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Analysis of an Abandoned Reform Initiative: The Case of Mathematics in British Columbia

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Abstract

Throughout this era of greater educational accountability, assessment researchers have argued that large-scale comparative assessment data can enhance learning within and across systems of education and can foster reforms based on the practices of high achieving jurisdictions. Other researchers are less optimistic, warning that educational reform is fraught with danger. This paper explores an unsuccessful British Columbia Ministry of Education initiative to reform its mathematics curricula. This case study illustrates the myriad factors which prevent the success of planned reforms.

Introduction

Over the past decade, education systems around the world have undergone unprecedented levels of reform (Calderhead, 2001; Holt, 2001; Massell, 1998). As a result, large-scale assessment has become the "vehicle of choice" for promoting accountability within our public schools (Earl & Torrance, 2000, p. 114). Researchers have argued that national and international large-scale assessments can "enhance learning within and across systems of education" (Plomp & Loxley, 1994, p. 176) by enabling policy-makers at all levels to see their systems in an international context and to initiate reforms and policies based on the practices of high achieving jurisdictions (cf. Beaton, Martin & Mullis, 1997; Schmidt & Burstein, 1993; Schmidt & McKnight, 1998; Stigler & Perry, 1998).

Following this line of thinking, assessment researchers have investigated multiple factors impacting differential assessment outcomes observed across education systems, including: teaching load (McKnight, 1987); teacher qualifications (Robitaille, 1990); instructional differentiation, such as tracking and streaming (Ma & Willms, 1999; Robitaille & Garden, 1989; Stevenson, 1998); retention rates (Husén, 1967; Miller & Linn, 1989); opportunity-to-learn (Lapointe, 1989 & 1992; Schmidt & Burstein, 1993) and curricular variations (Linn & Baker, 1995; McKnight, 1987; Schmidt, McKnight, Curtis & Raizen, 1997a; Schmidt, McKnight, Valverde, Houang & Wiley, 1997b; Valverde & Schmidt, 1997-8).

In 1987, McKnight undertook one of the first comprehensive investigations into why American children consistently rank below most other industrialized nations on international mathematics assessments. He found that, in addition to having teachers with higher-than-average teaching loads, American students were also disadvantaged by the “spiral curriculum.” Proposed by Bruner (1961), the spiral curriculum “revisits” basic concepts each year for a “continual deepening” of student understanding. But for McKnight, although Bruner’s logic was “simple, elegant and intellectually appealing”, the “implemented spiral” was merely a fragmentation of “computationally-oriented content” (p. 97). McKnight argued that this curricular fragmentation had spawned an emphasis on topic breadth at the expense of topic depth. “Content and goals linger from year to year so that curricula are driven and shaped by still-unmastered mathematics content begun years before" (p. 9). As a result, curricular goals remain unfocused and there is no expectation for student mastery.

Other researchers have concurred with McKnight. According to Schmidt, Houang and Wolfe (1999) the "U.S. curriculum lacks focus, is highly repetitive — especially during the middle school years — and does not provide [American] children with a rigorous mathematics and science education by international standards" (p. 29). Valverde and Schmidt (1997-98) have concluded that topic coverage breadth had compromised topic depth resulting in "perfunctory" subject matter treatment.

Evidence would suggest that these researchers were not far off the mark. A case in point is the grade eight curriculum. The average number of mathematics topics mandated by American eighth grade curriculum guides is approximately 44, whereas other TIMSS countries average approximately 30, with some as low as 11 (Cogan, Houang & Wang, 2004). According to Cogan et al. (2004) little coherence exists across American curricula, textbooks or teaching, since items are presented

> one after the other from a laundry list of topics prescribed by state and local district guides, in a frenzied attempt to cover them all before the school year runs out. This is done with no regard for establishing the relationship between various topics or themes on the list (p.3).

Valverde and Schmidt (1997-8) have demonstrated that in countries where achievement is high, there is no repetition of the fundamentals from year to year as in the U.S. Rather, new, more complicated topics are carefully built up emphasizing links to past learning, without repeating the past in its entirety. The time devoted to revision and repetition in the average American curriculum is significant, since curricular differences yield "subtle differences in goals, textbooks, and instruction" as well (Schmidt, Jakwerth & McKnight, 1998, p. 524).

