Overcoming Another Barrier

Real Women Don't Do Math

BY PAT ROGERS

*Pat Rogers, National Coordinator for the International Organization of Women and Mathematics Education, and Academic Director of the York Centre for the Support of Teaching, reports that while feminist pedagogy is influencing the way math is being taught in schools, and more girls are doing math, women are still vastly underrepresented in math and science programs and professions. Canada's growing shortage of workers with scientific and technical training could be alleviated if more women specialized in these fields. As Rogers' 1985 article (*Affirmative Action, *Vol. 6, No. 4) explains, there are many social and psychological pressures contributing to math avoidance in women, but the decisive factor is the way math has traditionally been taught and experienced in the classroom. Her criticisms and observations still apply in 1991 but progress is being made as feminist pedagogy provides alternative classroom cultures and ways of learning.*

The math conference for Grade 10 girls described by Rogers, became a prototype for "Women Do Math," a similar conference held at Simon Fraser University in Burnaby, B.C. for the past four years. Others have grown out of the Simon Fraser conference, and in 1990 "Women Do Math" local conferences were held in Campbell River, Kamloops, Fort St. John and Terrace in B.C., and in Whitehorse in the Yukon Territory. These conferences report the same success in getting Grade 9 and 10 girls enthusiastically involved in doing math.

In terms of simple economics, to be competitive in the increasingly technological job market, women need to do math. That they can do math is certain; that feminist pedagogy is providing them the opportunity is encouraging.

"Real Women Don't Do Math" was the title of a three-day residential mathematics conference for grade 10 girls held at York University last June.[1] The broad aim of the conference was to provide the girls with a positive experience in mathematics among people who, either because of their own involvement with mathematics or because of their general attitudes, find it perfectly normal, acceptable and desirable for young women to be interested in mathematics and good at it. As expected, the girls had a wonderful time.

What has all this to do with affirmative action? In this article I will argue that encouraging women to continue the study of mathematics through the final years of high school is a crucial prerequisite for effective affirmative action. I will also show that women who avoid mathematics do so in response to a dissonance they experience between the way mathematics is usually presented and the way they prefer to make sense of the world.

Affirmative action is a bit of a conundrum. Aggressive hiring practices that benefit women can address present imbalances in the paid labour force, but they will have no impact whatsoever if women are ill-equipped to enter today's technological job market. While some companies, such as Warner-Lambert, do pursue policies of identifying and retraining promising women to fill more responsible and higher paid jobs, such policies are by no means widespread. Many women will have to retrain in their "spare time," and, in a society where women still assume the primary responsibility for the home and child care, this is neither feasible nor desirable. A further difficulty that adult women may face is having to pick up the necessary mathematical skills which are the foundation for most retraining programs.

By grade 13, girls form an alarmingly small proportion of the total enrolment in mathematics courses.[2] Yet there is evidence to suggest that many girls have quite high career aspirations, unaware that their rather vague plans will necessitate a mathematics background. Affirmative action may open doors wider and offer more possible career paths than in the past, but if girls avoid mathematics it will be very difficult for them, as adults, to take full advantage of such opportunities. Thus it is urgent that young women acquire mathematical skills at school where they have the opportunity, the study habits, and the freedom to do so.

Why do some women avoid mathematics? This is a complex problem with many causes. Our conference was designed to confront three of the main factors. The easiest ones to address are the general ignorance of the importance of mathematics to future career choices, and the social stigma attached to being female and good at mathematics – which is based on the belief that the study of mathematics is a male prerogative. The model we used to treat these issues is provided by "Expanding Your Horizons in Science and Mathematics," a one-day conference held at Mills College, Oakland, California, for young women interested in new career options.[3] This model uses a variety of panel discussions and hands-on workshops to increase awareness of the vast number of careers which require a mathematics background, and to provide girls with appropriate female "role models" (that is, women working in traditionally male occupations who have trans-

cended the social stigma of being mathematical but who are otherwise quite "normal").

By far the most serious factor contributing to mathematics avoidance is the commonly-held view of mathematics as a collection of rules and procedures handed down from above by someone ("The Authority") who knows all the right answers. Such a view of mathematics is fostered by the way mathematics is taught.

But isn't this the way mathematics is? No, not to those who *do* it. Doing mathematics *really* involves searching for patterns, making connections, leaping into the unknown without any idea of how you will survive or what the outcome will be. It can mean spending days and days working on your own with only a mound of waste paper to show for it, but it can also mean hours of intense communication with a friend who helps you, often in some inexplicable way, to see through a mess of seemingly unconnected facts and figures and relationships. The process I describe is at times tortuous, but the moment of discovery when everything falls into place is fabulous. Yet this is not the view of mathematics that is presented in the classroom. Classroom mathematics is beautifully polished and ordered, received rather than created. There is no hint of the mental and emotional anguish that preceded its discovery, no hint of the personalities involved or the real-world questions that inspired it.

