

## Interdisciplinarity in mathematics education: psychology, philosophy, aesthetics, modelling and curriculum

Bharath Sriraman

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As I begin this editorial, there is a tremendous sense of relief that comes from bringing a massive undertaking to an end. The idea for this special issue on interdisciplinarity spawned at the first editors meeting in Hamburg in January 2007, when ZDM was transitioning into a new era with Springer. At one point in this meeting, we were brainstorming to determine themes of interest for the mathematics education scholarly community, and the idea to release a special issue on interdisciplinarity was born. Little did I realize the reckless bravado with which I volunteered to put together such an issue would result in a two year roller coaster of intellectual stimulation, and a whole host of other contradictory emotions that come into play when one is working with a large group of collaborators and stake holders on the task at hand. For the quantitatively inclined reader, I can break this double issue up by the numbers into an interesting identity. ZDM, vol 41, nos 1 and 2 = 3 International Symposia + 5 years of collaboration + 22 months of planning + 44 reviewers + 3 rounds of reviews, revisions, commentaries, re-revisions + 24 authors + 1 idiosyncratic guest editor + 1,123 e-mail communications = 22 articles.

I find many of these numbers pleasing; 22 is a pentagonal number, i.e a polygonal number of the form  $\frac{n(3n-1)}{2}$ .

1,123 is even more pleasing because it is not only prime, but also has the four starting digits of the Fibonacci sequence concatenated together, in addition to being a centred 17-gonal number. Alas this editorial is not being written on the 23 of November! The preceding sentences were meant to make the reader think about the different

ways in which our mind perceives “things”, mathematically or otherwise. We are capable of imposing meaning on just about anything, sometimes the search for meaning leads to the discovery of nothing. Nihilism and Nirvana are two sides of the same coin.

Human beings are by definition “interdisciplinary”—we are complex neurobiological organisms capable of juggling a wide array of tasks that intertwine the physical, psychological, inter-personal, intuitional, intellectual, cultural and spiritual dimensions of being. Yet schooling and institutional practices utilize a fraction of our capabilities with the goal of reducing us to functional specialists who propagate the existing status quos.

This double issue has been organized into five sections, namely *psychology*, *philosophy*, *aesthetics*, *modelling and curriculum*. Why 5 sections? and not 4 or 3 or 2? The answer is that it simply worked out that way. I might also add 5 is a very special number in many cultures and for many reasons! The contents of this double issue can be viewed in terms of a metaphor. The metaphor is that of a Banyan tree (*Ficus benghalensis*), which grows in the tropics. This tree is most unusual because its starts out with a main trunk like any other tree but on reaching a certain level of maturity starts to produce hanging roots from the branches. When these hanging roots get long enough and make contact with the soil, they in turn become other trunks and the tree grows enormously large.<sup>1</sup> In the long term, i.e., over the period of centuries, it is nearly impossible to count the order in which these new trunks formed and to forget that they are all connected. This metaphor characterizes the fragmented nature of knowledge today.

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B. Sriraman (✉)  
Department of Mathematical Sciences,  
The University of Montana, Missoula, USA  
e-mail: sriramanb@mso.umt.edu

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<sup>1</sup> The largest banyan tree is said to be on the island of Sri Lanka, with over 350 large trunks and more than 3,000 small ones. (see <http://www.itsnp.net/common/btree.html>).

The birth of the main trunk is analogous to Knowledge (capital K, unifying) with the myriad branches being the theological, philosophical, artistic, political, social, cultural, literary and scientific traditions that flowered in numerous golden ages of our collective heritage. The hanging roots of these branches (golden ages) in turn produced trunks which are today distinct domains of knowledge such as mathematics, physics, music, astronomy, history, theology, mysticism, the liberal arts, different forms of humanism, etc. The subordinate trunk of mathematics as a discipline in turn produced other branches and hanging roots among which we find mathematics education, and true to form, mathematics education is in turn producing the next generation of subordinate trunks (sub-disciplines). Indeed at a recent conference, I was puzzled that a semiotician was unable to communicate with a discourse analyst when communication whether by gestures, signs or language was paramount to both their disciplines! I hope this is not the foreseeable future of mathematics education.