Interestingly, whereas much comparative curricular research has taken place in the U.S. no research to date has compared Canadian jurisdictions. Indeed, in 1999, Canadian researcher Willms noted that for well over a decade Francophone students from Quebec had been significantly outperforming other students on national and international mathematics assessments, yet there had been "little effort to systematically examine why" (p. 480).

Purpose of the Study

Willms' (1999) observation — as well as growing recognition of links between curriculum and achievement — sparked an interest in mathematics reform among British Columbia's education officials. In 2000, the B.C. Ministry of Education initiated a project to compare British Columbia's and Quebec's mathematics curricula. This paper tells a tale in two parts. The first part reports on the comparative research project commissioned by the B.C. Ministry of Education in 2000 (B.C. Ministry of Education, 2000). Although the research illustrated significant curricular differences between the two provinces, the ministry's reform initiative was short-lived. The second, and arguably more revealing, part of this paper analyzes the fate of B.C.'s reform initiative and discusses the barriers which have been found to prevent educational reform. In the case of British Columbia, neither large-scale assessment outcomes, nor a better understanding of the practices of a higher achieving jurisdiction succeeded in enhancing learning – in spite of assessment researchers' hopes otherwise. (cf. Beaton et al., 1997; Plomp & Loxley, 1994; Schmidt & Burstein, 1993; Schmidt & McKnight, 1998; Stigler & Perry, 1998). Instead, British Columbia's short-lived mathematics initiative ran aground on the jagged shores of top-down educational reform (cf. Fullan, 1991; Harris, 2000; Reynolds, 2000).

Part I: British Columbia's Reform Initiative: The Research Project

From 1988 to 2000, students across Canada participated in five national and international mathematics assessments. These included the 1993 and 1997 School Achievement Indicators Program (SAIP) administered by the Council of Ministers of Education, Canada (CMEC 1993 & 1997); the 1988 and the 1990/91 International Assessment of Educational Progress (IAEP1 and IAEP2), conducted by the Educational Testing Service (Lapointe, 1989 & 1992); the Third International Mathematics and Science Study (www.timss.bc.edu, 1995), administered by the International Association for the Evaluation of Educational Achievement (IEA), as well as the TIMSS-R (www.timss.bc.edu, 1999). According to the B.C. Ministry of Education (2000) research, Quebec's students generally outperformed students from other Canadian jurisdictions at grades four, eight and eleven (p. 14).

Officials in B.C.'s Ministry of Education wondered if curricular differences might have contributed to differential mathematics achievement and launched a research project to compare British Columbia's mathematics curricula (BC Ministry of Education, 1987) with Quebec's (Ministère de l' Education du Québec, 1980) at grades four, eight and eleven, the years in which students write the comparative assessments.[1] The ministry's analysis sought to distinguish similarities and differences between the two programs of study. Item by item, the curricular objectives were juxtaposed and compared through content analysis. Analyses indicated that although the two provincial curricula covered similar mathematics topics (or curricular organizers), the two jurisdictions' documents also differed considerably (B.C. Ministry of Education, 2000).

[1] Although both British Columbia and Quebec revised their mathematics curricula beginning in the mid-1990s to the early 2000s, these documents were not all in place early enough to have had an impact on national and international assessments that spanned from 1988 to 1999. Therefore, the decision was likely made by the ministry to use Quebec's 1980 and British Columbia's 1987 documents.

B.C.'s 2000 research indicated that Quebec's and British Columbia's mathematics curricula differed on seven key dimensions. These included: the number of topics and objectives covered; the degree of abstraction versus concreteness; the role of mental calculation; coherence of topics and teacher directives both within and across grade levels; learning theories and the role of problem-solving; and the use of curricular differentiation – such as tracking.

Overall, across grades four, eight and eleven, Quebec's curricular documents covered fewer topics and objectives than did B.C.'s. For example, B.C.'s grade four curriculum included 130 objectives, whereas Quebec's had 23 terminal and 68 sub-objectives. This difference is exemplified in the study of *measurement* whereby Quebec's curriculum dealt with *length, area* and *volume* while B.C.'s students covered *length, area, capacity, mass, time, temperature* and *money* with time, temperature and money being repeated from previous years' curricula. This repetition occurred again in grade eight, where 43% of B.C.'s *Numbers/Operations* objectives had appeared in grades five, six, and seven.

