

The Canadian Mathematics Curriculum
from New Math to the NCTM Standards

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In Canada, education is the responsibility of the provinces. In effect this means that there is no "Canadian" education system; rather, there are ten provincial and two territorial systems. Education in each jurisdiction is controlled to a greater or lesser extent by a ministry or department of education of the provincial or territorial government. Each ministry has its own mandate--and these vary greatly--to establish curricula and to evaluate student performance. In most provinces, the ministry provides detailed curriculum guides for each subject area; about half the provinces require students to write centrally set and marked examinations as part of the final evaluation for high school graduation. There is no national office of education.

Such circumstances make it difficult to set out a "Canadian" history of the school curriculum. Nevertheless, there are similarities in the ways the provinces develop and examine curricula, and some measure of common purpose can be ascertained by examining curriculum guides, research reports, provincial mathematics teacher journals, and, more recently, international studies of mathematics curriculum and achievement. For this chapter, it is assumed that three provinces, British Columbia, Ontario, and Québec are broadly representative of the Canadian scene. The first two are the most populous English-speaking provinces and have somewhat different approaches to curriculum. The province of Québec is unique within Canada, having its own linguistic, cultural, and educational traditions. Together, these three provinces constitute approximately 70% of the Canadian population.

A further factor confounding the interpretation of the Canadian scene is the variety of ways in which the school systems are organized across the country. The final year of secondary schooling in 1980, for example, for the three provinces mentioned above were Grade 12 in British Columbia, Grade 13 in Ontario, and Grade 11 in Québec. A summary of the organizational structures conceptualized for curriculum

purposes, as of the year 1980, is presented in Figure 1. It should be noted that some provincial systems changed over time--Ontario, for example, eliminated Grade 13 in the late 1990s. Moreover, Figure 1 does not convey all the within-provinces variability in school organization. In Saskatchewan, for example, elementary schools typically enrolled Grades 1 to 8 and secondary schools were for students in Grades 9 to 12. By the late 1990s, a number of provinces were experimenting with middle schools, and this further blurred the boundaries between traditional elementary and secondary school configurations.

[Figure 1 not available for this document]

The curriculum model which serves as an organizing framework for this chapter was adopted from the Second International Mathematics Study (Travers and Westbury 1989, p. 6). In this model, curriculum can be thought of as intended (by curriculum developers), implemented (as realized in the classroom), and attained (as demonstrated by student achievement and attitudes). The focus of this chapter will be on the intended curriculum, as determined through an examination of official documents and journal articles. Some attention will be given to the implemented curriculum, as described in research reports and assessment documents. The attained curriculum will be briefly addressed as part of the ongoing controversy regarding standards of performance.

The time period covered in this chapter, with the exception of British Columbia, spans the early years of the "new math" period in Canada (the 1960s) to the end of the twentieth century. Events will be discussed over two periods of time, with the publication of the National Council of Teachers of Mathematics' (NCTM) *Agenda for Action* in 1980 marking the boundary between the two. That year also coincides with the undertaking of a major review of mathematics curriculum across Canada which

provides a comprehensive picture of mathematics education in the country at that juncture.

MAJOR THEMES

In identifying and describing material in this chapter, I have been painfully aware of the needs of two, possibly disjoint, audiences. The first is the reader who wishes to obtain a general picture of developments in Canada. The second is the future researcher who may wish to use this chapter as a resource to investigate specific issues in the Canadian mathematics curriculum. It is difficult to strike a balance between the needs of these two readers, and I may have tipped the scale in favor of the researcher.

In either case, it will be helpful to know in advance what themes will be adduced from the data. The historical details, which are presented, for the most part, chronologically by province, can then be assessed to determine whether or not they are related to the hypothesized major curriculum developments across the country. Evidence in support of the themes will be summarized and discussed in the concluding section of the chapter.

