

The DELTA09 Conference at Gordon's Bay South Africa: Nov 30-Dec 04, 2009

Summary and Impressions

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With the title Mathematics in a Dynamic Environment, the Seventh Southern Right Conference on the Teaching and Learning of Undergraduate Mathematics and Statistics, DELTA 09, was held at Gordon's Bay near Cape Town, South Africa. Its predecessor in southern Patagonia, Argentina was at 50° South probably the most southerly mathematical conference ever, but Gordon's Bay proved to be an excellent well positioned site facing south-west with the long flat beach of False Bay to the west and smartly rising stark mountains to the east. For much of the time the weather was good and settled though the Cape Doctor south-east wind blew with great regularity and bracing effect. Gordon's Bay is to the east of the Cape Town conurbations with Stellenbosch and the very pretty vineyards in mountain meadow country only a short distance inland. Further to the east is the ocean coast and Hermanus famous for its whale watching. The delegates were on the Wednesday privileged to take a trip on the sea to see the whales at first hand and we were somewhat lucky as by early December many whales have already departed to the south. There are sharks on view as well and one of them was snapped in classic Jaws pose by an alert delegate.

Beginning in Australia in 1999 the Delta conferences are a regular biennial event held in late November, hitherto in Australia, South Africa, New Zealand, Argentina and most recently at Gordon's Bay, South Africa. Themes are based upon learning mathematics and statistics at undergraduate level, both for specialist mathematics students, and student teachers and other key users such as engineers. Their remit is however somewhat wider than that at UK national conferences such as the IMA Mathematical Education of Engineers, with a greater emphasis on pedagogy. There were close to 100 abstracts or equivalent contributions, with some authors being listed three or four times, with papers presented in both plenary and parallel sessions. The aim here is look at some of the themes and a few of the contributions but everybody who took part made the event the great success it turned out to be.

As with past Delta conferences, some of the major contributed papers were presented to the participants on arrival, having already been published in the International Journal of Mathematical Education in Science and Technology (IJMEST) in a Special Issue. In an editorial foreword Greg Oates (University of Auckland, NZ) and Johann Engelbrecht (University of Pretoria, SA) set out some of the major themes. We will be looking at some of these shortly but the Special Issue of 12 papers began with Eric Muller (Brock University, Canada) who noted that the conference theme should be reflected in the qualities needed to build a dynamic university mathematics department. Of the others Patricia Cretchley (Queensland University of Technology, Australia), examining the promotion of teaching and learning, or T & L activity within Australian universities, noted that there are still entrenched attitudes in academia with regard to the very limited value and esteem with which T & L is held with respect to more traditional research. This affects the reputation and funding of academics, an experience all delegates to Delta conferences understand only too well.

The main proceedings of 25 papers with abstracts made up the third set of pre-published material. These included all the themes of the conference from pedagogy to the interpretation of the dynamic environment as dynamical systems, but with a strong emphasis on undergraduate T & L in terms of subject specifics such as linear algebra. Our task here is to give a short overview of some of the themes addressed but only a few of the contributions. They were wide and varied but here is a flavour.

Preparedness at the school/university interface

There is now a well reported worldwide concern about the mathematical preparedness of new undergraduates. In Delta 07 several speakers spoke of strategies being adopted to mitigate its effects, such as diagnostic testing, self-assessment, the use of bridging units and foundation study. In Delta 09 there was similar discussion with emphasis on the secondary/tertiary interface. Tracy Craig (University of Cape Town, SA) reported on an initiative within first year engineering mathematics to teach and assess school-level mathematics skills, noting student deficiencies particularly in log laws and trigonometry. Ye Yoon Hong et al, (Rajabhat University, Thailand), in a collaborative investigation with New Zealand academics and teachers, found that teacher and lecturer perspectives were quite different, and many of us would feel that this is true widely and that much closer links need to be fostered. Jeanetta du Preez (University of Pretoria) has for some years been investigating the under-preparedness of engineering students for concepts in calculus and her recent survey shows that the real problem is a lack of critical thinking and problem solving skills as well as a superficial depth of knowledge. David Easdown (University of Sydney, Aus) addressed this superficiality by quoting examples of student errors in reasoning and alleges that this may be due to a tension between syntax, or form of mathematical expression, and semantics, the underlying ideas or meaning.

Support – external and internal to the degree programme

This is a major issue. It may be that the first serious ventures in providing external student support emanated from the UK as it was there that the first substantial decline of student knowledge, drill and practice became manifest in the 1980s. Martin Harrison (University of Loughborough, UK) spoke about the Centre for Excellence in Teaching and Learning at Loughborough and Coventry Universities (CETL). Otherwise known as Sigma, this is a large government funded venture (US\$7M) aimed at providing mathematics support services for students with dissemination to other higher education institutions in the UK and abroad. As well as extensive ‘drop in’ facilities with one-to-one student access to staff, there has been a deliberate strategy of proactive teaching intervention to address the problems of all students. Technology and pedagogic research has supported all the activities and a special centre, Eureka, has been set up to support students with special mathematical anxieties. In many universities across the world the large lecture is still the mainstay of mass dissemination though several studies have often questioned its efficacy. In mathematics (Christer Bergsten et al, University of Linköping, Sweden) surveying students concluded that organised clarity, demonstration examples, explanations to support understanding, and a steer towards tutorials and exams and personal contact were the main ingredients. Not included might be active engagement though Sepideh Stewart et al, (University of Auckland) using Quizdom ‘clickers’ issued to students has been obtaining instant feedback responses in bar-chart form not only to multiple-

choice type questions but to those related to levels of understanding. This has enabled teaching emphasis to be changed with topics revisited if necessary with improvements all round. Technology in the classroom can now no longer be considered as an innovation and Greg Oates (University of Auckland) has produced a taxonomy of integrated technology from responses to two international surveys.

