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Guest Editorial

Dynamic software in the teaching and learning of geometry: Selected papers from ICTMT-7

Keith Jones and Federica Olivero

The 7th International Conference on Technology and Mathematics Teaching (ICTMT-7) took place in Bristol (England) in July 2005. As with earlier events in the series, the 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).

There were 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, John Cabot City Technology College (www.cabot.ac.uk), an ultra-modern state comprehensive school for pupils ages 11 – 19. Located in Bristol, JCCTC is superbly equipped with ICT resources and provided a 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.

It is with much pleasure that we launch the first of the ICTMT-7 special issues. The papers contained in this special issue explore a number of aspects related to the use of dynamic software in the teaching and learning of geometry, including aspects of 2D and 3D geometry, transformations, vectors, and problem solving. Throughout the set of papers the authors reflect, in particular, on how new technological tools allow access to, and representation of, mathematical meanings that might otherwise be out of reach of the learner.

The paper by Kynigos and Latsi, *Vectors in use in a 3D juggling game simulation*, explores the mathematical meanings constructed collaboratively by 13 year-old students concerning the mathematical notion of vector as an object, as a set of properties, and as a representation of physical vectorial entities when engrossed in an educational computer game 'the Juggler micro-world', designed by the same authors. The micro-world simulates motion in three-dimensional space and places vectors in a central role both for controlling and measuring the behaviours of objects. The authors argue that playing in the 'Juggler' game could make a considerable contribution to the development of intuitions and to the generation of meanings related to vectors through the use of vectorial properties.

Representations of three-dimensional objects are also the focus of the paper by Accascina and Rogora, *Using 3D diagrams for teaching geometry*, which explores the use of *Cabri 3D* as a support for teaching three dimensional Euclidean geometry. The paper reports on an experiment with pre-service and in-service teachers aimed at observing their interpretation of *Cabri 3D* diagrams. By comparing the representations of 3D objects via manipulatives, paper diagrams and digital diagrams, the authors focus on the misconceptions that might arise from the use of *Cabri 3D* given that *Cabri 3D* diagrams represents three dimensional objects on the two dimensional screen of a computer, a projection that, in general, does not preserve angles and distances.

The paper by Lopez-Real and Lee, *Encouraging the use of technology in problem-solving: some examples from an initial teacher education programme*, illustrates distinct functions of dynamic geometry software (DGS) in problem solving in situations in which ICT is seen as an alternative method that might help solving a problem. They describe those functions as (i) DGS opening up new perspectives, (ii) DGS as explanation and insight, (iii) DGS highlighting the nature of exact and approximate methods, (iv) DGS as illustration and generalisation. The authors also argue that underlying these different functions there is an important common feature, the re-formulation of a problem in way that makes it meaningful in an ICT environment.

In her paper *Designing tasks with Interactive Geometry Applets for use in research: some methodological issues*, Sinclair explores another aspect of the use of dynamic geometry software by focusing on issues around the development of tasks designed to help students learn mathematics. In drawing attention to the complexity of the design process, and the need to explicitly address methodological issues in applet design research, Sinclair points to the need to develop strategies to learn more, either directly or indirectly, about the needs and abilities of the end-users.

The paper by Leung and Chan, *Exploring Necessary and Sufficient Conditions in a Dynamic Geometry Environment*, describes a hypothetical dragging experiment in a dynamic geometry environment aimed at exploring necessary and sufficient conditions for cyclic quadrilaterals. The authors provide a detailed analysis of dragging modalities in relation to functions of variation in a framework aimed at interpreting the conjecturing process when learners use a dynamic geometry environment (DGE). The authors seek to initiate further discussion on how functions of variation could 'instrumentalise' dragging in DGE, within the process of geometric exploration, contributing to shedding more light on proof and pedagogy in DGE.

Finally, it is fitting that a paper Oldknow, a prime instigator for ICTMT-7 completes this special issue. In the paper on *Researching With Software: CAS, DGS and Cabri3D*, Oldknow illustrates, though a series of well-chosen example, how the practice of mathematics in the world outside education has changed considerably as a result of the development of powerful software tools. As he argues, it is necessary, before deciding

to reflect any such changes in the development of the mathematics curriculum, to evaluate fully what extra dimensions such tools bring to the educational context, and at what cost. For example, Oldknow argues, it is possible to view computer algebra (CAS) solely as a threat to traditionally-valued algebraic skills, dynamic geometry (DGS) as just a more sophisticated means of illustrating the current 2D geometry curriculum, and software such as *Cabri 3D* as something fun to play with but of no curricular relevance. Through the use of well-chosen examples, Oldknow presents a counter argument demonstrating how software tools such as CAS and DGS may make accessible aspects of mathematical content that would otherwise be out of reach and can also spur the acquisition of new techniques, terminology, and notation.

That new understanding and new knowledge might be needed when interacting with technological tools indicates that further research is needed in order to gain better insight and awareness about 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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Keith Jones works at the Centre for Research in Mathematics Education at the University of Southampton, UK. His areas of research expertise, on which he has published widely, include the teaching and learning of geometry, the development of mathematical reasoning and proof, and the use of technology in mathematics teaching. He co-edited a special issue of *Educational Studies in Mathematics* on "proof in dynamic geometry environments", was a member of the UK Royal Society inquiry into the teaching and learning of geometry, and has led the thematic group on Tools and Technologies in Mathematical Didactics for the European Society for Research in Mathematics Education (ERME). He is founder and co-organiser of the geometry working group of the British Society for Research into Learning Mathematics, see:
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Federica Olivero joined the Graduate School of Education, University of Bristol (UK) as a full time PhD student in 1998, after obtaining a BSc in Mathematics at the University of Turin (Italy). Since completing her PhD in 2003 she has been working as a Research Associate in the School of Education. Federica's main research area is concerned with the mediating role played by new technologies in the teaching and learning of mathematics, focusing in particular on dynamic geometry software. Her recent work also includes a focus on the use of digital videos as methodological and analytical tools in classroom-based research. She has presented her research in a number of national and international conferences and wrote several papers.