ABSTRACTS FOR INVITED PAPERS

ABSTRACT FOR 21193

Can Technology make a difference to school Mathematics Teaching?

AUTHOR: Douglas Butler

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Douglas is in the fortunate position of having the benefit of 30 years teaching, 20 years developing mathematics software, and 20 years promoting TSM training workshops to help teachers make the most effective use of technology. Despite its obvious advantages, and considerable investment from Education Ministries, the majority of mathematics teachers do not allow technology to enliven their teaching. This is mainly through lack of access, but also lack of training.

At the same time the software and hardware spectrum is changing rapidly, and many teachers simply fail to keep abreast of all the change. The gradual shift from teacher-centric fixed hardware to student-centric mobile technology is a massive challenge to teachers and to students, and also to those developing appropriate software.

This presentation will include some lesson plans that maximise the potential of technology using web resources, spreadsheets and dynamic software, and delivering exciting visualisations and engagement.

ABSTRACT FOR 21209

Rhombohedra Everywhere

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A rhombohedron is a 6-face polyhedron in which all faces are rhombi. The cube is the best-known example of the rhombohedron. We intend to show that other less-known rhombohedra are also abundant. We are to show how the rhombohedra appear in the algorithm of rhombic polyhedral dissections, in designing 3D linkages and in supplying concrete examples in mathematics amusement.

ABSTRACT FOR 21256

Mathematics, secrets and smartphones

AUTHORS: Jose A Vallejo, Lina Rubí Ipiña

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It is commonplace that Mathematics are everywhere, and we recurrently mention to our students some examples of this occurrence. One of the most used is the mathematics of cryptography. Of course that is true: modern cryptographic methods are strongly mathematics-based, and there are many excellent texts and web resources explaining at any imaginable level of sophistication their foundations. However, still it is difficult to find resources with a hands-on approach, in which the student can do more than merely academic computations and examples. Taking advantge of the interplay between mathematics, free software and the computational capacity of current smartphones, we will illustrate

how these ingredients can be cooked to build an elementary course on number theory and cryptography with a twist: everything will be done in your (Android) smartphone.

ABSTRACT FOR 21271

Exploiting Digital Technologies for Learning Mathematics

AUTHOR: Jose Celia Hoyles, Richard Noss

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A key challenge for task design in mathematics education and an organising design principle is to enhance engagement with mathematics. One way to achieve this is to exploit digital technology to reveal more of what mathematics actually is; first, by offering a glimpse of the mathematical models underlying a given (and carefully chosen) phenomenon; and second, by fostering an approach to mathematical tasks that transcends the purely procedural. We describe in this paper how we have attempted to address these challenges.

ABSTRACT FOR 21272

Outbox Centroid Theorem: An Episode of Dynamic Geometry Exploration

AUTHOR: Weng Kin Ho

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An outbox of a given convex quadrilateral is a rectangle such that each vertex of the quadrilateral lies on one side of the rectangle and all the vertices lie on different sides, with all the sides of the rectangle external to the quadrilateral. This paper reports on a new geometrical result concerning outboxes of convex quadrilateral -- the Outbox Centroid Theorem, and gives a new proof of an existing result of M. F. Mammana. Interestingly, the investigation that leads to this new result comes from dynamic-geometry explorations.

ABSTRACT FOR 21274

From One to Infinity: What DGS Has or Could Have Changed in our Teaching and Learning

AUTHOR: Jean-Jacques Dahan

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The collaborative work enhanced by the communication tools developed in the last decade is perceived by everybody as a progress for teaching and learning. We will see in this paper that this way of working avoids to use all the knowledge developed by experts especially in the use of the technological tools. We will focus our analysis on « dynamic geometry software » and especially on the Cabri environments. We will remind the special role of DGS in a more experimental way of practicing maths (researching, teaching and learning) sustained by the theoretical framework I have developped in my PhD thesis (different stages of an experimental process of discovery, different levels of techniques of investigations known as praxeologies G1, G1 informatique, G2 and G2 Informatique, the heuristic power of dynamic approach of figures…). We will give a lot of examples showing the new tools of exploration or investigation provided by DGS (such as traces, loci, animation, redefinition, macro, sliders…) to understand the difference between a paper and pencil approach or a DGS approach of a problem (that can be not necessarily a geometric problem). In these examples, we will present different techniques that must be taught in order to be used appropriately by the users of DGS. At last we will present my YouTube channel where lots of situations are provided to help teachers and students to use DGS without ignoring all the work of the experts during the last 30 years.

ABSTRACT FOR 21279

Quadratic and Cubic Polynomials in Applied Problems: Finding Maximum – no Calculus, using CAS (Maple)

AUTHOR: Bill Blyth

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We use CAS to provide a new algebraic approach in some optimization applications where the objective function (to be minimized or maximized) is a quadratic polynomial. These problems can be solved just by knowing properties of quadratics and so give context to why we want to complete the square. Without calculus, to find the max/min of cubics, we introduce a new straightforward algebraic method (no calculus). The use of a Computer Algebra System, CAS, such as Maple easily deals with any messy algebra! The key property of a function is that, near a maximum or minimum, the function “looks like a quadratic”. This visual idea is combined with some straightforward algebra to find this local quadratic approximation of a cubic near the maximum. Traditional “find the maximum ...” problems are introduced to senior school or first year undergraduate students in their calculus course. With our approach, these applied problems and the Polya method of problem solving can be introduced to pre-calculus students. We use the CAS, Maple, for algebra and visualization. We use small group collaborative learning in the computer laboratory, so we parameterize the problem and recommend the use of Computer Aided Assessment (such as provided by the package MapleTA). Students engage with the visualization and algebra, are active learners with deep learning of the concept of maximum and have fun doing so.