By grade eleven, 60% of instructional time was earmarked for Algebra, with 33% of objectives repeated from prior years. This repetition is exemplified in B.C.'s Mathematics 11A *Data Analysis* whereby one objective required students to "read graphs related to cost of living and earnings", a skill covered in Mathematics 10A using "utilities, water, gas, hydro and bulk buying". In contrast, under Quebec's *Data Analysis*, students solved problems using correlation and probabilities.

Quebec's and B.C.'s curricula also differed with respect to the degree of abstraction demanded from their learning objectives. Quebec's curriculum moved fluidly between abstract and concrete operations, with concrete manipulations serving to facilitate comprehension of abstract concepts. For example, Quebec's grade four *Numbers/Operations* required students to *perform additions, subtractions and multiplications on fractions using concrete material,* whereas in B.C.'s curriculum *Numbers/Operations* was dealt with highly abstractly, including objectives like *evaluate expressions which involve brackets*.

Unlike British Columbia's mathematics curricula, Quebec's also demonstrated substantial dedication to mental calculations. For example, Quebec's grade four objectives included the ability *to develop speed and accuracy in mental and written calculation*; and *to multiply a number by 10, by 100 or by 1000 and to perform the inverse operation mentally*. Perhaps Quebec is unique in North America in its insistence on developing mental automaticity, since some researchers have noted that it has recently become "undervalued", "no longer considered an important part of elementary school mathematics curriculums" (Kaplan, Yamamoto & Ginsburg, 1989, p. 69).

Quebec's curriculum also appeared to be more unified and coherent than B.C.'s. Within every topic area, directives advised teachers to establish relationships with previously learned material. For example, one of Quebec's grade four *Numbers/Operations* objectives called for students to *establish the relationship between the operation of multiplication and the operation of division*. Another grade eight objective required students to "be able to transform figures in a Cartesian plane *using relationships established between algebra and geometric transformations*". A grade eleven objective required that students summon *all their knowledge (algebra, geometry, statistics and the sciences) and all the means at their disposal (computers, calculators, instructional materials) to solve problems.* This interconnectedness was not evident in B.C.'s curriculum - although it is possible that individual teachers helped students make these connections.

The role of problem-solving differed markedly across British Columbia's and Quebec's mathematics curricula, reflecting differences in the learning theories valued by each jurisdiction. At all three grade levels, Quebec's curricular documents wove together activities fostering conceptual understanding, calculations, operational applications and problem-solving. For example, in grade eleven, a note under the topic of *Vectors* advised teachers that *students' understanding of a geometric proof is as important as the mechanics of presenting it.* Furthermore, all of Quebec's objectives directed teachers to assign open-ended problems thereby indicating a cognitivist learning orientation (cf. Bereiter & Scardamalia, 1992; Resnick & Kopfler, 1989).

By contrast, British Columbia's curriculum reflected a more behaviorist view of learning. Many topics simply required students to respond to stimuli by applying requisite operations, such as in the following grade eight example: *Use the concepts of ratio, rate, proportion, and percent to solve problems; given 2 numbers, determine the percent that one is of the other; determine the percent of a given number; given the percent of a number, determine the number*. As well, B.C.'s mathematics curriculum dealt with problem-solving as a separate topic, unlike Quebec's where problem-solving was integrated throughout all learning objectives.

Both Quebec and B.C. track their learners into three different mathematics eleven courses. B.C.'s courses included: Mathematics 11A (Basic), Introductory Mathematics 11 (Transitional) and Mathematics 11 (Advanced) whereas Quebec's included: Mathematics 514 (Basic), Mathematics 526 (Transitional) and Mathematics 536 (Advanced).[2] In B.C., the contents of each class differed significantly from the others. For example, only Mathematics 11A students encountered *Numbers/Operations* as well as *Income & Budgeting*. Yet, Quebec's grade eleven

[2] During the 1980s and 1990s, B.C.'s tracking began officially in grade 9 but, as reported in the IAEP surveys, students experienced frequent in-class and within-programme streaming at much earlier grades. Quebec's tracking officially began in grade 11 (B.C. Ministry of Education, 2000, pp. 21-22).

offerings were almost identical, with differences lying not in topics but in depth of coverage of each topic. Under *Data Analysis*, students in Mathematics 526 and 536 learned to estimate and interpret correlation coefficients for two-variable distributions, but 536 students also sketched the regression line and determined the equation of that line.

