Seoul searching at ICME 12

Close encounters of the 'Math ED' kind

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Held every four years, the International Congress of Mathematics Education (ICME) is organised under the auspices of the International Commission on Mathematics Instruction (ICMI), started in 1908 as the International Commission on the Teaching of Mathematics with this aim: "To make an inquiry and publish a report on current trends in the secondary teaching of mathematics in various countries" ([1]). Over the years, ICMI activities have contributed to the development of a new discipline: research in mathematics education.

Every fourth year starting with 1972, ICME has brought together math educators, researchers, teachers, policy-makers, students and mathematicians to collaborate on issues and challenges of math education. The aim is to present trends in math education research and the practice of math teaching at all levels. It serves as a meeting space for the international math education community, provides an opportunity for discussion, debate and the presentation of new research and theory. ICME-12, held this year between 8 and 15 July, in Seoul, South Korea, was attended by over 4000 people from over 100 countries. From India, there was a delegation of 25 individuals drawn from across the country.

At Right Angles shares first hand accounts of ICME-12 as reported by Shreya Khemani and Geetha Venkataraman.

Geetha: This was a journey involving many firsts: the first ICME I was attending, and the first time I was visiting a place as far east as Seoul. This essay is not just about mathematics education or about visiting Seoul, it is also a collage of impressions of ICME-12: the talks, the Indian National Presentation, people and places in Seoul, and other vignettes. ICME-12 was held at Coex Mall, a huge mall several floors of which were devoted to ICME-12. Soon after settling into our accommodation on July 8, we headed to the Conference venue, which turned out to be about 45 minutes away by walk and subway. It was soon to become our daily routine for the next seven days.

Shreya: Sessions were held in parallel, making it very difficult to choose one lecture or event over another. There were 7 Plenary Events, 5 Survey Teams, 78 Regular Lectures, 37 Topic Study Groups, 4 National Presentations, 47 Workshop Sharing Groups, 17 Discussion Groups and reports of various ICMI Studies, and we often found ourselves dashing across rooms or across floors, trying to catch as many events as possible. Most people attached themselves to a single Topic Study Group (TSG) of their field of interest. I was a part of TSG 7—Teaching and learning of number systems and arithmetic—focusing on primary education, where I presented a paper (co-authored with Jayasree Subramanian) on our work, *Tackling the Division Algorithm*. The study group consisted of a core population of around 15 people, while others floated in and out. Papers presented differed greatly in scope and method. Unlike the larger events at the Congress, the study group provided a more intimate atmosphere where thoughts

and questions could be shared openly. Similar concerns, a growing familiarity over the course of the week and the small size of the group allowed for lively discussions and a meaningful exchange of ideas.

Geetha: The journey began in early 2011 when plans for the Indian National Presentation (INP) at ICME-12 started taking place. India was one of several countries that were given the opportunity to make a presentation on the state of math education in their country. The aim was to cover different aspects of math education in India, to critically review the situation at the different levels: primary, middle, secondary and tertiary, through the dual lens of curriculum and pedagogy. Several regional conferences and one national conference later, the INP began to take shape.

There were many topics and viewpoints that the INP planned to represent through different media. In addition to a book, audio-visual presentations were to be showcased in short clips. A video film was to be made and an exhibition organized, and all this had to be done with people collaborating from far and wide, across India.

With July approaching there were mad deadlines that everyone was trying to meet, and bouts of panic because of the Air India strike. But despite it all, the team arrived in Seoul. The book ([2]) was ready, as were individual team members' presentations ([3]), the video film ([4]) on mathematics education was canned in time, and charts, posters and display items ([5]) for the exhibition were assembled.

