

NCGC ABSTRACTS

PLENARY LECTURE

1. Twenty years of changes in pedagogy and content that ultimately gave students a richer and deeper understanding of mathematics

Ron Lancaster, Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education of the University of Toronto OISE/UT, Toronto, Ontario, Canada

Anytime someone embarks on a new adventure, it is useful to hear from another person who has been there. Not for the purpose of imitating the experience, but to gain insight into what went right, what did not go well and what benefits were derived. This certainly applies to the use of technology, where it is helpful for teachers to have some sense for where things can go, for knowing what is possible and for knowing what to avoid.

About twenty years ago Ron Lancaster began to use a graphing calculator with his secondary students. In this talk Ron will share his observations about how his teaching style gradually evolved and how the curriculum changed as more teachers joined in the adventure. This talk will inspire and inform the majority of teachers in Malaysia who are just setting out on their own personal adventure with handheld technology.

2. The computer algebra system (CAS) and mathematics assessment

Peter Jones, School of Mathematical Sciences, Swinburne University of Technology, Victoria, Australia

This paper uses a recent pilot program in Australia to look at the impact of allowing students to use CAS on the assessment of university entrance level mathematics. Issues addressed will include: What is a CAS and what does it do? How does teaching with a CAS impact on what is taught and how it is taught? and What is the impact on mathematical assessment as measured by end of the year examinations?

REGULAR LECTURE

1. Students' reactions to learning mathematics with graphing technology

Rosihan M. Ali, School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM Pulau Pinang, Malaysia

Kor Liew Kee, Faculty of Information Technology and Quantitative Sciences, MARA University of Technology, Kedah, Malaysia*

The School of Mathematical Sciences at Universiti Sains Malaysia has offered a laboratory course on the integration of hand-held technology into the teaching and learning of mathematics since the beginning of the 2001/2002 academic year. The course is taught with an inquiry-based format that highlights explorations and applications of mathematics in a data rich modeling environment. In addition, the course addresses several issues related to the effective integration of such technology into the mathematics curriculum. This paper discusses the appropriate use of graphing technology to present mathematical concepts and to support student's understanding in a student-centered learning environment, and shares knowledge on the new mathematics that was made possible by the hand-held technology. A four open-ended questions survey questionnaire was administered to a population of 39 students. The respondents' written remarks were expounded and contextualised in terms of cognition, affect and values. The overall result shows that students' reactions to the learning of mathematics with graphing technology were favorable and encouraging.

2. Distributed cognition and the use of graphing calculators in the learning of mathematics

Pumadevi Sivasubramaniam, Mathematics Department, Maktab Perguruan Raja Melewar, Seremban, Negeri Sembilan Darul Khusus, Malaysia

Graphing calculators are powerful tools that eliminate the drudgery of tedious computations and algebraic manipulations. Despite the facilities provided by this tool, the acceptance of the use of graphing calculators in the mathematics classrooms are greatly impeded by false beliefs. This paper aims to dispel these beliefs and highlight the advantages of using graphing calculators in the learning of mathematics in the light of the theory of distributed cognition.

3. Integrating calculator in the development of students' meaningful understanding of secondary school mathematics concept by teaching through problem-solving

Norjoharuddeen Mohd Nor, Head of Division (Mathematics), SEAMEO RECSAM, Malaysia

We may have come across students who know how to do mathematical procedures without having meaningful understanding of the mathematical concepts underlying these procedures. This paper propose that students might be able to develop meaningful understanding of these mathematical concepts by trying to solve real-world problems before they are taught with the formal mathematical procedures. They will be solving these problems using their intuition, informal strategies or heuristics with the help of graphic calculators. This paper will provide an example of how graphic calculators can be used to help students develop meaningful understanding of the concept of solving linear inequalities.

4. DERIVE 6 – A computer program for teaching and learning mathematics

Bernhard Kutzler, ACDC (Austrian Center for Didactics of Computer Algebra)

Since the days that computers emerged as fast and diligent number-crunching devices, mathematicians have searched for ways of getting them to perform increasingly sophisticated tasks. This has led to the latest development in technology, computer algebra systems, a sort of mathematical expert system which is necessarily changing the way we do mathematics.

Derive is a very mature computer algebra system for PCs, its roots go back to the late Seventies. It is the first computer algebra system which was widely used as a tool for teaching and learning mathematics. Many ministries and school authorities throughout Europe have adopted Derive as the primary computer tool for mathematics education.

