CHAPTER 1

ABSTRACTS

The following is the list of chapters that you will fin in this Web site. They are alphabetically ordered by the last name of the first author. After the abstract of each chapter, you will find a table like the following:

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By clicking on the WWW link you will be taken to the WWW page of that chapter. You will be to read the paper using your browser. If you click on the PDF link, you will be able to save the PDF file of that chapter. You will then be able to read and print the chapter using Acrobat Reader. The PDF file contains the chapter exactly as it will be printed in a forthcoming publication.

Introduction

Pedro Gómez and Bert Waits (Editors)

A brief description of the goals, organization and achievements of the Topic Group 18.

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Discovering advanced mathematics with calculator activities

John Berry and Bob Francis

"Discovering Advanced Mathematics" is the outcome of two years development of a series of textbooks to support the learning of mathematics in upper secondary schools in the UK. During the development phase of the project, a series of graphic calculator activities were developed to introduce various topics within the curriculum. Having gained confidence in using graphics calculators to introduce a topic, students are then encouraged to use appropriate technology in the problem solving process. This paper describes our experiences of using calculators in developing mathematical concepts and in the problem solving process.

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P. GÓMEZ & B. WAITS (EDS.). *ROLES OF CALCULATORS IN THE CLASSROOM*, 1-9

Possibilities and fears

Per Broman

The graphing calculator is much more than a calculator that can draw graphs. It has developed into a well programmed mathematics computer in pocket size opening possibilities to be used as a mathematics laboratory. It is well fitted for "problem-based education" in mathematics teaching and learning. However, neither teachers nor textbooks seem to have realized its advantages for the teaching and learning of mathematics.

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Are graphing calculators the catalyzers for a real change in mathematics education?

Jaime Carvalho e Silva

In many countries, the teaching of mathematics has always taken a classical lecture form, for the majority of teachers, in a more obvious way at the secondary school and the university levels. There have been very successful experiences, major changes in the official syllabus have taken place almost everywhere, materials were produced in big quantities. But inside the mathematics classroom, the teachers speak and the pupils/students listen. The national examinations in the whole, test more routine knowledge than critical or independent thinking. But with the dissemination of graphing calculators things will have to change. Almost all the usual routines will become trivial. And the machines will never solve problems; the ones using it will have to think about what to do, and how to interpret the display. Computers can of course have the same effect; but they are not, and they will never be available as widely as the graphing calculator. At least beginning in the 10th grade, the daily availability of a graphing calculator will have an impact in teaching comparable with the impact of the availability of written texts after Gutenberg.

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Much more than a toy.
Graphing calculators in secondary school calculus

Thomas P. Dick

Graphing calculators are too often dismissed as mere "toys" compared to powerful computers. However, their accessibility in terms of portability, user-friendliness, and cost have resulted in an influence and impact on mathematics education that has far exceeded that of computers. This paper discusses the profound impact that graphing calculators have had in secondary school calculus instruction. We draw on the experiences of the Calculus Connections Project involving over 400 secondary school teachers in the U.S.A. using graphing calculators to teach calculus from a "multi–representational" viewpoint. We also note ways in which graphing calculators can be used for visualization in more advanced mathematics instruction and how the latest generation of hand-held devices has evolved to become true mathematics learning machines.

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The Texas Instruments TI–92 as a vehicle for the teaching and learning of functions, graphs, and analytic geometry

Gregory D. Foley

From 1986-1990, the author was a principal investigator on the Ohio State University Calculator and Computer Pre-Calculus (C2PC) project, which developed a curriculum for advanced secondary school students to strengthen their problem-solving skills and improve their understanding of function, graphs, and analytic geometry. This paper explores the question, How should this curriculum be revised in light of the Texas Instruments TI-92, a hand-held hybrid of graphing calculator and computer?

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Graphing calculators and mathematics education in developing countries

Pedro Gómez

By permitting students to experiment with "new" forms of learning and "seeing" mathematics, graphing calculators affect the learning process and, as a consequence, can put pressure on teachers and curriculum developers concerning the teaching process. In this way, when adequate conditions are given, this new technology can reinforce the change process that is taking place in the teaching and learning in some areas of mathematics. Nevertheless, in developing countries the necessary conditions to create this dynamic relationship between curriculum and the new technology does not necessarily exist. Therefore the use of calculators present a series of risks and opportunities. The effect that they can have on student behavior and, consequently, on the reflections that teachers make on their own practice, can be used in those countries as a means to initiate and consolidate a process of change through curricular innovation and teacher preparation. Developed countries and the international community can make important contributions in that sense.

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Mathematical modelling with a graphics calculator

Fiona Grant and John Searl

The Texas Instruments Calculator Based Laboratory used with graphics calculators, enables students to undertake mathematical modelling through problem solving using classroom generated data. The easy transfer of data to each student's calculator allows self–paced, independent work either individually or in small groups. There are opportunities for discussion between students and teacher and between the students themselves. The activities can facilitate cross–curricular links between mathematics and the sciences. They provide a means for concept development in the students and they demonstrate practical applications of mathematics. This study has evaluated the use of the CBL in a number of Scottish schools. It has shown that the activities are rich in mathematical concepts, that

they can be tailored to the mathematical maturity of the students and that they enhance the quality of learning.

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Handheld technology & mathematics: Towards the intelligent partnership

Peter Jones

The pace of technological change is so great that any attempt to focus our attention on a particular technology and its potential impact on the teaching and learning of a particular topic in mathematics is likely to be of transitional value only. Everyday a new and even more sophisticated version of the current technology emerges to take its place. How do we make progress in such a volatile situation? One way is to try and put the problem in a broader perspective by recognizing that we have always used some sort of technology to support mathematical activity in the classroom and to understand what this meant in the past and what are the implications for the future.