Quebec’s and B.C.’s differing ideological orientations were also evident in their stated philosophies and mission statements. Quebec’s stated purposes for mathematics instruction were 1) to prepare the child for further study and 2) to initiate the child into a way of thinking that characterizes mathematics via certain fundamental concepts – two goals that focus firmly on mathematics subject matter. In contrast, B.C.'s stated purpose for mathematics instruction was for students “to function productively in society,” with a particular emphasis on workplace competence. This purpose is much broader than Quebec’s as B.C. also aimed to develop general reasoning, problem-solving ability, communicative skills and the use of technology – all within the study of mathematics.

In short, British Columbia’s and Quebec’s curricula differed in various significant ways, including: the number of topics and objectives covered; the degree of abstraction versus concreteness; the role of mental calculation; coherence of topics and teacher directives both within and across grade levels; learning theories and the role of problem-solving; the use of curricular differentiation – such as tracking. British Columbia’s curricula exemplified what researchers have described as the “transmission” model of curriculum whereby the purpose is to “transmit facts, skills, and values to students” (Miller & Seller, 1990, p. 5). This model reflects analytic philosophies of Bacon and Lockes, as well as behaviorist psychology most clearly articulated by Thorndike and Skinner. By contrast, Quebec’s mathematics curricula fit better within the “transaction” curriculum model in which the individual is considered to be “rational and capable of problem solving" (Miller & Seller, 1990, p. 6). Rooted in the philosophies of Pestalozzi and Dewey, the main goal of transactional curricula is to develop rational intelligence and complex problem-solving skills.

Part II: Persistence of the Curricular Status Quo

The 2000 Ministry of Education research project was undertaken over six years ago. Since then, there has been no ministerial discussion of the findings nor follow-up to the research. Nor has further research been conducted which would illuminate some of the strengths and weaknesses of mathematics instruction in the province. In short, Willms' (1999) remark about Quebec's superior mathematics performance sparked momentary intrigue but failed to ignite the flames of sustained inquiry. Why the passing interest in mathematics reform in B.C.?

While large-scale assessment researchers have insisted that such assessments can "enhance learning within and across systems of education" (cf. Plomp & Loxley, 1994, p. 176), other researchers have argued that educational reform is a complex and multi-faceted undertaking frought with dangers and prone to failure (cf. Earl & Torrance, 2000; Fullan, 1991; Gaffield, 1994; Harris, 2000).

In particular, attempts at system-wide, centrally controlled reform have been soundly criticized (Schmidt & Prawat, 1999). In a study of American urban high schools, Louis and Miles (1990) concluded that governments have greatly underestimated problems and processes associated with teaching reform due to preoccupations with policy development, and regulatory compliance. What is essential and absent, these researchers argue, are understandings about how governments can support, guide and motivate schools to build "within-school" capacities to deliver programs more effectively. Other researchers concur (cf. Reynolds, 2000; Scheerens & Bosker, 2000). In the words of Clarke, Harris, and Reynolds (2004), "despite the dramatic increase in education reform efforts in most countries, their impact upon overall levels of student achievement" has not been "as successful as anticipated" (pp. 2-3).

Other researchers have found that the success of curricular change may hinge upon the subject area being reformed. Curriculum researchers Price and Lowenberg Ball 1997) have argued that numeracy reform is less likely to be reach fruition, since numeracy is considered less important than other areas of the curriculum, most noticeably literacy. These researchers found that principals, district officials and parents alike attributed less importance to reforming numeracy instruction than literacy, partly because of their own lack of expertise in mathematics. Furthermore, Price and Lowenberg Ball (1997) found that mathematics' low status led to fewer resource allocations, in terms of time, materials, and personnel than was the case for the more high status language arts. "Both by interest and by default, reading is central to the elementary curriculum… Mathematics enjoys no such automatic attention or interest" (Price & Lowenberg Ball, 1997, p. 662). Although it is beyond the scope of this research to discuss the status of contemporary subject areas, this example highlights just one of the many perspectives researchers have explored in investigating failed reform initiatives. Price's and Lowenberg Ball's 1997 hypothesis is certainly worthy of future reseach.

