



Brock Teaching

News from the Centre for Teaching, Learning and Educational Technologies, Brock University

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Mathematics takes an exciting new direction with MICA program

Right: Professor Bill Ralph stands in front of a projection of one of his mathematically generated images, entitled *Sylphs*.



By Professor Bill Ralph

What's revolutionary, unique in Canada, starts in September and was created by mathematicians here at Brock? Give up?

The answer is Brock's new mathematics program called MICA (Mathematics Integrated with Computing and Applications) that puts Brock in the vanguard in mathematics education. The creation of MICA was an enormous team effort by the mathematics department in which every detail of our program was rewritten from the ground up. To understand the rationale for MICA, let's go "back to basics."



Most people would agree that students should be able to divide 14 by 8 without a calculator. But do they really need to spend hours and hours of valuable class time learning to divide 2348.77 by 139.453 using pencil and paper? A parallel situation has emerged in mathematics courses at universities due to the appearance of powerful computer programs, such as MAPLE, which can do so much of the algebra and calculus we once taught. Fifty years ago, you would be guaranteed a job if you knew how to find the area under curves using calculus. Much of a calculus course would be devoted to

teaching students the hundreds of tricks and algebraic manipulations required to perform those calculations. These days, a Grade 8 student with MAPLE can find such areas faster and more accurately without knowing any calculus at all! So where does that leave the teaching of university mathematics?

In his article in the April 1997 *Mathematics Notices*, renowned mathematician John Conway writes:

"We have to embrace technology, I don't mean just tolerate it; embrace it and celebrate it... The professional mathematics community must adapt and learn how to best incorporate technology into instruction. With the existence of powerful, inexpensive computers, I see mathematics departments rethinking their entire curriculum... Otherwise, we are out of business..."

In order to create a curriculum that makes effective use of technology, Brock's Department of Mathematics began by looking at some of the most successful mathematics programs in North America. That exercise was an important step in defining the goals and objectives for MICA.

"This is an exciting direction for the study of mathematics at Brock," says Professor Eric Muller, Chair, Department of Mathematics. "MICA is a cutting-edge program that will prepare students for mathematics careers in our technology-driven society."

The pedagogical goal of the MICA program is to help students internalize a unified framework of mathematical concepts by interpreting them computationally, visually and algebraically. Lectures will focus on motivating and applying mathematical concepts as much as possible. To encourage creativity, our MICA courses will challenge students with interesting projects that require them to develop their own strategies for handling complex real world mathematics problems. To help them understand the relevance of the mathematics they have learned, students will regularly prepare projects based on data from researchers in other departments.

With its special attention to the role of technology, the MICA program will be unique in Canada and of particular interest to students looking for careers involving applications of mathematics that require technology. We expect our students to be in demand for their ability to apply, interpret and present mathematics using modern tools. Our new graduates will meet the need for mathematicians who are computer literate and we anticipate them making significant contributions to the practice, creation and teaching of mathematics. We are looking forward to welcoming the first students this coming fall.

Guiding principles of MICA

1) *Encourage Creativity and Intellectual Independence.*

The new MICA courses in first, second and third year will constantly present students with applied problems which require experimental and heuristic approaches. In these situations, students will be expected to develop their own strategies and make their own choices about the best combination of mathematics and computing required to obtain approximate solutions.

2) *Develop mathematical concepts hand in hand with computers and applications.*

All students in the MICA program must learn a programming language in first year. This programming language, along with programs like MAPLE and statistical packages like SAS, will be used intensively in the MICA courses to explore mathematical concepts and applications.

3) *Guarantee Prerequisites.*

A detailed course outline and a minimum skill set was written for each course. Instructors can look at the minimum skill sets for prerequisite courses and be reasonably certain that students have a solid background in those concepts.

4) *Strengthen our BSc/BEd program.*

The concurrent program in mathematics and education has been very successful at Brock and attracts some of our best students. A very exciting aspect of the new program is that those future teachers will now learn to design and create educational computer programs that their students can access over the net. We expect graduates of our teaching program to be leaders in the use of technology in the classroom.

5) *Create upward mobility.*

Course prerequisites have been kept to a minimum in order to maximize the program's flexibility and student's options. Many of the third-year courses are accessible with first-year prerequisites.

6) *Strengthen ties with other departments.*

One of the first things in developing the new program was to send out questionnaires to departments interested in our courses. This feedback was useful in constructing the new courses and joint programs.



Brock University

Careers begin here!