

Technology and mathematics teaching

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1. Introduction

This issue of the Electronic Journal of Mathematics and Technology is the first of two special issues outcome of the International Congress of Mathematics Education 2012 (ICME 12)- Topic Study Group 18, co-chaired by both Wei-Chi Yang and Morten Misfeldt, on technology and mathematics teaching. The group aimed at providing a forum to discuss the current state of art of the presence of technology in diverse aspects of teaching mathematics conveying a deep analysis of its implications to the future. Technology was understood in a broad sense, encompassing the computers of all types including the hand-held technology, the software of all types, and the technology of communication that includes the electronic board and the Internet. The discussions served as opportunity for all interested in the use of technology in education environment, to understand its diverse aspects and to share the creative and outstanding contributions, with critical analysis of the different uses.

The Topic Study Group had 42 contributions and more than 80 participants. The topics addressed were diverse but evolve around the use of technology in the classroom practice, design and use of digital teaching materials, Technology in teacher education, Distance education and the use of learning management systems. The use of technology in the teaching of mathematics is an expanding and diverse field, and in the following we will summarize the status and consensus that became apparent through the work in the Topic Study Group. One way to gain an overview of the image of the field presented in the topic study group is to look at the different technologies involved, and another way to gain such overview is to present the discussions and concerns that were prevalent in the discussion and contributions. We will do that in the following sections.

2. Technologies used for mathematics instruction

Computer Algebra Systems, Dynamic Geometry Systems and spreadsheets has been a part of mathematics instruction for decades, yet the mediations of the technologies as well as the research problems addressed by the community is still developing. The presentations in the TSG

showed that these technologies are to some extent adopted in the mathematics education practices. The contributions relating to these technologies hence addressed issues relating to teachers adoption, the possibility to deploy such technologies for supporting low achievers, the teaching of specific mathematical concepts in new ways with technology, and the integration of these technologies into learning management systems. Learning management systems signifies a class of systems that is used to support and augment teaching practices. In relation to these systems a number of initiatives to augment their mathematical capabilities were presented. Apart from the integration of Computer Algebra Systems and Dynamic Geometry Software into learning management systems, the work related to the use of such systems related to the construction of multimodal learning environments including video and interactive manipulatives, within learning management systems. Technology that allows for the development of interactive visualizations and for sharing content were presented for several topics and educational levels ranging from primary school to university. Online task environments for students to train their skills with mathematical tasks were also presented. Online streaming of video was presented both as stand-alone and as a part of an online environment for teaching of mathematics. One project applying tablet pcs and interactive whiteboards was also presented. Hence a wide range of the applicable educational technologies were present in the Topic Study Group.

3. Problems addressed in the TSG

The main problem addressed in the contributions was the potentials of using technology to enhance teaching of mathematics to become a more efficient enterprise. This problem was addressed in a multitude of ways in the topic study group. Interventions aiming at using technology (typically CAS and DGS) to teach mathematical topics in new ways were presented in the groups. It is difficult to summarize the role and influence of technology across these interventions since many factors other than the use of technology influences such interventions. Teacher training and teacher practice with technology conducted was addressed in several of the contributions. One motivation for a specific attendance to this area is that the teachers' choices and practices are, in many ways determining for the success of technology integration in the teaching of mathematics. Motivation and recruitment is an important theme underlying several of the contributions to the topic study group. New interactive illustrations or video presentations might not only make it possible for more students to grasp the abstract mathematical concepts, it might also make mathematics more appealing to larger groups of students.

Apart from addressing concerns, some of the reports in the Topic Study Group also demonstrated new technological developments, addressing the aim of improving mathematics instruction. Technology can automate aspects of the process of teaching mathematics, such as assigning and marking tasks. This is a development with many possible advantages and represents an area where the technological development currently is quite rapid. Another area where new technological developments were presented was the integration of mathematical tools such as CAS and DGS, into web 2.0 internet technology, in a way that supports collaboration and distance education.

4. This special issue

This special issue of the electronic Journal of Mathematics and Technology is the first in a series of two. It contains six papers. The first paper "Technology as a partner in geometry classrooms", by Dragana Martinovic and Agida G. Manizade deals with technology-based activities in geometry that promotes pre-service teachers' mathematical reasoning. Martinovic and Manizade

lets future teachers explore carefully structured activities supporting the development of technological skills and geometrical knowledge. The technology was used as a partner in both of the examples presented and the students.

In the second paper “Learning Design Map (LDMap) for Mathematics Teachers in Developing Countries and the Benefit of Its Use for Curriculum Review” Maman Fathurrohman, Anne Porter and Annette L. Worthy propose a Learning Design Map (LDMap) to document and share mathematical teaching and learning experiences. These maps are intended to be used by mathematics teachers in developing countries. The development of the map is based on a survey that gathered information related to the real and perceived ICT infrastructure, facilities, and resources in one accessible area in a developing country. Teachers can create their own LDMaps, and it is expected that the maps will be shared and modified by teachers and that there will be a circulation of the documentation of mathematical teaching and learning experiences among teachers through the use of these maps.

In the third paper “The Role Of Virtual Manipulatives On The Concrete-Pictorial-Abstract Approach In Teaching Primary Mathematics” LEE Ngan Hoe and TAN Boon Leong Jeremy review the key pedagogical approach advocated in Singapore Primary Mathematics Curriculum – the Concrete-Pictorial-Abstract Approach in view of the changes brought about by technological advances. Through a case study, they seek to determine the possible impact of this proposed revised approach on teachers’ delivery of lessons.

The fourth paper by Mette Andresen reports from the development of an online interactive tool for linear algebra learning. The study explores the driving forces and obstacles in the teachers’ integration of the visualization tool in a linear algebra course? Data for the study includes interviews with the teachers and students’ answers to two questionnaires and tasks from the linear algebra course.

The fifth paper “Teachers practices and professional geneses with ICT”, by Mariam Haspekian, presents some theoretical issues concerning teachers’ professional genesis with spreadsheets, aiming at gaining insight into the teacher practices with technology and how these practices evolve. By comparing the evolution of an ordinary teacher integrating spreadsheet in her practices, with expert practice, Haspekian finds some similarities in the way of using this tool, and make some hypotheses on the importance of these common elements as key issues in ICT integration in teacher training.

The last paper “Domain specific language approach to technology-enhanced learning”. by Pozdniakov Sergei and Ilya Posov, deals with the development of languages for representations of problems and solutions. These papers constitute the first special issue of the Electronic Journal of Mathematics and Technology, that comes as a result of TSG 18 at ICME 12. A second issue is planned to appear summer of 2014.