

MATHEMATICS EDUCATION

Integrating Technologies

By Eric Muller, PhD

During the 20th century, we have experienced tremendous growth in technologies, and some, for example the telephone, impact our daily lives. The development of these technological advancements would have been impossible without the direct or indirect application of mathematics. Unfortunately, mathematicians and scientists have failed to communicate the vital role of mathematics in these innovations. Few people are aware that new mathematics has been and is being developed to solve problems arising

from the development and use of new technology.

We know the word processing programs have had a great impact on writing and communicating. There have been comparable software developments for doing mathematics as well. Powerful programs, called computer algebra systems, manipulate not only numbers but also graphs and symbols using the rules of mathematics. These systems can help solve both simple and complex mathematical problems. Other computer programs are available to perform statistical analyses of very large data sets. These

programs, designed by mathematicians, are now being integrated into the classroom by educators who examine how students use the programs in their learning of mathematical concepts.

In recent years, educational mathematics software has been designed specifically for the mathematics classroom to help students develop their understanding of mathematical concepts. Examples of these are Geometer's Sketchpad (GSP) for geometry, Fathom for statistics, and Journey Through Calculus (JTC) for calculus.

Learning and doing mathematics using technology provides a dynamic

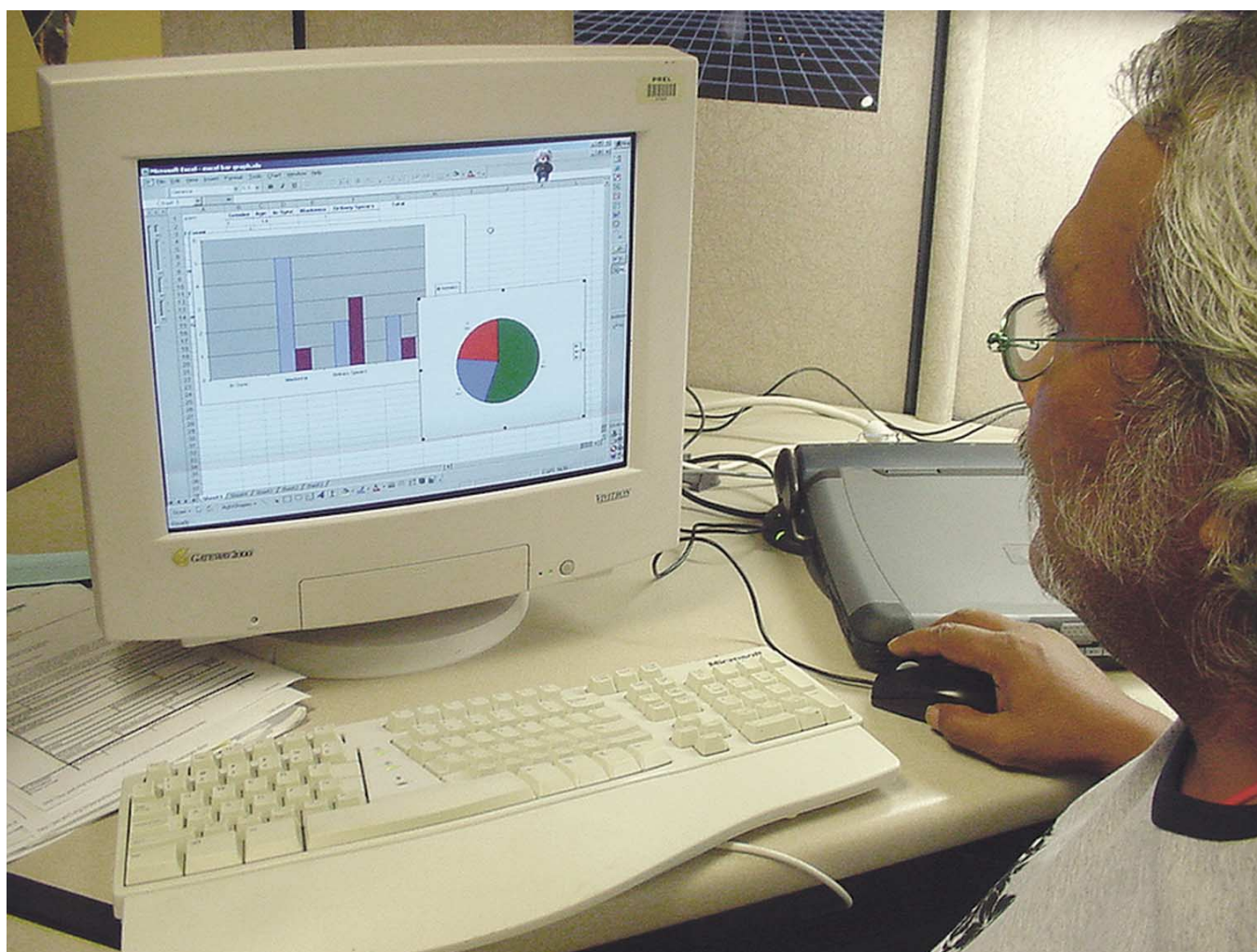


Photo: Kavita Rao

▷ Computer programs capable of manipulating numbers, graphs, and symbols are designed for use in mathematics classrooms.



environment rarely possible with a pencil and paper. When students do geometry with GSP, they can manipulate geometric objects, thereby generating hundreds of different diagrams. From this activity, students can see which properties of the object change, and which ones stay the same. The study of invariant properties of mathematical objects is fundamental in all branches of mathematics.

Recently developed mathematics education software engages students first in a game or an activity, and then leads them to explore and develop an understanding of mathematical concepts. Less ambitious software, called learning objects, focuses on mathematical concepts the teacher can introduce at appropriate times. Examples of these can be found at the Brock University website, www.brocku.ca/mathematics/resources/learningtools/learningobjects. This type of software requires little teacher intervention and is single purposed. Such is not the case for comprehensive software like spreadsheets that a student can use in a variety of classes and for different applications.

The ability to choose wisely among a number of alternatives is an important life skill that can be developed in the classroom. Mathematics teachers should help develop this skill by placing students in situations requiring decision-making. For example, when students tackle a math problem, they should be encouraged to consider which numerical, graphical, or algebraic representation is most appropriate. Students should also experience alternative technologies, such as manipulatives, calculators, and computer software. As an example in mathematical decision-making, consider the following scenario.