Derive 6 is the newest version with a lot of features which support teachers and students in a mathematics class. We give an overview of Derive 6 with emphasis on these more pedagogical product features. We demonstrate these features with appropriate classroom examples from lower and upper secondary school mathematics and put them into a general didactical framework.

5. Exploration and entertaining mathematics: Why graphic calculator?

Noraini Idris, Department of Mathematics & Sc. Ed, Faculty of Education, University of Malaya, Kuala Lumpur, Malaysia

Students who are engaged in their work are energized by four goals - success, curiosity, originality, and satisfying relationships. But the question now is "How do we cultivate these drives in the students' lives?" What kind of work do students find totally engaging? Students want and need work that stimulates their curiosity and awakens their desire for deep understanding. To prepare students for life in today's highly technical society, their mathematical and science knowledge must include and go beyond knowledge in the simple skills to solving more complex problems. Malaysia, like many nations, is cognizant of the need to facilitate the education of smart learners capable of working competently with others in teams in an information technology environment and aware of their own learning and performance. We need to prepare students who know how to identify problem and its solution, work in teams, communicate well, and know how to evaluate progress and learning. In this presentation, the presenter will share how the TI-83 Graphic Calculator is an essential tool for teaching, learning and doing mathematics. When technological tools are available, students can focus on exploration, decision making, reflection, reasoning, and problem solving.

6. Giving shape to the ICT landscape: The case of mathematics education

Nicholas R. Jackiw, Chief Technology Officer, KCP Technologies, Inc., Emeryville, California, USA

This paper proposes two models for systematizing, comparing, and evaluating various instructional technologies within mathematics education. The first model focuses on how tools differently construct the location of mathematical learning; and the second focuses on how

different tools balance the competing requirements of mathematical flexibility and curricular specificity. The models are then evaluated in practice by using them to categorize existing exemplary technologies (such as graphing calculators and Dynamic Geometry Software), and assessing the implications of such categorizations.

CONTRIBUTED LECTURE

1. Ecological modeling with the TI-92 graphics calculator

Zarita Zainuddin*, **Husna Hasan & Suraiya Kassim**, *School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM Pulau Pinang, Malaysia*

Student understanding of nonlinear systems can be enhanced by explorations using the TI-92 Plus. A principle advantage of the TI-92 Plus is that students can investigate concepts such as critical point, equilibrium solution, constant population, etc. that would otherwise be difficult to explore. The presentation will describe one or more models involving two-dimensional first-order systems of the form

$$\frac{dx}{dt} = F(x, y)$$
$$\frac{dy}{dt} = G(x, y)$$

in which the independent variable t does not appear explicitly. This presentation will emphasize and demonstrate how the features of differential equation graphing can be utilized to investigate and analyze the behavior of solutions.

2. Exploring the value of e using graphing calculators

Ong Hong Choon* & **Suraiya Kassim**, *School of Mathematical Sciences, University of Sciences of Malaysia, 11800 USM Penang*

Teh Seok Cheng, *Methodist Boys' School, 250 Jalan Air Hitam, 10460 Penang*

Lawrence Chang Hooi Tuang, *Communication Skills and Entrepreneurship Centre, Northern Malaysia, University College of Engineering, 01000 Kangar, Perlis*

In this paper, we present a short write up on the value of e and we use the graphing calculator to explain how this value is calculated. A graphical exploration is given on the value of e and this is supported by tabular values.

3. Drawing graph and understanding the meaning of graph

Shin Watanabe, *Tokai University Japan, Japan*

It is easy to draw graphs using a graphic calculator. These graphs are plotted without utilizing differential calculus. It is important to be able to interpret the graphs one sees on a graphic calculator. The ability to interpret graphs will enable us to better understand concepts and phenomena in mathematics and science. The CBL system can enable us to interpret graphs. In this paper I describe how the graphic calculator and CBL system are used to interpret the meaning of graphs and to prepare students for differential calculus.

4. Use of graphic calculator to promote the construction of algebraic meaning

Mohan Chinnappan*, *Faculty of Education, University of Wollongong*

Mike Thomas, *Department of Mathematics, The University of Auckland*

The need to assist students to construct rich understanding of mathematical concepts is a dominant theme in current reform statements. Towards this end, it has been suggested that the teaching of algebra needs to be buttressed by technology including the use of graphic calculators. While there is consensus about the pedagogical value of tools such as graphic calculators, there is limited data about how teachers actually deploy graphic calculators during the course of their teaching. In this paper, we describe the use of graphic calculators by an experienced classroom teacher in her attempts to develop both procedural and conceptual aspects of functions.