ABSTRACT FOR 21294

Challenges in Integrating Technology in Teaching and Learning Mathematics in Basic Education

AUTHOR: Yuriko Yamamoto Baldin

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This paper presents considerations about the role of technology in teaching and learning mathematics from the perspective of teacher education programs that is required to prepare new generation of teachers for the potentialities of diverse uses of technology in the teaching mathematics content on one side, and in the learning new classroom dynamics on other side. The reflections retrieve some insightful initiatives and foresights of pioneering researchers about the educational possibilities of technology tools from late 90´s and 2000´s, bring frameworks from researches in mathematics education, and are illustrated with examples from the author´s work about development of teaching materials for prospective and in-service teachers, regarding the contemporary needs of mathematics education. The paper discusses the concept of experimental mathematics as a core concept that connects the learning of mathematics content, at student level, with the learning by teachers of new methods of teaching, at professional level. The examples, not exhaustive, will be given with CAS, DGS, and Calculators. The challenges to integrate effectively the technology in educational context are commented considering the presence and advantages of information and communication technologies that imply necessarily the rethinking of teacher education. The reflections of this paper take into account the power of technology towards the educational needs of developing countries that strive for a quality education.

ABSTRACT FOR 21297

Technology: Inquiry based learning, inverse questions, and control

AUTHOR: Matthias Kawski

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New computational tools become available at every faster rates. A fundamental question asks how such tools can help achieve clearly defined learning objectives. This article argues, in a sequence of examples, that computing technologies can much support the implementation of modern pedagogy. The focus is on enhancing a learner centered environment. Of critical importance is that the learner takes the key role of asking further questions, to take ownership of the discovery experience. We highlight the special role of asking inverse questions with examples ranging from math circles to vector calculus.

ABSTRACT FOR 21298

Technology in Mathematics Education: A Stocktake & Crystal-Ball Gazing

AUTHOR: Greg Oates

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This paper seeks to conduct a stocktake of the current use of technology in mathematics education, and engage in some crystal-ball gazing as to how it might be used in the future. First, it briefly discusses the history of the use of digital technologies in mathematics education, focusing primarily on the period of growth from the mid-1990's. It will consider some of the theoretical perspectives that have emerged over that period, and using the framework developed by the author [x; x], will attempt to describe the 'current state of play' for the effective integration of technology into the teaching and learning of mathematics. Then using this position and framework as a starting point, the paper postulates what might be some significant challenges ahead for teachers and institutions in the continuing search for effective meaning-making in mathematics with technology.

ABSTRACT FOR 21300

Locus, Parametric Equations and Innovative Use of Technological Tools

AUTHOR: Wei-Chi Yang

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In this paper, we discuss two problems found from Chinese college entrance exam practice problems [8]. We see how original problems in 2D, stated in an exam static and somewhat uninspired setting, can be extended to other interesting cases in 2D and more challenging corresponding problems in 3D for students to explore with the help of a Dynamic Geometry Software (DGS) and a Computer Algebra System (CAS). We use a DGS to construct the locus or locus surface geometrically, and use a CAS to verify our locus or locus surface analytically. We shall see with the innovative use of technological tools, mathematics can be made more fun, accessible, challenging and applicable to broader group of students. Finally, we attempt to make these problems relevant to real-life applications, we invite readers to investigate how these problems can be interpreted differently.

ABSTRACT FOR 21304

A litany of ladders: easy problems with hard solutions

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Mathematics is full of problems from the easy to the intractable; in fact it may be quite fairly said that mathematics is the study of problems. Some problems are straightforward enough to be used as exercises in schools; others are of a difficulty and complexity to occupy the attention of scholars all their lives. The purpose of this paper is to look at a few problems which are neither trivially easy nor impossibly difficult. These problems all have the similarity that in their classical statements they are about the placement of ladders. However, they are difficult enough that solving them is more than an elementary routine exercise. And in particular, they are perfect vehicles for the use of a Computer Algebra System.

ABSTRACT FOR 30001

Teaching and Learning Mathematics with Mobile Technology

AUTHOR: Ma.Louise Antonette N.De Las Peñas

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This talk will discuss a current government funded project in the Philippines on the creation of software applications and applets for mobile technology that will enhance the teaching and learning of mathematics.

The Department of Education in the Philippines has recently implemented the K to 12 Basic Education program. The K to 12 curriculum recognizes that calculators, computers, including mobile devices such as smartphones and tablets can be appropriate tools in teaching mathematics. These can help learners demonstrate understanding and appreciation of key concepts and principles of mathematics as applied in problem solving, communicating, reasoning, making connections, representations and discussions in real life (Dep Ed, 2012).

To fully support the implementation of Mathematics Grade 7-10, a comprehensive resource has been created to aid teachers develop their competencies in teaching various strands in mathematics and promote critical thinking and problem solving in the classroom. In this talk we present segments of this resource, which includes interactive software for mobile technology together with a framework for the design of teaching guides, arranged according to competencies prescribed by the curriculum. The extent and manner for which technology can be used in the teaching of mathematics depends not only on the availability of resources (software, internet) but on the teacher's ability and disposition to use the devices. The teaching guides are aimed to optimize the use and benefits of technology. Suggested activities for the students are given which promote student centered learning.

The mobile apps are designed to support student investigations, promote student centered learning and at the same time enhance teaching practices and student engagement. These cover topics in algebra, geometry and statistics. These include apps for proving in Geometry. Related literature studies show the novelty of these proving applications.