



Computer Algebra in Mathematics Education

Report on ICTCM-13 by Tony Watkins

<http://itsn.mathstore.ac.uk/came>

The International Conference on Technology in Collegiate Mathematics (ICTCM) is an annual event and this year's, the 13th in the series, was held in Atlanta from 16 to 19 November. We were hosted by Georgia Perimeter College at the Hyatt Regency Hotel under the very able Conference Chair, Grace Cascio-Huston.

As usual there was a Pre-Conference Session on Thursday 16 November followed by the full Conference from Friday 17 to Sunday 19 November. The International Strand was represented by some 23 colleagues from the UK, Austria, Holland, Spain, Slovenia, Japan, China, Singapore, Chile and Costa Rica. Together with Antonio Quesada, I chaired an International Panel of speakers.

This year's Conference will be held in Baltimore, Maryland, from 1 to 4 November. The host College/University and Chair have yet to be decided but the venue will be the Baltimore Marriott Waterfront Hotel. Although I am no longer Chair of CAME, I remain Co-Chair, with Antonio Quesada, of the ICTCM Sub-Committee for International Speakers. Please think about what you might offer for the next Conference.

Please remember, also, that what follows is a personal reflection on the Conference, it deals with the sessions I attended and participated in. Further details of ICTCM-13 may be found at the following Web sites:

<http://www.awlonline.com/ictcm/>

for the full conference programme;

<http://archives.math.utk.edu/ICTCM/>

for the proceedings of this conference, when they become available, and for all previous proceedings.

PRE-CONFERENCE SESSION: 16 November 2000

This pre-Conference day was dedicated to exploring the topic:

“The Internet: Is it Communication or is it Something Different?”

From my own point of view, in some ways I often enjoy the pre-Conference day more than the rest of the Conference as it focuses on one current issue in depth and provides much food for thought. Hence my notes about this day are more comprehensive than those of the remaining days.

There were three presenters followed by two small group discussions to follow up on the issues raised.

The presentations were given by Don Allen (Texas A & M University), Marcelle Bessman (Jacksonville University) and David Mathews (Southwestern Michigan College).

1st Session

Don Allen led the first session about putting mathematics on the Web and admitted that there were many questions and as yet few answers as to best practice. He remarked, and many of us know it only too well, that it can sometimes take 12 to 15 hours a day to set up a mathematics web page! In his opinion the best way to get mathematics on the Web is using T_EX and graphic images. The Scientific Notebook software creates T_EX files and is a Web browser.

On-line help was discussed and the ‘virtual whiteboard’ was commended. However, there is new software being released called Net Tutor from Link Systems International. It is a Java based tool and comes with a whiteboard ‘pallet’. Don recommended that it was necessary to keep ‘e-office hours’ when interacting with students over the Web, otherwise they can swamp you with their questions and problems!

A key piece of advice which Don gave us for putting mathematics on the Web took me back to the early days of computer algebra systems and which one to choose for using with students. “Make the math look as perfect as you can make it, especially when working with students at sub-degree level.” He mentioned that for writing mathematics to the Web, in addition to Scientific Notebook, T_TH uses HTML and MathML is coming soon.

Homepages need to be attractive and comfortable to navigate. Student assignments need to be given in great detail, with information inserted daily ‘just in time’ to keep the students engaged with the assignment and the homepage. Don felt that assignments should be on-going. In his opinion it was a waste of the medium to give the assignment as a one-off for the student to print and file away.

Don suggested an ‘onion paradigm’ for mathematics on the Web: decide carefully what you want to be in the core, then build the course layer by layer and adapt it at regular intervals. He also spoke wryly of the “ROI model” - Return on Investment, a model especially appealing to administrators! Overall, Don cautioned, “Don’t forget the importance of human contact.”

2nd Session

Marcelle Bessman first drew a distinction between Web enhanced instruction which employs course management systems and posted course documents, and Web supported instruction which needs tutorials, a research resource, 'chat rooms' for discussion and on-line quizzes. She was fully in support of the second as a medium for teaching and learning but quite categorically stated that, "If I had to put it there by hand, I wouldn't do it!" In other words, Web supported instruction needs a management system and someone other than the teacher to manage it.

