Asian Technology Conference in Mathematics
An enjoyable and instructive conference

List of abstracts for plenary and invited speakers at ATCM 2014 as of August 13

Abstract for 20461
Islamic architecture, mathematics and technology

Authors: Miroslaw Majewski
Affiliations: New York Institute of Technology, Abu Dhabi Campus

Architecture and mathematics in any civilization are interconnected disciplines. Ancient architects in all cultures used geometry to design their palaces, temples and even private buildings. Islamic architecture is not an exception. It has very strong roots in mathematics of ancients Greeks and the Byzantine geometric approach. In this lecture I will show how mathematics influenced design of old mosques and architectural ornaments. I will show also what kind of mathematics was used in these creations. In the second part of this paper I will show how traditional Islamic geometric ornament influenced development of modern mathematics and how modern mathematics influenced design of Islamic geometric ornament. I will discuss works of modern architects and designers of Islamic architectural decorations. Some the most famous contemporary creations will be presented. This includes works of famous French mathematician and designer Jean-Mark Castera and a few others as well as technology approach to Islamic geometric ornament represented by Nomad

---

Abstract for 20625
Interactivity and flexibility exemplified with Cabri

Colette Laborde
Colette.Laborde@cabri.com

This presentation will support an approach in the development of technology, in which interactivity is not only devoted to student use but also to teacher use. This kind of technology enables the development of students centered resources fostering exploration and inquiry by students but also enabling teachers to adapt them in relation with their pedagogical aims and the needs of their students. Such technology scaffolds in Bruners' sense a progressive process of integration and instrumentation of technology by teachers while teachers may in a first step experiment ready made resources in their classes and then make changes increasing over time as they are more confident and gain experience.

To provide students with interactive resources requires
- the design of tools enabling exploration by students and feedback to their actions
- an analysis of possible types of feedback that students can build on to progress in solving tasks given in the environment.

To provide teachers with flexible and adaptable resources requires
- the design of tools in the technology facilitating possible changes by teachers ;
- identifying the different facets of teachers' work , where technology can bring a contribution and how it may improve the use of time by the teacher ;
- analyzing the different types of tasks given by teachers to students and the relevant didactic variables in these tasks at the disposal of the teacher.

These points will be developed and illustrated by means of resources created with the Cabri technology.

Abstract for 20464
Mathematics, Teachers & Technology

Authors: Miroslaw Majewski, Krongthong Khairiree, Hee-Chan Lew, Jen-Chung Chuan
Affiliations: New York Institute of Technology, Abu Dhabi Campus, Suan Suandha Rajabhat University, International College, Bangkok, Thailand , Korea National University of Education, Cheong-Ju, South Korea , National Tsing Hua University, Taiwan

In ancient China technology has been used in teaching mathematics since II century b.c. In Japan soroban was used in schools since XVI century. First symbolic calculator was developed by Hewlet Packard in 1987 and it gained a lot of interest in educational community. In last 40 years we face tremendous development of educational software for experimenting and visualizing mathematical concepts. After many years of experimenting we all know benefits of using technology in teaching mathematics. Surprisingly, for some reasons, mathematics teachers and university professors do not use technology as much as we could expect. Why?

The objective of this talk is to analyze current status of mathematical software and discuss the use of it in secondary schools. We will point out what can be done in order to make it part of our mathematics curriculum.

Abstract for 20495
"Managing all the change and keeping teachers motivated

Authors: Douglas Butler
Affiliations: iCT Training Centre, Oundle (UK), Autograph-Maths

Software and hardware solutions for mathematics teaching are evolving all the time, leaving many teachers bewildered by the ever increasing kaleidoscope of possibilities. Douglas will attempt to bring this audience up to date with some exciting lesson plans drawing on a new generation of hardware independent resources, the emphasis always being to let the mathematics shine through.