Shreya: An interesting feature of an ICME is the large number of Workshop Sharing Groups (WSG). These are informal small group activities designed to "exchange and discuss relevant mathematical experiences" ([6]). No formal presentations are made; rather, groups are invited to share their experiences of a project they have worked on and open the floor for discussion. I attended the WSG on the Urban Boundaries Project: Mathematics and the Struggle for Survival. It described a project led by a varied group of individuals (architects, biologists, physicists, teachers, math educators) working with two communities in the outskirts of Lisbon, Portugal — an ancient Portuguese

fishing community, and an immigrant population, consisting of people from different ethnic groups living on agricultural land where settlement is deemed illegal. Both communities face problems of social inclusion, and the project seeks to address their educational needs. Coming from within the discipline, one rarely thinks about the relationship between mathematics and politics. One thing that struck me was the difference in the way that mathematicians and math educators view mathematics. As Lyn Steen observes: "To a mathematician, mathematics is singular —a Platonic paradigm in which there are . . . unquestionable criteria for distinguishing right from wrong and true from false. But to math educators, mathematics is plural. Mathematics, among other things, offers a lens through which one can look at the world. In math education the direction is reversed — one looks at mathematics through the lens of the learners [and the teachers]" ([7]). I had never conceived of mathematics as plural. Nor had I ever imagined being at a conference on math education where it would be relevant to ask about the immigration laws of Portugal!

Hans Freudenthal, a prominent topologist of his time, was President of ICMI from 1967 to 1970, and it was under his initiative that the first ICME was launched in 1969. He worked extensively for reform in math education and wrote widely on the subject. In 1971 the Freudenthal Institute was established, with Freudenthal as its first Director. At its heart was the 'Wiskobas' project (Mathematics in Primary School) which laid the foundations for the development of Realistic Mathematics Education, an approach rooted firmly in Freudenthal's interpretation of mathematics as a 'human activity'.

Geetha: An event that left an impression was the Regular Lecture by Alan Schoenfeld (Klein Medal awardee), How we think: A theory of human decision-making, with a focus on teaching ([8]). The Abstract seemed to suggest that the speaker was working on a theory that could explain why teachers took particular decisions in class. It seemed to apply to any kind of goal-oriented decision making activity.

Alan had started his career as a mathematician, and a reading of Polya's How To Solve It ([9]) got him thinking about 'heuristics' and strategies that mathematicians use to solve problems. This led him to the obvious question as to whether it is possible to teach students to be better problem solvers and to enjoy the profound beauty of mathematics. From here it was a natural step to turn his attention to teachers and teaching. Eventually this led to his research on goal-oriented decision making of which teaching is an example. The aim was to build a theory to help model goal-oriented decision making tasks like teaching, problem solving, cooking or brain surgery, which could explain and even predict decisions taken in the classroom by a teacher, in the kitchen by a cook, or on an operating table by a surgeon.

The talk was a sell-out. There was no standing space; even the aisles in the auditorium were packed! Interested readers should refer to [10] for details.

Shreya: Both the Plenaries and the Regular Lectures featured prominent scholars in the field, providing us an opportunity to hear at first hand the people whose work we admire. I particularly enjoyed Freudenthal's Work Continues by Marja van den Heuvel-Panhuizen. Her talk was about some recent projects in elementary mathematics education carried out at the Freudenthal Institute (Netherlands). In describing each project, she looked back to the work of Freudenthal and his collaborators on Realistic Mathematics Education (RME) which has influenced and inspired math educators and researchers around the world ([11]).What I found particularly interesting was how she placed each project in a larger historical perspective of the institute's history and Freudenthal's philosophy.

Geetha: One of the plenaries was a panel discussion titled "Mathematics Education in East Asia" which focused on the situation in Japan, Korea and China. It was well presented, with practiced remarks thrown in at various points. For example,

there were video clips shown of classroom situations in USA and China; in the former, students' faces were blurred to protect privacy, whereas no such means were adopted for the latter. The 'remark' then was to the effect that education was a public enterprise in the East and not about individuals.

The presentation seemed to suggest that the culture and societal practices of the East had resulted in a 'war footing' with which mathematics education is approached. There were statistics presented on the millions of dollars spent by students in private coaching, to climb the relentless ladder of success in mathematics. (I may mention here that while returning each day in the metro, we routinely met children returning home from various coaching classes, as late as 9 pm.) There was an attempt to show the contrast between practices in the West (USA) and East: between the focus on the individual learner in the former, and on the entire class in the latter. The fact that many countries of the East had done well in international studies on math achievement (TIMSS [12], PISA [13]) was highlighted.