I will argue that the nature of mathematics curriculum making in Canada changed dramatically over the second half of the twentieth century. The changes took a number of different forms: from individual provincial curricula to a nascent national curriculum; from an almost secretive bureaucratic process to an open process in collaboration with teachers; and from a view of curriculum as a syllabus or list of content topics to the view of a curriculum as a guide to content, teaching, and evaluation. The content of the intended curriculum also changed, and those changes were consistent with changes taking place in other countries, but attenuated. Canadian jurisdictions passed through the stages of the new math, back to basics, problem solving, and the NCTM Standards (e.g., NCTM 1989). New topics were added to the

curriculum, most notably statistics and probability, and curriculum developers wrestled with the problem of technology and its role in teaching mathematics.

Curriculum developers struggled with the issues of what mathematics was suitable for which students. In general, more mathematics became required of all students. Furthermore, within each province the curriculum common to all students shifted from the end of elementary school to a later stage in school, typically to the end of Grade 9. The mathematical curriculum for students not intending to pursue post-secondary education continued to be a problem, and appeared to remain unresolved.

In spite of mandated and suggested changes in the intended curriculum there were fewer changes in the implemented curriculum. There is doubt as to the extent to which teachers embraced problem solving or the use of technology. There is evidence that the teaching of statistics was slower to develop than the formal curricula would suggest.

Student levels of achievement, a measure of the attained curriculum, appeared to be stable across time. Moreover, they compared favorably, for the most part, with other countries and educational systems.

These, then, are the "big ideas" for this chapter.

{Body of report deals with curriculum developments over the last 40 years in British Columbia, Ontario, and Quebec, and the formation of the Western Consortium and the Atlantic Provinces Education Foundation.}

CONCLUSION

A number of important developments specific to the Canadian curriculum scene were foreshadowed in the introductory section of this chapter and can now be elaborated. The most striking changes are concerned with the intended curriculum and the process by which it was developed.

The Mathematics Curriculum

Traditionally, Canadian provinces have jealously guarded their independence in educational matters. In some cases, for example in British Columbia in 1936, it was a matter of pride to point to the perceived excellence of the local product. Late in the twentieth century, however, as financial resources dwindled and modern communication in the form of the internet developed, pressure was exerted to develop curriculum on a regional basis as demonstrated by the initiatives of the consortia in western and eastern Canada. In retrospect, the 1981 project of the Council of Ministers of Education, Canada may have served as a catalyst for these developments.

The NCTM Standards have been clearly demonstrated to be a major influence in curriculum design. They formed the kernel about which curriculum reform coalesced. Their influence was evident in the provincial curriculum documents and within the frameworks set out by the two consortia. The result was a de facto "Canadian" curriculum, at least for the grades prior to the senior level. This is an astonishing testament to the NCTM leadership who determined in the 1970s to set out policy statements and calls for action in the hopes of influencing policy makers and those responsible for curriculum development.

The eventual construction of a national curriculum seems to be a natural extension of the moves to regionalize mathematics curricula. The forerunner of this possibility in mathematics consisted of the development of a "pan-Canadian" science curriculum under the auspices of the CMEC's 1995 Pan-Canadian Protocol for

Collaboration in School Curriculum (CMEC 1997). Pressure from outside the education system was also being exerted to develop a national curriculum. The Canadian Chamber of Commerce, for example, recommended the establishment of national consortia "to develop a national core curriculum in mathematics and science that would be used on a non-threatening voluntary basis by the provincial and local jurisdictions" (Canadian Chamber of Commerce 1994). They also recommended developing examinations in basic mathematics and science that would monitor how well students, schools, and boards of education meet the national curriculum. While a national curriculum would benefit students moving across jurisdictions and would assure post-secondary institutions and employers that students had been exposed to a common set of learning expectations, as the century ended, there had been little examination of the negative ramifications of such a move. One would have expected, at least, some discussion of the potential elimination of much of the involvement and experimentation of teachers at the local and provincial level. Therein lay the danger-- that teachers would become subservient to a mandated national curriculum and give up their professionalism in favor of working simply as "conscientious employees" (Brochmann 1990) of the system.