The arrival of mobile devices delivers an exciting new dynamic for the mathematics classroom, with students, parents and teachers all in touch with each other. Such collaboration, coupled with GPS and camera facilities, mean that there is much more chance that students will be able to discover mathematics for themselves – be in in the classroom or on the bus going home.

The downside of this is that the mobile devices are small, touch driven and an order of magnitude less powerful than desktop computers. It is likely that older technology will still be the technology of choice for complex mathematical or publishing tasks.

Textbooks are rapidly being digitised, and a new generation of HTML-based software is allowing texts to come to life interactively. So as well as the obvious lack of weight to carry around, students will find that their text books are far more engaging.

All this change puts great demands on the need for quality professional development. Furthermore those delivering it need careful training, and are having constantly to re-evaluate new tools and teaching methods.

This session will be illustrated with resources from Douglas' TSM Resources website (www.tsm-resources.com).

Abstract for 20498

Teaching Experimental Mathematics: Digital Discovery using Maple

Authors: Bill Blyth
Affiliations: Australian Scientific & Engineering Solutions, RMIT University

One of the ``Recommendations" (by Klaus Peters) on Jon Borwein"s LinkedIn page starts with: ``Jonathan Borwein is a world-renowned research mathematician and one of the leaders in the emerging field of experimental mathematics to which he has made many original contributions. He has written several books that have helped to define the field." Examples include finding closed forms of integrals by numerically computing high precision approximations (accurate to hundreds of decimal digits) which is used to identify the answer. Knowing the correct answer facilitates the proof of its correctness.

Here this experimental mathematics approach is taken with a couple of traditional ``find the maximum \ldots " problems suitable for senior school or first year undergraduate students (who could even be pre-calculus students). We use the Computer Algebra System, Maple, for experimentation (and visualization) to compute high accuracy numerical approximations to the answer. Maple's identify(~) command is used to identify the exact answer. Knowing the answer, we prove that it is correct - without using calculus. 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, are active learners with deep learning of the concept of maximum and gain a gentle introduction to the important new field of experimental mathematics.

Abstract for 20572

SejfrieDian: full construction

Authors: Shelomovskii Vladimir
Affiliations: Deoma

The Sejfriedian is amazingly beautiful construction which contains five interlinked triangles, four circles and three points which form a projective line. In this paper we describe previously unknown Sejfriedian properties. We show the Sejfriedian construction under the condition, when A, B, and C are three given collinear points lying on the given projective line. We prove the existence and uniqueness theorems and the Sejfriedian properties. We have found the Sejfried function. We use the configuration for construction of the Steiner transformation mapping a straight line into itself in some special cases. In one of them the points A, B, and C are mapped into points A, C, B. We investigate the projective 3D transformation mapping a circle into a circle and the Sejfried pare into pare of regular triangles. This transformation gives us many Sejfriedian properties. In particular, we see that the common Brocard axis of the Sejfried triangles is perpendicular to the line AB.
We consider the inversion transformation, using the common point on the Apollonius for Sejfried pare triangles as the center of inversion. We show the pencils of the circles, and the images of the straight lines containing the sides of Sejfried triangles. We may understand why the axes of these pencils form equal angles with each other. We demonstrate the coincidence of these axes with straight lines connecting the points A, B, C, and the Apollonius point X15. This correspondence provides a simple method for the Sejfriedian construction. We consider another formulation of the problem: Given two points A and B and the projection center of the circle to the line. We prove that there are exactly two two-parameter solutions of this problem and find the Sejfried function.
This scientific research have been conducted by the authors with the use of DGS GInMA. The result of the research formed the content of the corresponding GInMA textbook. Dynamic geometric illustrations make it convenient to introduce the Sejfriedian study in training courses on geometry, show students all stages of the exploration. GInMA e-book have been created as a modern book on geometry, which uses

visualization, dynamism, interactivity, gives the opportunity to work with 3D-images. It is created for students who don"t like formulas, but respond well to images and experience great interest in its dynamic transformation. GInMA textbook "In-depth geometry" with visual library and interactive solutions is available at http://deoma-cmd.ru/en/Products/Geometry/. HTML-file tutorial contains links to manuals, videos, and offers a choice of various geometric topics. Download free tutorial and free DGS GInMA over the Internet, install on your PC DGS GInMA and learn geometry using the capabilities of the computer.