What struck me later was that they seemed so sure that their way of learning and doing mathematics was the right way. I wondered if this is actually the case, or whether there were other critical voices that did not find place in the presentation. Surely, if there is one thing that worries so many of us in India, particularly when policy decisions are made regarding the teaching-learning of mathematics, is whether we are on the right path or not.

Of course, we tilted the scales in the other direction during the INP! Each presentation looked closely and critically at some aspect of mathematics or mathematics education in the country. In our desire to acknowledge that there is so much yet to be done, we tend to be over-critical. But it is important to recognise the many positives that have been achieved.

The INP took place on 10 July. It covered a broad spectrum of topics: glimpses of history of mathematics and math education in India; curriculum and pedagogy for primary, middle and secondary school mathematics; assessment of math learning; math education, nurture and enrichment initia-

tives at the undergraduate level; teacher education and development; and research in math education. Three short films were shown. The preparation that had begun with the creation of NIME (National Initiative on Mathematics Education ([14]) had finally borne fruit. Of course, there were some lessons to be learnt as well. We should have publicised the INP better and tried to reach a larger audience. Our exhibition needed a dedicated team and seemed under-par compared to other National exhibitions. But one of the games exhibited in the stall — *pallankuzhi* — proved to be a great hit, especially with children. (We learnt that variants of this game are played all over the world.)

Shreya: The organisers also hosted a Math Carnival, filled with exhibits and fun activities. Visiting teachers and children spent hours playing mathematical games, pondering Escher-esque tessellations, climbing dodecahedrons, and challenging their friends by rolling the Silla Square. It was lovely to see so many young people running around in the midst of a serious academic conference.
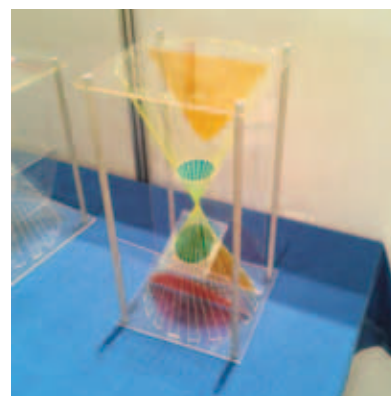
On 12 July, participants were taken on excursions through the city of Seoul. We walked through some historic parts of the city, visited the beautiful Gyeonghuigung palace and the Seoul History museum, attended a kimchi cooking class, and had a wonderful traditional Korean meal. Seoul is a large, striking megapolis, grid like and modern in its architecture, and surrounded by mountains. The Han River flows through the centre of the city, dividing it into two halves and separating the Northern, older part of the city from the Southern modern metropolis. July is a monsoon month; while the temperature and rain feel like Mumbai, the temperate vegetation and tall pine trees contradicted and confused what I associate with warm rain. We walked around in the evenings to take in the sights, sounds and smells. Street markets are vibrant and large, and stay open through the night. Filled with ingenious kitsch and delicious food, the markets come alive at night. The older part of

the city still has some of the ancient Hanoks that survived the Japanese colonial invasion, and more recently the real-estate mafia. Stumbling onto an ancient Buddhist temple on a lane just behind a 50-storey glass building leaves you wondering how the ancient and modern co-exist so seamlessly in this bizarre and wonderful city. People are kind and helpful; from missing a train to help you navigate the subway, to walking you to your destination when you ask for directions, Korean kindness—resonant of a Confucian past—is something I cannot forget. I was standing one evening outside a market place when it began to rain. Two young girls came and asked if I had an umbrella. When they found out I didn't, one of them promptly pulled hers out and handed it to me, got under her friend's umbrella, wished me a good evening and waved goodbye! It was difficult to make sense of Korea — with the myth of reunification, the growth of pop-culture, the abundance of 4G de-

vices and kindness—but I more than enjoyed my time in the wonderful city that is Seoul.

On the final day of the Congress, we were treated to a captivating performance by the dance troupe Noreum Machi that performs a percussion music called samulnori.