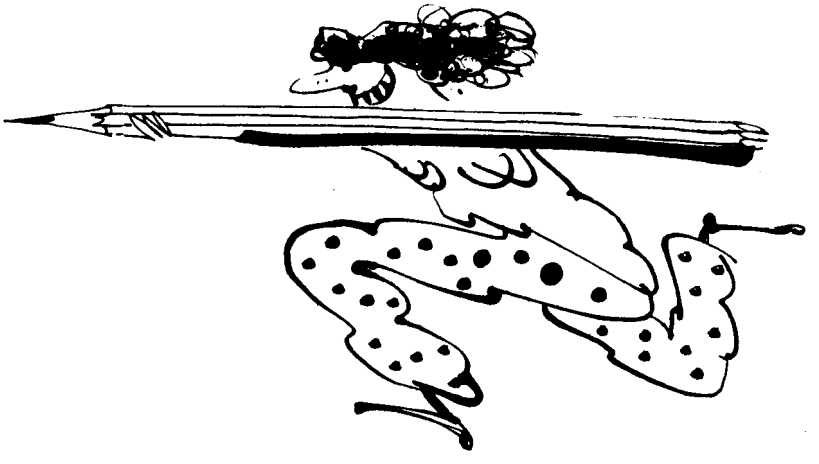
People who are taught mathematics in this handed-down fashion often experience the mathematics classroom as a stress-filled arena where they are rarely ever right and where their self-esteem is trampled on. Little that goes on bears any relationship to their experience of the outside world, and their self-confidence is reduced to such an extent that it becomes extremely painful, if not impossible, for them ever to risk their ideas in public. The situation I describe is possibly quite extreme, but there are aspects of it that most of us would recognise. Do teachers do this on purpose? I think not.

Most teachers really care about their students, but they, too, have been affected in adverse ways by their own experience with mathematics. For many elementary teachers, teaching mathematics is extremely stressful. Most of them are not specialists in mathematics and their confidence in their mathematical ability is far too shaky to allow for discovery in the classroom. Thus, despite the influence of Piaget, elementary classrooms are rarely organised to provide an active, exploratory mathematics program where understanding is enhanced by social interaction with peers. The same can also be said of many high schools were the teachers are unlikely to have experienced the creative process of mathematics themselves and merely ape the kind of lecturing they were exposed to at University. I believe that most of the responsibility for fostering negative attitudes towards mathematics rests elsewhere: with those mathematicians and text-book writers who never expose the messy workings of their minds to public scrutiny, and thus shield us from the discovery that mathematics is not certain and secure, that some questions have no answers (or at least not the ones we expect), and that the solutions we do have were not arrived at in the effortless, orderly and systematic way they would have us believe.

Boys and girls are both presented with the same stultifying view of mathematics. Why, then, are girls turned off more than boys? Career expectations and socialization, of course, play a large part, but I believe that deeper factors having to do with women's psychological development are also at work. Trained to accept and defer to authority, we readily embrace the view of mathematics handed down in the classroom. However psychologists, such as Carol Gilligan, point out that the experience of mathematics presented in this way is in total conflict with the way most women choose to relate to the world. While men are trained to get pleasure from abstractions, stripped of context, women arrive at understanding by forging connections with personal experience, not through the application of a system of rules.[4]

I wanted the girls attending our conference to be involved in *doing* mathematics. The girls worked in groups of five or six, alongside a mathematics professor and an undergraduate student. Together they worked on "real" problems where the solutions were not immediate or intuitively obvious and where all the hard work was not directed towards finding the answer they already knew, using the required method. The conference culminated with final presentations of the solved problems. No one expected that every girl would take part in this and, certainly, nobody was pressured to do so. However, in spite of the fact that some girls were adamant all along that they would not be involved in the final presentations, when the time came everyone was. Some were nervous, others surprisingly confident; but it was a very exciting experience for everyone involved. The presentations were wonderfully alive.

The final evaluations of the conference indicate a significant improvement in attitude towards mathematics. But let's not get carried away: the conference was a rarefied experience and provided three days away from the regular school routine and the same old faces. No matter how



exhilarating this experience may have been, it is only a beginning and its impact on the girls may well be eroded with time. Changing attitudes is a difficult and lengthy process. Changing the way we teach mathematics is a crucial step. Mathematics must be experienced as a creative endeavour, within a human and historical context, and in an environment where the teacher is a facilitator of learning rather than "The Authority."

Ironically, the way women prefer to reason is ideal for doing mathematics. Yet the combined effect of our socialization and the way we are forced to perceive mathematics keeps it out of our lives. Recognizing the "different voice" of women in the way we teach is vital. My own attempts to teach in this way have been encouraging, and I derive much hope from what I have recently learned about the mathematics program at Potsdam College in New York State. At Potsdam the proportion of B.A. degrees that are in mathematics is fifteen times the North American average – and more of these degrees are awarded to women than to men! Their way of teaching mathematics is not exactly what I am proposing here, but it is much closer in spirit than is the traditional approach. The faculty are dedicated to teaching and explicit in their concern to create an open, caring environment where their students can learn how to *do* mathematics rather than to receive information.[5]

Affirmative action takes place not only in the job market but also in our classrooms: it is there, where attitudes are formed that can have serious consequences for the rest of our lives, that we prepare our children to take their place in the world.

[1]Coordinated by Susan Scott, New Initiatives Officer, and chaired by Pat Rogers, a professor in the Department of Mathematics and the Faculty of Education, the conference was organised in cooperation with the North York Board of Education as part of the WISH (Women in Science, Hopefully) program. Funding was provided by the North York Board of Education, the Ontario Women's Directorate, Warner-Lambert Canada Inc., and York University.

[2]See, for example, *Mathematics: The Invisible Filter, a Report on Math Avoidance, Math Anxiety and Career Choices* (Toronto Board of Education, 1982).

[3]Joanne Koltnow, *Expanding Your Horizons in Science and Mathematics, Conferences for Young Women Interested in New Career Options, A Handbook for Planners*, available from Mills College, Oakland, California.

[4]Carol Gilligan, *In A Different Voice: Psychological Theory and Women's Development* (Cambridge, Massachusetts: Harvard University Press, 1982), p. 29.

[5]John Poland, "A Modern Fairy Tale," in *Four Papers on Mathematics Education*, (Carleton-Ottawa Mathematical Lecture Note Series, 5 May 1985).