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Graphics calculators and assessment

Barry Kissane, Marian Kemp, and Jen Bradley

Graphics calculators are powerful tools for learning mathematics and we want our students to learn to use them effectively. The use of these hand held personal computers provides opportunities for learning in interactive and dynamic ways. However, it is not until their use is totally integrated into all aspects of the curriculum that students regard them with due importance. This includes their use in all kinds of assessment tasks such as assignments, tests and examinations as well as in activities and explorations aimed at developing students' understanding. The incorporation of graphics calculators into assessment tasks requires careful construction of these tasks. In this paper, we discuss issues of equity relating to calculator models, levels of calculator use and the purpose and design of appropriate tasks. We also describe a typology we have developed to assist in the design and wording of assessment tasks

which encourage appropriate use of graphics calculators, but which do not compromise important course objectives.

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Visualization of solutions to certain elementary differential equations on the TI–85

John F. Lucas

Serious treatment of first and second–order linear differential equations is a relatively new focus that appears in the second calculus course in various reform curricula. This paper specifically addresses the graphical perspective of the Calculus Consortium at Harvard (CCH), using technology of the Texas Instruments TI–85 graphics programmable calculator. Considerable insight about the nature and solution of differential equations can be afforded by students using a combination of programs and the TI–85 **DifEq** *graphing option. We investigate five different solutions. First, we examine an algebraically–presented equation (drug–injection model) from which students produce a differential equation, then a slope–field general solution, and finally a* **DifEq***–presented specific solution which can be superimposed in the slope field and checked by drawing in the known algebraic solution. After that, we help solve a murder mystery using Newton's Law of Cooling and a "negative–incremented" time dimension, using the trace feature to approximate the time of the murder. The next two applications treat systems of first–order differential equations —an S–I–R model of an epidemic and a predator–prey model with slope field, trajectory and time–series analyses. The last example involves damped oscillation in a spring–mass system, where the solution curve is drawn first and then estimates are used to approximate its dampening and oscillatory functions.*

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On the impact of the first generation of graphing calculators on the mathematics curriculum at the secondary level

Antonio R. Quesada

Before the second generation of graphing calculators with true symbolic manipulation capabilities start influencing the mathematics classroom, it is important to ponder on the main contributions made by the first generation. In this note we present five of these contributions via a selection of examples that illustrate the impact of numerical and graphical capabilities, multiple representations and methods, and iterative and recursive solutions.

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Technology in the IMP classroom

Lynne Alper, Dan Fendel, Sherry Fraser, Diane Resek

The Interactive Mathematics Program (IMP) has developed a new four-year high school curriculum which is organized around units lasting from 5 to 8 weeks. Each unit centers on a rich problem, and students develop new concepts and skills by solving that central problem. Graphing calculators play an important role in the IMP curriculum, involving simulations, curve-fitting, operations with matrices, and programming. Examples of the use of calculators in the curriculum and guiding principles for their use are given in this paper.

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Latin American calculators in mathematics education project: PLACEM

Patrick (Rick) Scott

The Latin American Calculators in Mathematics Education Project (PLACEM) is experimenting with the use of calculators in mathematics teaching in seven Latin American countries: Argentina, Brazil, Chile, Colombia, Dominican Republic, Mexico and Venezuela. PLACEM has received calculators and some financial support from Texas Instruments. There has been only minor resistance to calculator use, and initial results from the projects indicate changes in

teacher perceptions on the nature of mathematics. Materials are being developed, teacher workshops held, and research projects initiated. Most countries experienced difficulty with importing the donated calculators, and there is an emerging demand for calculators.

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Will elementary algebra disappear with the use of new graphing calculators?

José R. Vizmanos

We begin with an historical look at the development of algebra by Diophantus, Al-Khowarizmi, Lucas Pacioli, Tartaglia, Descartes, etc. Then the relationship is established between the algebraic content and procedures necessary for students in secondary schools, which today can be solved very easily with a graphing calculator. A few examples will be given with the TI-92. Finally, we will insist that even if algebraic procedures will be obsolete in the near future, what will not become obsolete are the algebraic thinking strategies and the reasoning processes that permit us to model as equations situations that are given as verbal descriptions. These not only will not lose their importance with the appearance of graphing calculators; they should, much to the contrary, be the main objective of secondary teaching. Therefore, it appears that a profound revision of the algebra curriculum must be completed in order to adapt it to the future.

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Calculators in the classroom: A look to the future

Bert K. Waits, Franklin Demana

Computer symbolic algebra software on hand-held computers like the Texas Instruments TI–92 will likely become as popular as scientific calculators are today. Many paper and pencil computation methods learned today should become obsolete necessitating many changes in the mathematics curriculum of the future. The mathemat-

ics curriculum of the future can focus more on problem solving, applications concepts, and understanding.

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The change of the method in mathematics education with TI-82 in Japan

Shin Watanabe

Up to now Japanese mathematics education has been focused in formality and abstract notions, with a lot of time spent doing calculations. This has to change, and the introduction of the graphing calculator might help in this process. With graphing calculators, mathematics teaching and learning becomes interesting. In this paper this is shown through examples in which the calculator is used in precalculus, differential calculus and problem solving. Now many students can see and touch the mathematical knowledge using the calculator, and enjoy their time in the mathematical lessons.

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