Assuming that such support was available (apparently it is at Jacksonville), Marcelle described how her Web delivered instruction covered a region that was manageable for students to be able to come to the campus to take tests. She was cautious about taking tests at a distance - who was actually taking the test and who was invigilating it?

She spoke of 'the global classroom' and how she and Doug Quinney, from Keele University in the UK, have shared 'virtual classrooms' using the software Net Meeting, a Microsoft product with limited availability, apparently. It links one site to one site, has teleconferencing facilities and the option for the teacher to 'take over' a student's screen when necessary. (This sounds like an exciting development and I would be very pleased if Marcelle and Doug wrote a paper about it for IJCAME. I shall be approaching them about this on behalf of the Editorial Board.)

Marcelle believes that, used effectively, the Web provides opportunities for interaction between the teacher and the students, among the students, and provides a common thread for discussion. However, to build conceptual understanding in mathematics on the Web needs careful planning.

She offered her email address, mbessma@ju.edu, to anyone who wanted to have access as a guest user of her website, <http://www.users.ju.edu/~mbessma>

3rd Session

I have known David Mathews for over five years now and for me it is always a pleasure to hear him speak. He has written extensively about the use of technology for the teaching and learning of mathematics and I have used ideas suggested by him in my own work. It was therefore an intriguing surprise to find his session having the title, "So You Want To Go On-line?", and to find him putting a case against on-line distance learning of mathematics.

David's session was controversial, and it was an excellent balance to the optimistic, if cautious, "Let's go for it" approach of Don Allen and Marcelle Bessman. Consequently, on behalf of the IJCAME Editorial Board I shall be approaching him to write a paper for us explaining more fully his views. We hope that a future edition of IJCAME will contain the contributions of Marcelle Bessman and Doug Quinney alongside those of David Mathews so that you can judge for yourselves their points of view.

Throughout his presentation David was as positive as ever about the use of technology for teaching and learning mathematics but he made the following points about the Web:

- teaching and learning mathematics is hard, not the "how to" but the "why?"
- should we spend our limited resources of money and energy into teaching students thousands of miles away or should we spend these resources better in reaching, teaching and serving our current students?

- mathematics can be taught on the Web, but should it?
- “it’s the technology, stupid!” - the technology is there and its power is compelling; how much of this is a half-truth and how much is driven by market forces?
- it is time consuming for staff to get involved with
- it can interfere with the assessment of full-time ‘non-virtual’ students
- staff have tolerated for a long time doing their best with limited resources, so they don’t talk about this any more, they don’t ‘rock the boat’, they don’t try to change the ‘status quo’
- suddenly resources are available for new ‘glitzy things’; where have these resources come from and how do administrators expect long-term, hard pressed staff to respond?
- cheating and denial: in the USA surveys have shown that 70% of students report that they cheat in their campus-based examinations while 60% of staff report that students never cheat in these examinations; are staff going into denial mode about the examination system; are staff going to seriously address this issue?
- how shall we invigilate Web-based examinations and could there become a ‘black market’ in examination taking?
- access to technology and the ‘digital divide’: surveys in the USA have shown that access to technology is correlated to location on the socio-economic scale; will the access of low-income groups still be under-represented in distance learning?
- staff resources: on 14 May 2000 the Washington Post reported that there had been a 100% increase in the employment of part-time staff in educational institutions over the past 10 years, and over the past 15 years a 15% decline in the number of full-time staff; why use the precious time allocation of full-time staff to divert them from their primary task?
- if the process goes on, will the next generation of students expect all university/college courses to be Web-based, if so what controls will be required to assure quality and standards?

I believe that these are serious questions and opinions which the whole education system of every country needs to address. David Mathews has been, and continues to be, an exemplar of good-practice in the use of technology for teaching mathematics. His critique is timely and challenging, as are the final points of his talk.

