawn from the prehistory and history of mathematics. Goldin discusses the "pre-theory" exploration of Moreno-Armella & Sriraman and pragmatically points out that the really difficult task lies ahead, which requires the community to move beyond the general level, to create a detailed, specific, and practically useful characterization of the processes of mathematical learning and development. Finally Claus Michelsen presents a European perspective on Lesh & Sriraman's (2005) ambitious proposal of re-conceptualizing the field of mathematics education research as that of a design science.

We hope that these two ZDM issues on theories re-kindles the discussion of theories within the mathematics education community and offers ideas for viable research projects for interested researchers.

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#### **Authors**

Bharath Sriraman  
Editor, The Montana Mathematics Enthusiast  
<http://www.montanamath.org/TMME>  
Dept. Of Mathematical Sciences  
The University of Montana  
Missoula, MT 59812  
USA

Lyn D. English  
Editor, Mathematical Thinking & Learning  
School Mathematics, Science, and Technology Education  
Queensland University of Technology  
Kelvin Grove  
Brisbane,  
Australia, 4059  
[http://eprints.qut.edu.au/view/person/English\\_Lyn.html](http://eprints.qut.edu.au/view/person/English_Lyn.html)