Geetha: There was also the presentation of the big ICMI (International Commission on Mathematical Instruction) awards: the Felix Klein and Hans Freudenthal Medals. "ICMI awards the Felix Klein Medal to a person who has shown consistent, and outstanding lifetime achievements in mathematics education research and development, and the Hans Freudenthal Medal to a person who has developed a theoretically well-conceived and highly coherent research programme which has had a significant impact on the community" ([15]). The awardees of the medals for 2009 and 2011 were felicitated at the ICME-12 inaugural ceremony. The 2009 and 2011 awardees of the Klein medal were Gilah Leder (Australia) and Alan Schoenfeld (USA), while the Freudenthal medals went to Yves Chevallard (France) and Luis Radford (Canada) for 2009 and 2011 respectively.

Shreya: As we said goodbyes and exchanged email IDs, and I walked off into the rain with my newly-gifted umbrella, I reflected on all I had heard and seen. I found myself faced with two questions, one pertaining to the relationship of mathematicians to math educators; the other, to the relationship of theory to practice in the world of math education. In his plenary address, "Whither the mathematics / didactics interconnection?" Bernard R. Hodgson spoke of the long-standing tradition of eminent

In the late 19th Century, the great mathematician Felix Klein published an important study of the icosahedron. Around the same time, he was busy initiating a reform of secondary mathematics education in Germany, focusing in particular on teacher education, to deal with the problem he described as the double gap — "the discontinuity between school mathematics and university mathematics and the double forgetting of the respective knowledge: first one had to forget school mathematics upon beginning one's university studies and later as a teacher one had to forget university mathematics and return to school mathematics." He believed that 'the whole sector of mathematics teaching, from its very beginnings at elementary school right through to the most advanced level research, should be organised as an organic whole', and that without this view, 'even the purest scientific research would suffer, inasmuch as, by alienating itself from the various and lively cultural developments going on, it would be condemned to the dryness which afflicts a plant shut up in a cellar without sunlight'.

mathematicians being involved in education, but warned of a growing 'opaqueness' between educators and mathematicians. I wondered if Felix Klein could have foreseen this drift.

One of the striking things for me about ICME-12 was how senior researchers, Ph D students, mathematicians, school teachers, practitioners and people working in the field were all given a common platform to present their work, raise their concerns and talk about issues in mathematics education. I remember how, at a conference I once attended, a famous mathematician requested for a woman mathematician in the room to be asked to leave as she was accompanied by her little child who made a sound. In contrast, ICME-12 allowed so many voices to be heard, so many people to be present, so many narratives to be told. For me it was a platform that served to include rather than exclude.

References

1. http://www.icmihistory.unito.it/introduction.php
2. R. Ramanujan and K Subramaniam, (editors), Mathematics Education in India: Status and Outlook, HBCSE, 2012. (May be downloaded from http://nime.hbcse.tifr.res.in/articles/ INPBook.pdf.)
3. http://nime.hbcse.tifr.res.in/articles/presentation-slides
4. Three short films excerpted from the video titled 'Puzzles & Inspirations: Mathematics Education in India' can be downloaded from http://nime.hbcse.tifr.res.in/articles/videos.
5. http://nime.hbcse.tifr.res.in/articles/exhibition-posters
6. http://www.icme12.org/sub/sub02_08.asp
7. Kilpatrick, J. (2008). The development of mathematics education as an academic field. In M. Menghini, F. Furinghetti, L. Giacardi & F. Arzarello (Eds.), The first century of the International Commission of Mathematical Instruction (1908-2008). Reflecting and shaping the world of mathematics education (pp. 25-39). Roma: Istituto della Enciclopedia Italiana fondata da Giovanni Treccani.
8. Alan Schoenfeld, How Humans think: A Theory of Human Decision-Making, http://www.icme12.org/upload/submission/1900_F.pdf.
9. G. Polya, How to Solve It: A New Aspect of Mathematical Method, second edition, Princeton University Press, 2004.
10. Alan Schoenfeld, How We Think: A Theory of Goal-Oriented Decision Making and its Educational Applications, (Studies in Mathematical Thinking and Learning Series), Taylor and Francis, 2011.
11. Van den Heuvel-Panhuizen , M. (2012), Freudenthal's Work Continues, pre-proceedings of ICME 12.
12. http://nces.ed.gov/timss/
13. http://www.oecd.org/pisa/
14. http://nime.hbcse.tifr.res.in/
15. http://www.icme12.org/data/icme12_Final_Programme.pdf

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