Abstract for 20573

Can Tightly Packed Circles be Movable?

Authors: Jen-chung Chuan
Affiliations: Department of Mathematics, National Tsing Hua University, Hsinchu, Taiwan 300

Stereographic projection is an important transformation linking circles on the sphere and that on the plane. Whenever an animation involving circles on a sphere, their stereographic images on a plane can be implemented by taking the inversion with respect to an appropriate sphere. Through this transformation, every closed Steiner chain on the plane can be thought of as the inversion of a pair of circles sharing the same axis together with symmetrical arrangement on n circles packed between the two. Based on the idea that an arbitrary pair of disjoint circles on a sphere can be inverted simultaneously into a pair of circles having the same axis, we are to display various contact graph preserving dynamic circle packing phenomena.

Abstract for 20576

Software Support of Functional Line in Mathematics Studies

Authors: VLADIMIR NODELMAN
Affiliations: Holon Institute of Technology

The functional line penetrates and closely interlaces with all areas of mathematics at different levels of studies, often determining their content and methods. Starting from familiarity with the concept of function in the secondary school, through precalculus studies, the functional line penetrates to all courses of matematics: calculus, algebra, geometry, complex analysis, differential equations etc.
An adequate software, which concentrates students" attention not only and not so much on the demonstration of examples of the concepts being studied, as activates independent creative activity in detection and use of the suitable properties of the studied material and the connections between them, can significantly increase the strength and depth of understanding of the studied matter.
This report presents an approach to development and use of such software and its implementation in the author’s non-profit program VisuMatica. Various examples illustrate the technique of dynamic creation and evolutionary development of generalized models as result of live collaborative analysis of the needs and characteristics of the studied material, its specifics from the point of view the functional line, and proper activities of the students.

Abstract for 20577

Technological tools have enhanced our teaching, learning and doing mathematics, what is next?

Authors: Wei-Chi Yang
Affiliations: Radford University

In this paper, we give an overview why technological tools have advanced so fast since ATCM 1995, and yet the adoption of open-ended exploration activities have not been widely implemented in many mathematics curricula. We give examples to demonstrate the types of exploration that require the integration of CAS and DGS. We outline the components needed when developing an interactive online

system, which is crucial for communications and collaborations on mathematical fields.

Abstract for 20578
Professional Development for Teachers in Mathematical Modelling

Authors: Keng Cheng Ang
Affiliations: Nanyang Technological University, 1 Nanyang Walk, Singapore 637616

The importance of mathematical modelling and its value in mathematics education has been discussed and emphasized by various researchers in the field. However, it is widely acknowledged that mathematical modelling can be demanding for students and teachers. Many teachers, including experienced practitioners in Singapore, do not have any formal training in mathematical modelling as a student either at school or in the university, and teaching it has been very challenging. Very often, a teacher's decisions, from planning of a mathematical modelling task to its execution in the classroom, depend on his orientation, resources and goals. Unless a teacher has been properly trained, adequately prepared and well resourced, his decisions are unlikely to result in a successful mathematical modelling lesson.

In this paper, we discuss a school-based professional development (SBPD) programme aimed at preparing teachers to teach mathematical modelling in the classroom. This programme has been successfully carried out in several schools in Singapore over a period of about two years. A case study will be presented to illustrate the key principles of the programme. Examples of student work and modelling tasks designed by participating teachers will be presented. In addition to the observation that there is a definite paradigm shift in the teachers' orientation and goals in teaching mathematical modelling, it is also evident from these examples that technology had played a crucial role in the success of the modelling lessons designed by the participants of the SBPD programme.