5. Measuring the adoption of graphic calculators by secondary mathematics teachers

*Boris Handal**, Faculty of Education, University of Technology Sydney, Australia

Tony Herrington, Faculty of Education, University of Wollongong, Australia

Mohan Chinnappan, Faculty of Education, University of Wollongong, Australia

The low level of use of graphic calculators by mathematics teachers is a major concern of curriculum developers and teacher educators. While several reasons have been advanced to explain this situation, recent developments have shown that there is a need to examine not only teachers' skills in the use of the calculators but more importantly the link between teachers' attitudes and beliefs about mathematics and the use of graphic calculators to support classroom instruction. In this paper we describe an instrument (Teachers' Attitudes Toward Information Technology Questionnaire, TAT) that would allow researchers to generate data about the above link and develop strategies for encouraging a higher and more effective use of graphic calculators by mathematics teachers

6. Graphic calculator explorations to enhance mathematics in public high schools

*Daniel L. Seth**, Department of Mathematics and Computer Science, Morehead State University, Kentucky, USA

Lisa Willis, Math Department, Bath County High School, Owingsville, Kentucky, USA

Morehead State University has initiated a Professors In The Schools fellowship program, a professional development program for faculty to reengage in the public schools of the Morehead State service region. Under the auspices of the PITS program, graphic calculator explorations were developed to enhance the understanding of math concepts from the public high school curriculum. The explorations were implemented in the classroom at Bath County High School, Kentucky. This paper discusses relevant issues, the PITS program, and introduces sample explorations.

7. The pedagogical Trojan horse: Handheld technologies in the secondary mathematics classroom

Allan Leslie White, The University of Western Sydney, Australia

It is claimed that access to quality education enables individuals to effectively participate in the workforce and contribute to society. Poverty, political conflict, and a lack of teachers and infrastructure can hamper access to education. Within the educational system the traditional classroom that is associated with teacher centred pedagogy and behaviourist learning principles can act as a further impediment. It can be argued that there are five broad categories of teacher behaviour when it comes to the integration of ICTs within their classroom. Teachers tend to view ICT as either: a demon; a servant; an idol; a partner; or, a liberator. Traditional teachers most often see ICT as a demon to be avoided and feared. Handheld technologies can help overcome many of these physical, educational and sociological barriers in the traditional classroom setting while providing a 'Trojan Horse' for change to traditional pedagogy. This paper will examine ways in which hand held technologies can gain entry inside the defensive walls of traditional teaching by enhancing and supporting current classroom pedagogy. It will examine ways of moving beyond current practice, because once unleashed within the classroom, handheld technologies alter the very nature of the teaching and learning process. As teachers and students gain in confidence and experience in the use of these technologies, the speed of transformation increases and the walls of past practices crumble. The traditional teacher moves from regarding handheld technology as a demon or servant to regarding handheld technology as a partner, and in some cases a liberator. Hand held technologies in mathematics and science classrooms become a vehicle to equip students with the skills needed in an emerging knowledge society, by engaging them in active, meaningful, collaborative learning, that stimulates their creativity, encourages them to solve problems, to think critically and turn information into knowledge. They provide a vastly cheaper vehicle, in comparison to computers, and allow learning to reach beyond the walls of the classroom and into the daily lives of the students.

8. Pengajaran dan pembelajaran matematik menggunakan kalkulator grafik di sekolah menengah.

*Husna Hasan**, *Munawir Azizan*, *Zarita Zainuddin* & *Suraiya Kassim*, School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM Pulau Pinang, Malaysia

Tahun-tahun kebelakangan ini menampakkan usaha yang bersepadu kearah memperkasakan lagi proses pengajaran dan pembelajaran Matematik di sekolah-sekolah. Antara usaha tersebut termasuklah melaksanakan Proses Pengajaran Sains dan Matematik dalam Bahasa Inggeris (PPSMI). Seiring dalam pelaksanaan PPSMI tersebut ialah penggunaan alatan Bantu mengajar seperti komputer dan bahan berteknologi mutakhir. Kalkulator saintifik juga telah digunakan di sekolah-sekolah menengah. Mulai daripada tahun 2003, kalkulator saintifik boleh digunakan dalam peperiksaan awam iaitu PMR dan SPM.

Namun begitu, kegunaan kalkulator saintifik adalah terhad. Oleh itu, penggunaan kalkulator grafik telah mula diperkenalkan di sekolah-sekolah pada tahun ini. Kalkulator grafik dapat memplot graf, mempermudah ungkapan algebra dan lain-lain lagi. Ini bukan sahaja dapat meningkatkan kefahaman pelajar terhadap topik-topik tertentu dalam Matematik malahan juga dapat meningkatkan minat pelajar.