- if it is not we, the ‘professional educators’, who take control of this new medium who will do so? AOL, Time-Warner and Disney are already queuing up to become the purveyors of on-line education
- in which direction should we devote our technological energy in mathematics education? - the generation of on-line tests, perhaps; continue to provoke mathematical thinking using technology, certainly; demanding the resources to continue to do what we already do so well with our students, without doubt.

THE MAIN CONFERENCE 17 – 19 November 2000

Ed Laughbaum from Ohio State University re-stated the evolution of 'flash technology'. He has written about this recently in IJCAME. Flash technology is a way of 'upgrading' calculators just as software is upgraded. No longer will we have to discard the calculator 'box' and buy a new one when the latest applications appear. Instead, all we shall need to do is access the TI Website and download what we want to our computer. The application may then be transferred to the calculator by means of the TI GraphLink. Some applications are free, others must be purchased.

It is amazing to realise that today's TI-89 is more powerful than the early Macintosh's of the 1980s. The TI-73, TI-83 Plus, TI-89 and TI-92 Plus all come equipped for flash technology. They are being referred to as 'TI Graphing Calculator Platforms'.

Some useful web pages are:

<http://www.ti.com/calc>

<http://www.math.ohio-state.edu/~elaughbaum/>

Paul Lumakis of Rowan University talked about mathematical modelling with a calculator-based ranger (CBR) and the TI-83 in a Calculus/Physics laboratory course. He focussed on the use of a CBR and the TI-83 in collecting and analysing data for two different laboratory exercises. The first involved students trying to 'discover' Hooke's Law and the formula for the period of a simple pendulum. The second was an attempt to 'mimic' Galileo's experiment for computing the acceleration due to gravity. Both showed how the use of technology can bring experiments in physics directly into contact with the mathematical analysis required to reveal the underlying 'laws'. Paul made use of linear and other regression models for immediately analysing the experimental data from the CBR with the TI-83. I was intrigued by the way he had developed his course out of the SMP 16 - 19 Mathematics Series, which was developed in the UK. I was also amazed, and delighted, to have my first experience of an American teacher using the metric system!

Paul Blanchard of Boston University gave a presentation about the use of animation in the teaching of ordinary differential equations to sophomore (2nd year) students. In particular he showed how certain favourite tools in the package Interactive Differential Equations, authored by Addison Wesley, were used. Other demonstrations, particularly animations developed at Boston, were given.

Some useful Web pages are:

<http://www.math.rice.edu/~dfield>

<http://www.math.math.sc.edu/~meade/math242>

<http://math.bu.edu.odes>

To contact him use either odes@math.bu.edu or paul@bu.edu

Roseanne Hofmann from Montgomery County Community College is always a delight to listen to. Her enthusiasm, wit and self-deprecating humour make her an excellent teacher. The lecture hall was filled to standing room only, something in itself which pays tribute to the respect in which she held across the USA. Her topic was “The Process of Developing Several Online Mathematics Courses: the Good, the Bad and the Ugly.” Roseanne described how she worked together with three other staff members of her College to develop four on-line mathematics courses required for a degree programme and subject to the constraints imposed by College Senior Management. (A familiar tale with which we are all familiar, and *pace* David Mathews above!) She described the process by which decisions were made within the group, the preparation of different types of materials and their actual implementation. This involved teaching statistics, finite mathematics and business calculus.

For complete details see <http://www.mc3.edu/gen/faculty/RHOFMAN> or email rhofman@mc3.edu

The International Panel was an impressive array of speakers from five different countries. Each spoke about the level they represented (high school, college, university), gave a brief overview of their education system (i.e. centralised or regional, examination driven or not), described which technology systems are in most common use (computer algebra - DERIVE, MathCAD, Maple, Mathematica, MatLab, other; hand-held technology - TI-83, TI-89, TI-92, other) and how they are used (assignments only, examinations, with or without restriction, a mixture). They also spoke about how teachers and students reacted to the use of technology and attempted to give a realistic glimpse into the future. The speakers were:

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André Heck (Holland)

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Antonio Quesada from the USA (aquesada@uakron.edu) co-chaired the Panel with me.