Graduates and Skills – or the lack thereof

Neil Challis (Sheffield Hallam University (SHU), UK) spoke about a major UK government funded project (US\$5.5M) 'More Maths Grads' aimed at widening participation in the mathematical sciences. With four themes, careers, students, teaching and the university curriculum, SHU has looked at the curriculum and has disseminated the quite complex findings of the questionnaire surveys and structured interviews via seminars and websites. The survey results have identified pointers to attitudes of staff and students to such degree programmes which hopefully will increase innovation in the curriculum. Bill Barton (University of Auckland) in his plenary talk started by saying that it is not possible to establish a core programme in mathematics generally and that the mathematics community needed to act responsibly and had a professional duty to the public. The recent economic crash may have been in part due to misapplication of derivatives and an unwise use of the extrapolation of apparent trends. A degree programme needed expository lectures with more processing and less content. Focus should be more on the quality of graduates and their preparedness for the workplace. There was much discussion outside the conference sessions about graduate skills. In some institutions students using mathematics are encouraged to work together in modelling problems and to deliver their findings in both presented form and in a written report, and there is some evidence of the success of such activity. After all very often team working skill is needed by graduates at the outset. Chris Sangwin (University of Birmingham, UK) spoke about the use of the 'Moore Method' in which students not only present their modelling findings to their peers but are asked to comment and criticise the solutions of others. Jeff Waldock (SHU) noted that graduate skill training was embedded in courses at SHU and that the UK national survey of students, NSS, had given high praise for such practice. There is not, nor should there be a standard way in which mathematics is taught in universities across the world. A comparative study is however very useful and Cristina Versavsky (University of Monash, Aus) and Marta Anya (University of Buenos Aires, Argentina) have done this for their two countries.

Subject specific shortcomings/misconceptions (Linear algebra etc)

As always at Delta conferences some contributors had looked into subject specific shortcomings. At Delta 09 linear algebra received particular attention. At lower levels students often cope with linear algebra but Sandra Britton (University of Sydney) noted that things get tougher with deeper concepts such as subspaces of vector spaces. John Hannah (University of Canterbury, NZ) had similar experiences with the concept of subspace whereas linear combination and span were better understood. Gulden Karakok et al (Umea University, Sweden) interviewed students being introduced to eigenvalue problems in the context of quantum physics and among many conclusions found that students especially recalled a particular activity involving group discussion.

Pedagogy

Mathematics for schoolteachers is always a major part of Delta, and Kevin McLeod (University of Wisconsin-Milwaukee, USA) spoke about mathematics knowledge for teachers within a capstone course. In this prospective teachers look deeply into fundamental ideas and develop connections between some mathematics that might seem unrelated to those needed in highschool but nonetheless are aimed developing good mathematical habits of mind. Danielle Huillet (Eduardo Mondlane University, Mozambique) in her plenary talk also focused on bringing teachers close to the real world of mathematics, this time with teachers' knowledge of limits of functions and its evolution through research. All the same she emphasised that it might be prudent to stint on full mathematical rigour, relying only on heuristic justifications, if that was the price to keep students engaged.

.... And so for Mathematics itself

One of the great things about the Delta conferences is that mathematics itself does not get squeezed out by the emphasis on education and pedagogy. Mathematical explorations for teachers who wish to enthuse their students always have a special place. In their plenary talks both Poobhalan Pillay (University of KwaZulu-Natal, SA) and Leigh Wood (Macquarie University, Aus) spoke respectively about the never ending challenges of prime numbers and the power and passion of mathematics. Ansie Harding and Johann Engelbrecht (University of Pretoria) completed a trilogy of papers on sibling curves having featured them at previous Deltas. Temple Fay (Tshwane University, SA) took his investigations from generating Pythagorean triples to the subtleties of period doubling, or not, in Duffing's equation. In an equally versatile portfolio Victor Martinez-Luaces (University of the Republic of Uruguay) offered four papers on widely differing aspects of modelling.

.....And so on

So where do we go from here. Delta has for many years united the widely disparate Southern Hemisphere in a quite unique form of conference. Maybe not totally education and certainly not totally mathematics but definitely a forum of challenge that has no obvious parallel further North. In pointing the way ahead many ideas were put forward in the final session that we take on to Rotorua in New Zealand in 2011.

- Effectiveness of tablet technology
- Seminal proofs of classical conjectures, e.g. Riemann hypothesis
- Rationalisation of pathways
- Public engagement
- Teaching styles
- New roles in expanding science
- Supporting students in new efficient and effective ways

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