Secondary Mathematics Education Curriculum Developments: Reflecting on Canadian Trends

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I recently attended a professional meeting where a conversation focused on the potential changes in the Western and Northern Canadian Protocol (WNCP) secondary mathematics curriculum. The suggestion was made that Alberta drop its applied mathematics courses in favour of returning to the Mathematics 10–20–30, Mathematics 13–23–33 and Mathematics 14–24 programs of the early 1990s. I was saddened to hear this conversation.

I am a mathematics teacher educator in Saskatchewan, a province that does not have an applied or consumer mathematics program. There is one mathematics program for all secondary students. Most of the teacher candidates in the teacher-education program at the University of Saskatchewan are graduates of the provincial system. I am saddened when I hear about their experiences in the secondary mathematics program—experiences that have led many of them to believe that they cannot "do" mathematics. Yet, the teacher candidates who tell these stories are the elementary mathematics teachers of the future, the teachers who will be expected to excite children and help them develop a passion for mathematics.

A 1981 report by the Council of Ministers of Education, Canada (CMEC) provided the impetus for provinces and territories to consider how they might humanize mathematics (Wheeler 1982) through their curricula. O'Shea (2003) describes the recommendations of the CMEC report as follows:

> The use of applications as a motivation for learning mathematics and as an experience in using mathematical models received increased emphasis. Respondents asserted that this reflected an effort to link the mathematics of the classroom to the real world in the interest of helping students see the practical uses of mathematics, understand the relationship of mathematics to other disciplines, and understand more clearly the mathematical ideas themselves.

O'Shea continues,

> In general, the trends at this level reflected a reduction of emphasis on rigor and formal structure. The reason usually given for this was that students might not be ready for formalization until they had developed concepts through informal approaches, including finding patterns, working with physical models of mathematical concepts, and using other manipulable aids. The result was an evolving mathematics curriculum that included emphasis on topics such as numerical skills, applications, and problem solving, and an accompanying de-emphasis on abstract topics such as set theory and algebraic manipulations.

Across Canada we see mathematics curricula that include a focus on problem solving, applications and the development of mathematical concepts from a concrete approach; the design of programs intended for students who are postsecondary-bound but are not going into science and mathematics; and the inclusion of computer technology (O'Shea 2003). Below are examples of how the provinces and territories have responded to the CMEC report and taken a more humanistic approach to mathematics.

Applied Mathematics

To address the needs of postsecondary-bound (but not necessarily science- or mathematics-bound) students, the Western Canadian Protocol (WCP) (now the WNCP) developed a series of three courses called applied mathematics. The curriculum document states that the "applied clusters . . . emphasize applications of mathematics rather than precise mathematical theory. The approaches used are primarily numerical and geometrical" (WCP 1996, 19). Throughout the applied mathematics courses, students are engaged in projects and activities that explore the mathematics in a given context. The textual resources that support the courses are filled with projects and laboratory

activities. Students are encouraged to work collaboratively throughout the courses, and the mathematical ideas are expected to be developed from the numerical and geometrical approaches.

An example of an applied mathematics expectation is "Use properties of circles and polygons to solve design and layout problems" (WCP 1996, 107). Students might work on a problem such as the following:

> The pattern on a piece of vinyl flooring consists of a square and four equilateral triangles. Each equilateral triangle has as its base one side of the square. Circles are inscribed in each triangle and in the square.
>
> a) Start with a square of side length 6 cm. Draw the design, full size.
> b) Determine the ratio of the area of the small circle to the area of the large circle. (p 107)

In the Atlantic Canada collaboration, the applied mathematics courses start in Grade 10, similar to the WCP collaboration. In Ontario, an applied mathematics course has been developed for Grade 9.

Consumer Mathematics

A second area in curriculum development for students who may or may not be university- or college-bound is the development of consumer or basic mathematics courses for Grades 10–12. Currently, three provinces (British Columbia, Manitoba and Ontario) and the three territories have adopted such courses. An example of a Grade 12 consumer mathematics curriculum outcome is "Develop, use, and justify mathematical strategies by analyzing puzzles and games" (Manitoba Education 2004). (As a side note, Manitoba Education has negotiated with its postsecondary institutions to accept consumer mathematics as a general admission requirement into postsecondary programs that are not mathematics intensive.) In Ontario, the courses are called Mathematics for Everyday Life and are referred to as workplace-preparation courses (Craven 2003).

Role of Computer Technology

The use of graphing calculators has been evident in the curricula of most provinces and territories since the early 1990s. More recently, however, computer technology has played a more prominent role in secondary mathematics. Across Canada, secondary mathematics students are expected to learn to use spreadsheet programs and geometry software. You will see curriculum expectations such as "Students will solve problems using spreadsheet functions and templates" and "Students will use geometry software to develop the geometric properties of circles."

Reflection

The mathematics education community and curriculum developers must not give up on the idea of investigating mathematics from a variety of perspectives. I believe that when we offer secondary students a variety of ways to see mathematics, they will begin to see themselves as mathematical beings and recognize that they, too, are part of the mathematical community. The development of programs such as applied mathematics and consumer mathematics and the use of computer technology in mathematics classes invite students to be engaged in mathematics from multiple perspectives.

Kissane (2002, 191) notes Wheeler's (1982) prophetic suggestion of more than 20 years ago that "mathematics teachers were in the midst of three major educational upheavals: mass secondary education, the rise of new and available technologies, and the revolution of humanizing mathematics." In Canada, we could say that in the past 20 years secondary mathematics curriculum development has also been in the midst of these three upheavals. I believe that secondary mathematics curriculum development has been addressing "the rise of new and available technologies" and "humanizing mathematics" in order to address "mass secondary education." Generally, we now see secondary mathematics curricula that include the use of technology (not just computer and calculator technology) to study mathematics and the introduction of courses, such as applied and consumer mathematics, that humanize mathematics.

We must continue to look for ways, through secondary mathematics curriculum development, to humanize mathematics. We must work hard as a profession and engage in problem solving to overcome issues around implementation and postsecondary acceptance of mathematics courses other than those labelled as pure mathematics in order to begin to make a difference in how our students view themselves within the mathematics community.

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