Sociologists and historians of education have also examined the phenomenon of educational reform. Researchers from these fields have argued that jurisdictional differences in curricula are hardly surprising, given that education systems reflect the societies within which they have evolved. Modell (1993) has suggested that it may be a conscious choice on the part of North Americans "that their children should master school subjects slower and later than children elsewhere" (p. 16). Moreover, Modell (1993) has noted that children in Canada tend to be noncompetitive and seemingly relaxed about their schooling experiences. In the words of Gaffield (1994),

> the meaning of schooling results from a convergence of forces in which any one element becomes important only in interaction with other elements. It is this convergence of forces that appears to determine the ways in which children will experience mass schooling (p.64).

If indeed education systems reflect differing jurisdictions' historically-rooted philosophies about childhood and child development that "embody differing social, political, economic, and resource needs and priorities" (Schmidt et al., 1998, p. 505), then it is hardly surprising that B.C.'s and Quebec's mathematics curricula differ so. After all, a curriculum represents a society's intents for the "interactions designed to facilitate learning and development and to impose meaning on experience" (Miller & Seller, 1990, p. 3). Quebec's and B.C.'s provincial education systems have evolved separately within two distinct societies. When mass schooling was implemented in Quebec, it was greatly influenced by schooling in France, with particular emphasis on intellectual development and the humanities (Gaffield, 1994; Henchey & Burgess, 1987).

Gaffield (1994) has argued that Quebec was able to maintain its intellectual, subject-focused approach whereas the rest of the North America wasn't because of the impact of "constant and substantial immigration to America; the rapid transition from agricultural to industrial capitalism; and the process of state formation in which citizens came to exercise political power" (pp. 40-41.) Under control of the Catholic church — largely in resistance to Anglo-Protestant assimilation and to Ottawa's encroachment on provincial autonomy with the growth of the Canadian welfare state — Francophone Quebec did not fully industrialize until the "Quiet Revolution" of the 1960s after the death of Union Nationale Premier Maurice Duplessis.

Under the Liberal government of Jean Lesage, a Ministry of Education was only formed in 1964, transferring control of education from the church to the state (Milner, 1986).

Unlike the rest of North America, Quebec's academic focus did not diminish with the growth of the secular state. With the Quiet Revolution it became apparent that young Francophones needed better training in mathematics and the sciences in order for Quebec to reach its goal of "maîtres chez nous" — masters of their own social and economic destiny. Quebec found an intellectual basis for its mathematics and sciences curricula in the growing field of Cognitive Science. References throughout Quebec's mathematics curriculum to cognitivist views of learning provide support for methods and approaches that have largely been ignored by educators in British Columbia, where the ideologies of researchers such as Bruner, Thorndike, Skinner and Bobbitt led to the adoption of behaviorist principles and a spiral curriculum.

Unlike Quebec, B.C.'s 1987 mathematics curriculum did not focus on intellectual development, although it can be argued that the emphasis of B.C.'s earliest mathematics curricula in the 1870s certainly did. According to Johnson (1964), developments in the U.S. began to influence B.C. as early as 1862 when education promoters worried about trailing behind Washington and California in the race to develop free, common schools. The move from a subject-focused, intellectual approach to more behaviorist and applied approaches was gradual, however, beginning with the 1925 recommendations of the Royal Commission on Education (Putman & Weir, 1925).

Schmidt, McKnight, and Raizen (1997a) have hypothesized that curricular fragmentation reflects a fundamental American belief in a technological approach to education that may have sprung from applying assembly line, mass production techniques to schooling. "Assembly line" tenets include the view that any knowledge, skill, or idea can be broken into simpler parts that can be learned independently of one another. Such fragmentation led to an increasing emphasis on behavioral objectives in the 1960s which, in turn, led to detailed specification of sub-skills and objectives, some of which were never reconnected to the "whole" skill or concept from which they were initially severed.