Abstract for 20579
Reflections on Teaching Applied Mathematics with Technology

Authors: Paul Abbott
Affiliations: School of Physics M013, The University of Western Australia, Crawley WA 6009, Australia
Keywords:

In most applied mathematics courses, simulation and modelling are taught by stressing numerical techniques, while visualisation often requires a range of specialised software tools. Standard texts teach computation by having students develop or edit procedural code fragments to model a particular physical problem or system. This approach requires the understanding of many details of a procedural programming language such as Matlab, Fortran or C. Although learning procedural programming is very useful it detracts from the desired goal of teaching exploration.

A second approach is to develop custom "black-box" applications for illustrating specific mathematical or physical concepts. When well done this approach has the advantage that such applications can be used with little instruction, and the focus is entirely on the situation under investigation. A disadvantage is that the student may not learn any computational techniques, though sometimes reading the source code can be enlightening.

The third way is to use an integrated computational environment. But how best to integrate technology into teaching in a non-trivial way? Buchberger (1990) proposed the White-Box/Black-Box principle (WBBB) to describe learning with a computer algebra system (CAS):

In the stage where area X is new to the students, the use of a symbolic software system realizing the

algorithm of area X as black boxes would be a disaster. Students have to study the area thoroughly, that is they should study problems, basic concepts theorems, proofs, algorithms based on the theorems, examples, and hand calculations.

In the stage where area X has been thoroughly studied, when hand calculation for simple examples become routine, and hand calculations for complex problems becomes intractable, students should be allowed and encouraged to use the respective algorithms available in symbolic software systems.

Kutzler (1999) modified the WBBB principle (MWBBB): students who do not master certain topics can use CAS as a scaffolding to help understand higher level topics. Drivers (2000) proposed inverting the sequence—Black-Box/White-Box (BBWB)—using a CAS as a generator of examples and as an explorative tool that confronts the student with new situations. The explorative Black-Box phase can lead to (directed) discoveries. In the White-Box phase the results of the explorations are examined and can lead to the development of new concepts.

Teaching mathematical concepts using Mathematica as a tool for problem-based learning (PBL), allows the use of all three approaches—WBBB, MWBBB, and BBWB. Mathematica is used in my courses immersively as both a presentation environment and a computational tool. In this talk I will demonstrate my approach, which has three main advantages:

[1] Doing the problems leads to a deeper understanding of the concepts involved;
[2] Students learn problem-solving techniques;
[3] Students learn Mathematica by “absorption”.

Abstract for 20592
Educating the Educators: Technology-Enhanced Mathematics Teaching and Learning
Authors: Leong Chee Kin
Affiliations: SEAMEO RECSAM,Penang, Malaysia
Educational research has shown that teaching quality is one of the most important factors in raising student achievement. There is a compelling need for educators to keep abreast of the important developments that are taking place in educational arena. One of the educational areas that is having massive development is on the use of technology to enhance teaching and learning especially in mathematics. Having this development the need for professional development among educators comes in. Being a regional science and mathematics education centre, the Southeast Asian Ministers of Education Organisation Regional Centre for Education in Science and Mathematics (SEAMEO RECSAM) has always been cognizant of the importance of these developments. Its training programmes for in-service teachers, teacher educators and ministry of education mathematics officers are planned to incorporate these developments. As the Centre"s mandate it aims to ensure that these participants from Southeast Asians as well as those from outside the region are equipped with emerging educational technology tools which can enhance teaching and learning of mathematics. This paper will share our experiences in continuing professional development of mathematics teacher, teacher educators and ministry of education officers on educational innovation and technology.

Abstract for 20607
Mathematics Interactive Learning Environment
Hongguang Fu; fu_hongguang@hotmail.com; University of Electronic Science and Technology-Chengdu
Mathematics Interactive Learning Environment (MILE) is the trend of educational technology where users can practice homework problems and take practice tests online. However, developing such a desirable online environment is still an open area and far from perfect.

