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IJTME Editorial

Guest Editorial

Digital technologies in mathematics education: Selected papers from ICTMT-7

Keith Jones and Federica Olivero

This issue of IJTME presents the third set of papers originally presented to the 7th International Conference on Technology and Mathematics Teaching (ICTMT-7) which took place in Bristol (England) in July 2005. As with earlier events in the ICTMT series, the seventh conference brought together educators, researchers, and developers all with a common interest in enhancing the teaching and learning mathematics (at any level) through the use of Information and Communications Technology (ICT). Yet there were also a number of unique features to ICTMT-7. First, the conference was the result of a pioneering collaboration between the conference organisers and a school in Bristol, John Cabot City Technology College (www.cabot.ac.uk), an ultra-modern state comprehensive school for pupils ages 11 – 19 and superbly equipped with ICT resources that became the wonderful venue for the conference. Secondly, contributors to ICTMT-7 had the opportunity to submit a full version of their contribution for inclusion, following peer review, in special issues of this journal, again a pioneering collaboration between the journal editorial board and the ICTMT-7 organisers.

The papers contained in this special issue demonstrate not only a range of uses of digital technologies (in the widest sense) in the teaching and learning of mathematics, but also how the use of digital technologies can aid the educational research and analysis process. Throughout the set of papers, the authors explore, in particular, how new technological tools permit both access to representations of mathematics that might otherwise be out of reach of learners, and also provide examples of the innovative use of digital data analysis tools that can illuminate how learners learn, and teachers teach, with such new technologies.

In their paper *Capturing the Real World in the Classroom*, Heck and Uylings report on a classroom experiment in which pupils in pre-vocational secondary education carried out tasks involving the collecting, representing, analysing, and interpreting of information captured using digital video technology. The context for the study is the Dutch school system for senior secondary education in mathematics and science in which pupils are expected to develop a broad range of research skills, including connecting real world phenomena with the scientific world. The paper focuses on the affordances of digital video technology in enabling pupil learning and, in particular, examines three particular problems experienced in practice, viz., perspective distortion of images when using digital video technology, the complexity of recording video clips, and the amount of time needed for collecting data.

Robutti, in her paper *Motion, Technology, Gesture in Interpreting Graphs*, reports elements of a long-term research project that is focussing on pupils' construction of mathematical meanings through the interaction with various technologies. The particular paper reports on a teaching experiment that enabled junior high school pupils (8th grade, age 13) to use sensors and calculators to explore human motion. The focus of the paper is on the cognitive evolution of the students' knowledge towards the construction of meaning for the performed motion. Analysis focuses on the passage from uniform to accelerated motion, with the data being interpreted within a semiotic-cultural approach (following the work of Radford) by looking at the progression in the introduction of signs and the shared use of them.

Botzer and Yerushalmy, in their paper *Interpreting Motion Graphs through Metaphorical Projection of Embodied Experience*, also focus on the cognitive processes that occur while students are exploring motion graphs. They report on a classroom experiment in which high-school students (aged 17), with backgrounds in calculus and physics, interpret the graphs they create when drawing the path of the movement of their hand with a computer mouse. Based on recent, and expanding, research on embodied cognition, Botzer and Yerushalmy analyse both the gestures and the terms that the students use, and probe the cognitive processes that their actions and discourse reflect. In the study, the students faced three main challenges: modelling 2D motion, understanding a rest situation, and dealing with instantaneous rest. Botzer and Yerushalmy show what happened when the students met these challenges. They suggest that the computerized representations that were available to students added to the visible path information that the students had about time, and that it was this that helped the students to conceptualize the physics of motion and aided their ability to link these concepts to the mathematical properties of the graphs.

Gibbs, in her paper on *Patterns of Interactions as Affected by Graphing Software*, looks to extend and develop theories of mathematical learning to provide a framework for the analysis of classroom video data of students using a computer to tackle a task aimed at increasing their understanding of multiple representations of quadratic functions. In her analysis, Gibbs shows how student interactions can be coded using novel software tools. Through the use of such techniques, and reference to the theoretical framework adapted for the study, Gibbs traces the development of student's mathematical learning over the course of one lesson and highlights the importance of feedback in the process. Of particular importance, Gibbs observes, is the role of the computer in providing this feedback.

In her paper *What do Students do with Personal Technology and How do we Know?*, Sheryn focuses not only on how and when students use a graphing calculator within a University-entrance-level Mathematics course, but also on the depth and type of learning that takes place when student use such calculators. In carrying out her research, Sheryn collected a variety of data, including interview and observation data, evidence from student e-journals, and also 'key-stroke' data when students' used their graphical calculators (key-stroke data, a recording all the user's key strokes with the calculator, was collected using a piece of software called *Key Recorder*). Within her paper, Sheryn presents the case of one student, illustrating how this particular student's use of her graphing calculator developed, and changed, over one year. Sheryn also looks at the advantages, and disadvantages of using the *Key Recorder* software as a data collection tool.

At the heart of this special issue are two related things – the use of theory to analyse and explain mathematics learning with digital technologies, and the development of innovative methodological procedures. Overall, this set of papers provides a wealth of evidence about the potential of digital technologies to support learner access to representations of mathematics. That new learner understandings might emerge (and that new forms of knowledge might be needed) when interacting with technological tools indicates that further research is required in order to gain better insight into the potential of technological tools in the teaching and learning of mathematics. Further examples of such approaches are invited for submission to this journal.

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