Menyedari akan hal tersebut, kajian ini dilakukan untuk membolehkan penggunaan kalkulator grafik secara maksimum di dalam kelas. Kajian ini mengenengahkan masalah dan kekangan yang dihadapi semasa mengendalikan kelas menggunakan kalkulator grafik serta cadangan bagaimana untuk mengatasi masalah. Implikasi penggunaannya terhadap topik yang dipelajari juga dibincangkan.

9. TBA

Ong Swee Hin, SMK Tun Sharifah Rodziah, Alor Setar, Kedah, Malaysia

10. Demonstrating probability and probability distribution with a graphic calculator

Suraiya Kassim, Husna Hasan, & Zarita Zainuddin, School of Mathematical Sciences, Universiti Sains Malaysia, 11800 USM Pulau Pinang, Malaysia*

For many students, the formal study of probability is often difficult. Much of the time, it is reduced to the use of an algebra of probabilities, with little intuitive feel for the content, and many misconceptions (Kissane, 1997). Studies have shown that students' misconceptions could be addressed through hands-on experiments and activities carried out in the classroom. Furthermore, educationists believe that a practical involvement of students in the classroom promotes learning. This paper suggests the use of the graphic calculator to get students to be practically involved in a probability class. The graphic calculator's capability of generating random numbers is utilised to simulate probability experiments. The results from the experiments are used to demonstrate probabilities of events and to create probability distributions. The reasonableness of the experimental probabilities are then compared to its theoretical counterpart.

* Presenter

WORKSHOPS

A1. All you wanted to know about CAS but were afraid to ask

Peter Jones, School of Mathematical Sciences, Swinburne University of Technology, Victoria, Australia

Computer Algebra Systems (CAS) are now available on graphics calculators and will soon become part of the technology which mathematics teachers are required to master and use in their classroom. This hands-on session, designed for CAS novices, aims to give participants an overview of CAS in the context of teaching introductory calculus.

B1. Energising secondary school mathematics through modelling with the graphics calculator

Allan Leslie White, The University of Western Sydney, Australia

This workshop allows participants with little or no experience on graphics calculators to develop their expertise while making a series of decisions about a real life scenario involving the wreck of an oil tanker, the MV "Braer". The story is based on events that actually happened, when the ship lost engine power in a severe storm off the Shetland Islands on 5th January 1993. As Chief of the Coast Guard, participants will be responsible for the disaster management plan and because the storm has disabled the computer systems, the graphics calculator is their only computation

assistant. Participants will have the opportunity to analyse relevant data with the aid of graphics calculators, in order to predict the course of the ship, evaluate the environmental impact of the oil slick resulting from the wreck, and ultimately determine who was responsible for the disaster. At the end of this entertaining session participants will be surprised at how quickly they have developed their skills on the GC. More importantly they will have experienced the power of technology to transform secondary school mathematics: the way of the future.

C1. Introduction to teaching with Derive 6

Bernhard Kutzler*, *ACDCA (Austrian Center for Didactics of Computer Algebra)*
Vlasta Kokol-Voljc, Faculty of Education, University of Maribor, Slovenia

Derive is a mathematical computer program. It is for algebra, equations, trigonometry, vectors, matrices, and calculus what the scientific calculator is for numbers. Derive can do both symbolic and numeric computations. These can also be visualized with extensive 2D and 3D graphics capabilities.

Derive eliminates the drudgery of performing long mathematical calculations. Thus Derive gives you the freedom to explore different approaches to problems – approaches that you probably would not even consider if you had to do the calculations by hand.

This hands-on workshop is for learning how to use the new Derive 6 and is for both beginners and advanced users knowing Derive 5. You will learn to handle Derive as much as is necessary to use the program for your own mathematical work, in particular for classroom preparations. You will also be introduced in the art of teaching and learning mathematics with the help of Derive.

A2. Transformations with the Geometer's Sketchpad (GSP) in Voyage™ 200

Krongthong Khairree, Penang, Malaysia

The workshop aims to provide mathematics educators with experiences in using a powerful tool for learning concept in geometry especially transformations. Transformations are not easy to visualize from static and from figures you draw with traditional tool like a ruler and protractor. With the GSP in Voyage™ 200, you can construct and measure figures easily and more precisely. In addition, the Voyage™ 200 personal learning tool is designed to adapt to the changing educational needs of students in both the classroom and home.