In this talk, I will present a system that provides an automatic theorem proving for geometry and automatic equations solving for algebra. Initial design is focused to provide an interactive learning environment for junior high schools mathematics. The MILE can automatically check if a student's homework is correct step by step. The system not only can determine the correctness for each step, but also provide assistance on each step if student chooses option for help. It is therefore a powerful learning tool for students working as a personal tutor. The complete description of this project can be found at my invited talk at the proceedings of ATCM 2014, its electronic version will be available around November 2014 at http://atcm.mathandtech.org/EP2014.

Abstract for 20608

Bar Model and GSP: The Effective Strategy in Solving Word Problems

Authors: Krongthong Khairiree
Affiliations: International College, Suan Sunandha Rajabhat University Bangkok Thailand

The purpose of this paper is to illustrate the effective strategy in enhance students' understanding in solving word problems and to develop their representation in mathematics. By using bar model, students will develop their visualization skills to assist in processing information, making connection, and solving problems. The Geometer's Sketchpad (GSP) is an effective tool that provides opportunities for teachers and students to use their ability to access, drag, animate and create graphical representation. The research finding showed that bar model strategy can be used not only as problem solving technique, but also to develop in students a deeper understanding of the four operations concept in mathematics. The students can explain, knew what to do and knew why they had to do. In addition, the students revealed that with GSP and bar model strategy they were able in visualizing and creating graphical representations, which will enable them to develop their mathematical thinking skills, concepts and understanding. The students explained that it was fun in learning mathematics by this method.

Abstract for 20613

Modern Geometry via Dynamic Tools

Authors: Ma. Louise Antonette De Las Penas
Affiliations: Ateneo de Manila University

Abstract. Dynamic Geometry Software has been often used in teaching Euclidean Geometry concepts. Not much has been documented on the use of technology in the study of more advanced geometry. In this talk, we focus on our experiences in the Modern Geometry classroom, where dynamic tools facilitate an interactive and engaging learning environment.

The first part of the talk will focus on the role of dynamic geometry software in the students' understanding of the Non-Euclidean geometries- Hyperbolic and Spherical Geometry. We present the advantages on the use of the software in studying a new geometry. For instance, in discovering geometric figures, investigating their properties and comparing these with familiar concepts in Euclidean geometry. We also give instances on how the students have used dynamic geometry as an aid in conjecture making and formulating proofs; including those that pertain to unanswered research problems.

The second part will pertain to Transformation Geometry. This will include connecting concepts on isometries to tilings and patterns in the real world. In our case, we look at geometric artwork created by Philippine indigenous communities.

Abstract for 20614

A Capstone Course to Improve the Preparation of Mathematics Teachers

Authors: Antonio Quesada
Affiliations: The University of Akron

Abstract. A decade after the first set of NCTM standards were published, and when a large percentage of USA secondary students were using graphing calculators in the mathematics classroom, we began to study the degree of readiness of pre-service mathematics teachers in two key areas. Firstly, to what extent were these pre-service mathematics teachers prepared to use research-proven teaching and learning approaches recommended by the standards? In particular, had these future math teachers been properly exposed to inquiry-based teaching and learning, to team work, and to exploration and discovery? Secondly, besides learning how to use graphing calculators, were these pre-service teachers ready to properly integrate this technology into the teaching and learning of mathematics? Our initial research pointed to a weak theoretical exposure with very little or no practice whatsoever conducive to the internalization of the approaches aforementioned. On the other hand, most students knew how to use the very basic functions of a graphing calculator, but could not use numerical and graphical techniques, let alone any of the new mixed techniques, to solve problems. Further research indicated that they lacked the basic conceptual understanding that the exposure to proper integration of technology promotes. Unaware of any existing course or textbook focusing in the outlined areas, we developed a capstone course aiming to address these deficiencies. In this presentation we will review the mathematical content, technology, teaching tools, strategies, and types of assessments used. In addition, quantitative and qualitative evaluation on the results of this course will be presented.

Abstract for 20626

Towards effective offline techno-blended Mathematics teaching and learning models for secondary schools in developing countries – a South African perspective.