A recent graduate is working for a building contractor. A customer enters the office with the measurements of two rooms to be tiled. To figure the total floor area, should the graduate use a calculator? Not in this case, because the addition could be done mentally or on paper. Another customer comes in who has the linear dimensions of six walls that need to be painted. Should the graduate use a calculator to find the total

wall area? Yes, because there is a sequence of multiplications and additions that would be too tedious to do using only pencil and paper. On another occasion, the graduate is asked by the employer to estimate the cost of building an extension onto a house for a potential customer. The cost of all materials and labor for foundations, floors, walls, doors, windows, and roofing would have to be calculated. A calculator wouldn't be useful here, but a spreadsheet recording the information would do all the arithmetic needed. The spreadsheet would allow the employer to explore, very rapidly and efficiently, changes in material pricing and time. In this example, if the graduate did not have significant experience in the use of spreadsheets in his or her mathematics education, the graduate and the employer would be at a disadvantage, and the customer could be lost.

Technology offers unprecedented opportunities for the mathematics education of today's child, who will be living in a world even more technologically driven than ever. Unlike videos and films, mathematics education software provides dynamic and interactive environments for students. These and other technologies challenge the assumptions in our existing mathematics curricula where the sequencing is largely based on a child's ability to perform certain tasks or techniques. What would a mathematics curriculum look like if the sequence of topics was based on a child's ability to understand mathematical concepts, as they use technology to complete the necessary tasks and techniques? Because this is all uncharted educational territory, the challenge for mathematics educators is enormous. However, denying access to mathematics technology severely reduces the number of different approaches to mathematical concepts. As a result, upon graduation, students may lack the technological experience many employers seek.

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REALITY

*I am a big boy now
I have left school;
But I am a fool still
A poor fool
With books and blackboards
Casting dark shadows
On me;
I look for a little opening
Of light
I hear people laughing
What are you going to do now
With your education and all?
There is the market place
Where the people
Sell their wares
Women chasing flies
From day-old pies.
I cannot do that
I have a certificate
I passed with honours
English, Maths, History and Geography
I learnt them all.
The laughter gets louder
I see my teacher
Sitting on a sterile rock
Near the beach
Selling green coconuts
What do I do now?
An old man close-by whispers,
"Come fishing with me today
For you have a lot to learn yet".
By Konai Helu Thaman*

(Konai Thaman, a native Tongan, is a public speaker on educational issues and a supporter of women's movements. She is a professor of Pacific Education and Culture at the University of the South Pacific.)