The workshop will be a hands-on activity. Prior experience with the GSP in Voyage 200 is not necessary. The knowledge on how to use GSP in Voyage™ 200 will be provided. During the workshop the educators will be provided with lesson plans on “Translations” to illustrate the balancing of the use of paper-and-pencil and graphing calculators.

At the end of the workshop conducted the educators will:

- gain knowledge on how to motivate their students and help them to develop better conceptual understanding of “Transformations” by using the GSP in Voyage™ 200 ; and
- know how to use hands-on activities on the GSP in Voyage™ 200 mathematics classes.

B2. Shuffling playing cards, mathematical magic tricks and much more

Ron Lancaster, Department of Curriculum, Teaching and Learning, Ontario Institute for Studies in Education of the University of Toronto OISE/UT, Toronto, Ontario, Canada

In this workshop we will discuss challenging and interesting questions (see the example given below) arising from the seemingly simple process of shuffling a pack of playing cards. We will also study several stunning mathematical magic tricks and we will discuss how magic tricks can be used to enhance the teaching of certain topics. This workshop will involve a wide range of standard and optional mathematical topics from the high school curriculum including functions, iteration, permutations and combinations, modular arithmetic and exponents. Several programs for the TI-83+ will be shared, including one that carries out a perfect shuffle for a deck of $2n$ cards, where n is any positive integer.

One of the problems to be discussed in the workshop:

Suppose that you are holding a deck of 52 cards, arranged in order with the Ace of Spades at the top and the King of Clubs at the bottom. The order of the suits is Spades, Hearts, Diamonds and Clubs. Discard the top card (Ace of Spades) and place the second card (the 2 of Spades) at the bottom of the deck. Discard the third card (the 3 of Spades) and place the fourth card (the 4 of Spades) at the bottom. Continue to do this until only one card remains. What is the card that remains? What card would survive if there were 54 cards in the deck?

B3. Developing students' mathematical modeling ability through the use of the graphic calculator

Norjoharuddeen Mohd Nor, SEAMEO RECSAM, Malaysia

One of the major goals of education is the development of student's mathematical thinking ability and one of the ways that this can be achieved is by providing students with the opportunities to experience doing mathematical modeling in the classroom. The aim of this workshop is to provide classroom teachers with examples to show that mathematical modeling is common and accessible to everyone especially with the use of the graphic calculator. Teachers should be able to appreciate the importance of mathematical modeling as a process to improve students' thinking, especially their mathematical thinking ability.

C2. Sketchpad in algebra: The case of slope

Nicholas R. Jackiw, Chief Technology Officer, KCP Technologies, Inc., Emeryville, California, USA

Despite its title, *The Geometer's Sketchpad* software is used not only for studying geometry, but also for algebra, trigonometry, pre-calculus, and calculus. This workshop is designed to give participants just starting with Sketchpad a chance to become acquainted with its use in some of these contexts outside of geometry---particularly, in algebra and calculus. We will anchor our explorations of the software by pursuing the mathematics of slope, from its first conceptual introduction in a pre-algebra setting (the slope of a line) through its role in various linear equations in algebra class (for example, point-slope form) up to its re-appearance in calculus with the discussion of the slope of arbitrary functions or curves at a given point (tangents).

This workshop will be hands-on in the computer-lab, and participants will work individually or in pairs. While brief prior experience with Sketchpad will be helpful, it is not necessary: we will cover Sketchpad topics "from the beginning." At the same time, advanced users will have the opportunity to increase their skills. Handouts will include activity masters participants can take back to their classrooms. Particular Sketchpad topics to be covered include: constructing lines; measuring coordinates, equations, and slopes; calculating dynamic values based on measurements; constructing secants; evaluating derivatives, plotting functions, and constructing tangents to arbitrary functions.

A3. Interconnectivity – Data exchange between Derive 6 and TI CAS calculators

*Bernhard Kutzler**, ACDC (Austrian Center for Didactics of Computer Algebra)
Vlasta Kokol-Voljc, Faculty of Education, University of Maribor, Slovenia

Derive is a mathematical computer program. It is for algebra, equations, trigonometry, vectors, matrices, and calculus what the scientific calculator is for numbers. Derive can do both symbolic and numeric computations. These can also be visualized with extensive 2D and 3D graphics capabilities.

The TI CAS calculators (TI-89, TI-92+, and Voyage200) are handheld devices combining the features of graphing calculators and computer algebra systems. The computer algebra engine of these handhelds is closely related to Derive.