Concomitant with the move toward a standardized curriculum was the expectation that more students would take more mathematics during their school years. At the beginning of the period discussed in this chapter it was common that students were not required to study any mathematics beyond Grade 8 or Grade 9. At the end of the period, students were required to achieve at least Grade 11 standing in a mathematics course for school graduation. This increasing expectation of mathematical competence exacerbated the problem of designing suitable mathematical experiences for students with little interest in, or aptitude for, the subject. The decline of traditional trades education in school eliminated most of the alternative mathematics courses,

although accounting remained as an option in several provinces. This problem led to debates across jurisdictions (e.g., within the Western Consortium, where Manitoba called for a common curriculum that would accommodate virtually all students), and within jurisdictions (e.g., in British Columbia, where the controversy continued as to whether the applications of mathematics course sequence was appropriate for what were termed "grey area" students (British Columbia Ministry of Education, Skill and Training 1997)).

The requirement for more mandatory mathematics education for more students also resulted in the extension of the common mathematics curriculum within provinces to a higher grade than formerly. Previously, most provinces allowed students to opt into different mathematics tracks starting in Grade 9. By the end of the century, however, differentiation of curriculum usually began in Grade 10.

The Mathematics Curriculum Guide

The curriculum guide itself was transformed over the years. At mid-century, guides typically took the form of a syllabus that simply listed the mathematical topics that were to be discussed at or across grade levels. In British Columbia, reference was made only to the single authorized textbook for each grade. By the 1990s, however, curriculum guides could more generally be seen as teaching resources. The curriculum was usually defined by a number of increasingly specific learning expectations, each accompanied by a mathematical problem to illustrate what might be expected of students working at that grade level. Guides also contained suggested instructional and assessment strategies, glossaries of terms, and lists of recommended teacher resource materials.

The increasing complexity of classroom and summative assessment resulted in the development of documents for teachers that, while not part of the formal curriculum guides, constituted major supplements to them. The publication of these

documents by ministries of education showed their intent to develop not only the intended curriculum but to influence the implemented curriculum beyond just the teaching of content. One example described in this chapter consisted of Ontario's suggested provincial standards for mathematics (Ontario Ministry of Education and Training 1995) which included samples of holistic performance indicators. British Columbia developed "reference sets" to show teachers how students developed mathematical skills across time and how to fairly assess those skills (BCME 1995). Alberta published a booklet to provide practical examples of "real world" applications of high school mathematics (Alberta Education 1991) and a handbook on assessing problem solving behavior in mathematics (Calgary School District No. 19 1993). Manitoba created sets of detailed standards, including illustrative performance samples for Grade 3, 6, and 9 teachers (see, e.g., Manitoba Education and Training 1996). In general, these documents provided useful addenda to a curriculum increasingly dominated by atomistic behavioral objectives.

The Curriculum Development Process

What was once a secretive process, in which committee members were not allowed to discuss their deliberations prior to official approval, changed to one marked by openness and extensive consultation. At mid-century, when curriculum guides were centered on a single or a few authorized textbooks, advance notice of curriculum change conferred advantage to publishers seeking to have their material selected as the single authorized textbook. By the 1990s, the openness by which curriculum was negotiated was beneficial to two parties: publishers knew that they were able to produce materials congruent with the curriculum, and education authorities were confident that materials would be available for teachers when the changes were put into place.

A second contributing factor to the change was the increasing professionalization of the teaching field. Provincial mathematics teacher organizations grew in strength and sophistication. They were no longer content simply to receive the curriculum, but were insistent on having a say in what was taught and how it should be taught. It may also have been true that, with fewer financial resources to allocate to education, ministries were more willing to devolve part of their traditional operations to the field.