Authors: Werner Olivier
Affiliations: Nelson Mandela Metropolitan University, FirstRand Chair in Maths Education

It is well-known that blended teaching and learning models have found wide-spread acceptance as appropriate delivery platforms towards the development of learners to become productive digital citizens in the 21st century. Most first world countries depend heavily on flexible access to quality online study material and social media as part of a learner-centered approach to teaching and learning in schools. In contrast, huge challenges exist in most developing countries to integrate e-learning as part of teaching and learning in schools. In this regard, a range of challenges serves as an impediment to the introduction of web-assisted model(s) in Mathematics classrooms in South Africa. Lack of ICT skills and/ or content knowledge of many educators, inadequate school infra-structure and internet bandwidth; are some examples of stumbling blocks in the way of introducing web based teaching and learning. At the same time, access to quality Mathematics study material remains one of the most serious needs in the South African schools system. Particularly in rural regions, where there is an acute shortage of Mathematics educators in schools, the need for web-independent “virtual” teaching and scaffolding learner support is dire. An innovative and modern offline techno-blended teaching and learning model (TBM) for Mathematics was developed over a five year period by the Govan Mbeki Mathematics development Unit at the Nelson Mandela Metropolitan (NMMU) in Port Elizabeth, South Africa, to address the need for offline Mathematics educator and learner support in secondary schools. In this paper the educational design and component structure of the TBM for Mathematics will be described and compared to an

equivalent on-line school based model in terms of factors such as access, cost, visualization, fitness for learner profile and making teaching and learning more interactive. Experiences with the use of the TBM in various challenging school environments will also be discussed and highlighted.

Abstract for 20628

Integrating Technology in Teaching and Learning (Mathematics)

Authors: Paulina Pannen

Affiliations: Directorate General of Higher Education, MOEC, Indonesia

With the rapid development of ICT and its ramification in our world, especially education, can we envision how will education look like in the future, especially in Indonesia, and in the teaching and learning of mathematics? Employing Zappa's Envisioning The Future of Educational Technology (2013) and NMC Horizon Report 2014 K-12 Edition, this paper will reflect on the effort of ICT integration in teaching and learning, especially in the teaching and learning of mathematics, in Indonesia. Taking stocks of the existing Government's policy on ICT and ICT in Education, also of the facts and figures of Indonesia's ICT profile, this paper discusses initiatives, practices, and studies on ICT in Education, integration of ICT in the teaching and learning of mathematics, what technology and how to integrate in the teaching and learning of mathematics, and some future prediction on the evolution of teaching and learning due to emerging technologies.

Abstract for 20629

Reconceptualizing Good Practice of Mathematics Teaching Through Lesson Study in Indonesia

Authors: M.A. Marsigit

Affiliations: Yogyakarta State University

Currently picture of Indonesian educational practices changes very fast at all level of dimensions; it offers the hopes and the challenges to re-conceptualize good practice of teaching. The implementation of the new Curriculum (Curriculum 2013) can be the starting point for mathematics teachers to reflect and move their old paradigms of teaching; due it offers flexible and various approaches of teaching. It encourages the teachers to evaluate the strengths and weaknesses of different approaches in order to make informed choices and, when necessary, should be prepared to learn new skills in the interests of effective teaching learning mathematics. Through this new curriculum, the mathematics teachers need to be able to respond to individual children as it is identified because the relevant curricular experiences and skills of children vary greatly and they need then in a better position to draw upon support services to enhance their classroom practice. The management of the range of support services should be available to maximize their effect in helping teachers to work towards good practices and to implement new curriculum. Lesson Study activities provide the schema for the teachers to promote good practice of mathematics teaching. It also gives the chance to the government officials of education in Indonesia to look in-depth the implementation of curriculum in the class-room level. However, re-conceptualizing good practice of teaching does not only emerge amides the reflection and monitoring of the new curriculum as the new schema to operate education; but also at any chance of initiating education improvement in which Lesson