The new Derive 6 offers a powerful new feature called "interconnectivity", which allows to exchange data between Derive and the TI CAS calculators.

In this hands-on workshop you will learn to perform this data exchange and you will learn to use the combination of software and handheld as a powerful teaching and learning environment. Thus you will experience a very fine example of the slogan "The whole is more than the sum of its parts."

C3. Exploring mathematics with the Geometer's Sketchpad (GSP)

Krongthong Khairree, Penang, Malaysia

The workshop is designed for participants to experience in using the Geometer's Sketchpad (GSP) with constructivist approach in mathematics lessons. The workshop will be a hands-on activity and the workshop will be conducted in such a way as to simulate a mathematics class.

Prior experience with the Geometer's Sketchpad is not necessary. The knowledge on how to use GSP and the important features of GSP will be covered in this workshop. The participants will learn both basic and advanced features of GSP Version 4.

Primary emphasis will be on learning how to use GSP effectively in Geometry, Algebra and Calculus. The participants will learn how to build and animate parameters with functions. The workshop also provides participants to learn how to use the GSP for classroom demonstrations and explanations.

At the end of the workshop conducted the participants will:

- gain knowledge on using the GSP to help their students better understand mathematical concepts;
- learn how to integrate the GSP in mathematics class;
- know how to use and when to use the GSP in mathematics classes; and
- have an opportunity to develop competence by using the GSP for teaching mathematics.

D1. Exploring TI Navigator

Rohini Sooriamorthy* & Lee Chong Liang, STATWORKS (M) SDN BHD

This workshop will offer the participants a hands-on look at one of the most innovative educational tools ever invented: the TI-Navigator, a Classroom Learning System. The TI-Navigator allows teachers to quickly distribute, collect, aggregate, and assess curricular materials from all students simultaneously.

Educators using the TI-Navigator will be able:

- to send class materials such as lecture notes and tests questions directly from the teacher's PC to students' TI handheld and vice versa the replies from the students;
- to assess students' understanding through immediate feedback by analyzing the class results retrieved through the TI-Navigator system
- and best of all, the teachers can maintain current teaching methodology within any established curriculum.

The objective for this workshop is to prepare teachers to use the TI-Navigator system and to introduce ways of incorporating the TI-Navigator into the mathematics and science curriculum to enrich instruction and extend students' comprehension.

DISCUSSION PANEL

The development of teaching-learning environment for science and mathematics using hand-held technology

Panelists:

1. **Mr. Abdul Wahab Ibrahim**, Assistant Director, Curriculum Development Centre, Ministry of Education Malaysia
2. **Associate Professor Noraini Idris**, Department of Mathematics & Sc. Ed, Faculty of Education, University of Malaya, Kuala Lumpur, Malaysia
3. **Professor Peter Jones**, Head, School of Mathematical Sciences, Swinburne University of Technology, Victoria, Australia

Moderator:

Associate Professor Munirah Ghazali, School of Educational Studies, Universiti Sains Malaysia, Pulau Pinang

One of the six principles of school mathematics as espoused by the National Council of Teachers of Mathematics (NCTM) in the United States is that "technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning."

The graphic calculator makes a very important contribution as an ICT tool as far as incorporation of technology into mathematics education is concerned. There has been ample research into the impact of graphing technology on mathematics education. The graphic calculator is widely used as a tool to support and enhance the teaching and learning of senior secondary mathematics in countries such as Austria, Australia, Canada, Denmark, France, Germany and the United States. Beginning 2002 Singapore allowed the use of non-CAS graphic calculators in its GCE A Level Exams in Further Mathematics. Over the last two years, the Malaysian Ministry of Education has supplied graphic calculators to several selected schools in Malaysia to explore calculator efficacy in the teaching and learning of secondary mathematics.

The Panel will discuss several aspects in the incorporation of graphing technology into mathematics education in Malaysia. First is the effectiveness of the graphic calculator as well as its potential for mathematics teaching and learning. What does the technology offer and how easy is it to use? Does it present mathematical concepts in a way that will support pupil's understanding? Secondly is to review the actual use of the graphic calculator, in particular in the classrooms of our schools. What role do mathematics teachers play? How do teachers develop lesson studies? Finally various issues on the incorporation of the graphic calculator into mathematics education will be discussed. These include the effectiveness and limitations on the use of graphic calculators, whether its use should be technology driven or mathematics driven, its link to the understanding of the nature of mathematics, and the development of test items in a graphic calculator permitted assessment.