The Match Between the Implemented and Intended Curriculum

Whereas it is relatively easy to determine and analyze with some confidence the intended curriculum, it is much more difficult to assess the extent to which the stated objectives are realized in the classroom. The implemented curriculum can only be determined through classroom observation and student and teacher self-report. Although few studies in Canada have been undertaken in this regard, they suggest that teachers may have been more influenced by the textbooks they used than by the official curriculum guide. The Russell et al. (1975) study in Ontario, for example, showed that far fewer changes had occurred in classrooms than might be assumed by examining the official curricula. Dirks (1986) in British Columbia found wide variation among Grade 8 teachers in the emphasis they placed on arithmetic, algebra, and geometry, and concluded that teachers using a textbook that placed more emphasis on a particular content area tended to spend more time on that content area in their classes. Program assessment reports in British Columbia in the 1980s consistently pointed out the discrepancy between teachers' self-reports of what they taught and what was suggested in official documents, and expressed concern about the lack of time teachers devoted to geometry, probability, and statistics, all topics new to the curriculum.

On the other hand, the results of the 1990 British Columbia Mathematics Assessment indicated that Grades 4, 7, and 10 teachers covered or intended to cover at

least 85 percent of the prescribed curriculum (Robitaille, Schroeder, and Nicol 1991). This may have reflected the growing match between the content of authorized textbooks and the ministry's curriculum.

The Attained Curriculum

As of the end of the twentieth century, Canadian universities, unlike those in the United States, did not require students to sit a common examination such as the Scholastic Aptitude Test (SAT). It was, therefore, more difficult for the news media in Canada to focus attention on perceived trends in mathematics achievement. Furthermore, since provinces were not in agreement on the need for students to pass external examinations for school graduation, little information was available on the relative performance of students across the country. Although some provinces took part in various international studies, participation was idiosyncratic and the studies varied in quality. Nagy (1996) analyzed "Canadian" performance on the mathematics and science studies undertaken by the International Association for the Evaluation of Educational Achievement (IEA) and the International Assessment of Education Progress (IEAP). He concluded that, at the elementary level, Canadian achievement was consistently within the top half or third of participating countries. End-of-school results, however, were more difficult to interpret given the large differences among countries in enrolment and retention rates.

Studies within provinces suggested that achievement levels were stable for topics that remained constant in the curriculum. Hedges's (1977) study in Ontario showed improvement from the 1930s to the 1970s for students in Grades 5 to 7, and a decline for Grade 8 students. The British Columbia assessment studies consistently demonstrated stability of achievement over the period from 1976 to 1990. By 1989, however, the Council of Ministers of Education, Canada, had become sufficiently concerned about the lack of comparability across provinces that they initiated the

School Achievement Indicators Program. The first mathematics assessment was conducted in 1993, and the report (CMEC 1993) showed generally consistent performance across provinces. Québec francophone students, at both ages 13 and 16, seemed to be superior to their counterparts in other provinces, both in mathematics content and in problem solving. This study may have been more significant in the fact that it came about at all rather than in its findings. This was the first time the Canadian provinces had achieved consensus on the elements of a national assessment program in the core areas of reading, writing, mathematics, and science.

Summary

The changes in the mathematics curriculum in Canada over the second half of the twentieth century paralleled curriculum movements worldwide. Canadian provinces experienced the euphoria of the new Math movement, and the subsequent sobering reaction from those proposing to return to a stronger emphasis on the basics. They also responded to the calls for change contained in the NCTM *Agenda for Action* and made problem solving central to the mathematics curriculum of the 1980s. Finally, the influence of the NCTM Standards in the curriculum of the 1990s has been evident in the events described in this chapter. At the same time, however, the Canadian swings in curriculum were muted compared to comparable movements in the United States. Because curriculum decision-making is centralized within provinces, and subject to considerable deliberation before implementation, it takes longer to effect curriculum change in Canada than in more decentralized jurisdictions. In a sense, this is a phase delay in the reform cycle that gives Canadians more opportunity to weigh the benefits and disadvantages of trying to institute particular reforms. Change, when it is proposed, is in a less intense form than it otherwise might be, and may be more palatable to teachers whose task it is to implement the changes.

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