Now engage in a thought experiment, where we step away from the metaphorical banyan tree and view its growth from the perspective of our collective history (in accelerated time). It will reveal the myriad interconnected links between all the so-called specialized and sub-specialized disciplines (or areas of knowledge). Again, if we look for meaning and common links between disciplines, it is there waiting to be discovered. The five links that connect many disciplines, which are unraveled in this issue are *psychology, philosophy, aesthetics, modelling and curriculum* but they are by no means complete or exhaustive and hopefully will prompt others to investigate more connections.

Many of the contributions to this special issue are the result of the activities of Mathematics and its Connections to the Arts and Sciences (MACAS). For the last five years, this group has focused on interdisciplinary initiatives in humanities, the sciences and arts with mathematics at the center and sometimes mathematics at the periphery. This group blossomed out of a topics study group on interdisciplinarity at the 10th International Congress on Mathematics Education in Copenhagen, 2004 after which Claus Michelsen (University of Southern Denmark), Astrid Beckmann (University of Education, Schwaebisch Gmuend) and I took the initiative to sustain the group and create long term research collaborations. Nearly five years later, MACAS has slowly mutated into an eclectic but core group consisting of mathematicians, physicists, philosophers, and math, science and art educators. MACAS1 was held in Schwaebisch Gmuend, Germany in May 2005, MACAS 2 in Odense, Denmark in May 2007, one mini symposium was held in Calgary, June 2007 under the auspices of the 9th International History and Philosophy of

Science Teaching Conference (IHPST). The third biennial symposium (MACAS3) has been planned for 21–23 May 2009 at the University of Moncton, New Brunswick, near the beautiful Bay of Fundy, as a result of obtaining a developmental grant from the Social Sciences and Humanities Research Council of Canada.

The papers from the Symposia have covered a variety of topics such as:

- Modeling activities to foster interdisciplinary projects in the school and university setting.
- Using connections between mathematics, physics and biology to design and research interdisciplinary activities in schools and the university
- How research within the ethnomathematics domain of mathematics education can be linked to critical mathematics education and interdisciplinary projects involving mathematics, art and culture.
- How the push for mathematical and statistical literacy can be connected to other subjects via interdisciplinary activities.
- Examples of classroom experiments that demonstrate connections/relations between mathematics, arts and the sciences with implications for pedagogy?
- Role of technology and new ICT interfaces in linking communities of learners in interdisciplinary activities involving problem solving and mathematical contests.

Some of the extended papers from the MACAS1, MACAS2 and IHPST9 have been included in this issue after two, sometimes three rounds of critical peer review. In addition, I solicited papers from researchers working in the domains of creativity and aesthetics, constructs that are crucial in any discussion of interdisciplinarity. The paper by Ron Beghetto and James Kaufman weigh the notion of polymathy or multicreative potential put forth in the papers by Jonathan Plucker and Dasha Zabelina, and Sriraman. The paper entitled *Mathematics Education research embracing the arts and sciences* provoked the reviewers and the author of the paper to engage in an interchange of ideas in the form of dialogues and reactions, which are both provocative and illuminating. Orchestrating commentaries and reaction papers can be a tricky enterprise but the participants (Norma Presmeg, Michael Fried, Ted Eisenberg and David Pimm) engaged in this exercise in an intellectually stimulating fashion, one that I hope engages the reader in the ideas being debated.

Finally, even though compiling and editing this special issue for ZDM has been a challenge, it has allowed me to act as a hub linking together different initiatives and researchers, both geographically speaking, as well as across a large spectrum of ideas, and in this respect the end product is rewarding and speaks for itself. Many individuals played important roles in orchestrating this special

issue. First and foremost, I wish to thank Gabriele Kaiser and Alexandra Corleis for tolerating my idiosyncrasies and facilitating the extensive review process. A rather large cast of reviewers played an important role in helping improve the numerous papers submitted to this issue, and in particular I would like to express my gratitude to Nathalie Sinclair for reviewing more than the “normal” burden of papers. The following reviewers played a crucial role in ensuring high quality control standards and I thank them for giving of their time and energy towards this endeavour. The lengthy list of Reviewers bears testimony to the quality control aspired for, as well as the interest and goodwill towards ZDM among the community of researchers. I hope this double issue on interdisciplinarity, which signals the start of 2009 for ZDM, is stimulating, provocative and of value to our community.

### Reviewers

Mette Andresen  
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