Curricular fragmentation may also be a bi-product of one of today's most cherished educational imperatives: meeting learners' individual needs. Streaming and tracking practices have been readily invoked in B.C. since the mid-1920s, when curricular differentiation was first introduced to the province (Putman & Weir, 1925). Influenced by Bobbitt's 1918 "scientific" model for curriculum design B.C.'s Putman and Weir Commission advocated differentiated instruction for students of differing needs. Bobbitt believed the role of schooling was to identify each learner's needs and dispositions and to fit the child to where he/she would be of most service to society. In short, the role of the curriculum designer was to discover the activities necessary to live within a given social class. According to Bobbitt (1924), this required that

> one go out into the world of affairs and discover the particulars of which these affairs consist. These will show the abilities, attitudes, habits, appreciations, and forms of knowledge that men need. These will be the objectives of the curriculum. The curriculum will then be that series of experiences which children and youth must have by way of attaining those objectives (p. 3).

More recently, as part of B.C.'s 1988 Royal Commission on Education, the curriculum committee (Robitaille, Oberg, Overgaard, & McBurney, 1988) affirmed its broad, socially utilitarian view of curriculum by stating that:

> in making decisions about what to include in the curriculum, we must consider the entire array of roles that students will be expected to play in society. We should be helping students prepare to assume their place as full participants in the democratic institutions of our society, as contributors to the level of social morality of our society, as economically productive citizens, and as caring and nurturing family members (p. 32).

This quote illuminates the profound philosophical differences between Quebec's mathematics curriculum which aims to prepare learners for a way of thinking that characterizes mathematics and British Columbia's which seeks to prepare learners to function productively in society. If, indeed, "national school systems are in part a product of the histories, national psyches, and societal aspirations of the systems in which they develop" (Robitaille & Garden, 1989, p. 22) is seems unlikely that one jurisdiction's practices could significantly impact those of another as suggested by researchers who maintain that large-scale comparative assessments can improve learning (cf. Beaton et al., 1997; Schmidt & Burstein, 1993; Schmidt & McKnight, 1998; Stigler & Perry, 1998).

Socio-historical circumstance aside, other complex factors conspire to impede curricular reform. As early as the 1920s, Dewey (1929) observed that research cannot "be converted into an immediate rule of educational art" without involvement of teachers (p.12). Like Dewey, contemporary educational change theorists, such as Fullan (1991), Hargreaves (1989), and Harris (2000) have argued that successful educational reform hinges on including teachers in the reform process. Reforms are doomed to fail, Frost, Durrant, Head and Holden (2000) have argued, when they are largely imposed in a "top-down" bureaucratic fashion from outside schools themselves. Fullan (1991) has noted that large-scale government-initiated reforms have been "spectacularly unsuccessful" because they ignore how people actually experience change as distinct from how it might have been intended" p.4). He likewise has maintained that school districts and state level governments must provide the necessary infrastructure to promote meaningful collaboration among teachers and senior-level decision makers (Fullan, 2000).

Other researchers have suggested that policy-makers can by-pass teacher involvement when reforms constitute structural "add-ons" that do not challenge or disturb regular school operations or the well-entrenched "grammar of schooling" (cf. Tyack & Cuban, 1995, p. 57). One such non-disruptive, structural add-on is Canada's French Immersion programs, where immersion teachers follow essentially the same curriculum as others and conduct their classes following the same routines and time schedules. But large-scale curricular overhaul is more deep-rooted and than benign structural add-ons for such reforms eventually entail reworking teachers' pedagogical practices, as well as restructuring teacher education requirements in college and university-level education facilities – not to mention the potential impacts on the powerful textbook industry. The incentives are great for avoiding a "Pandora's box" of substantive curricular change.

Clues about the B.C. government's failure to pursue mathematics reform reside in another of Tyack's and Cuban's precepts. They argue educational changes "stick" when "influential constituencies" become committed to ensuring their success (Tyack & Cuban, 1995). "Not all reforms are born equal" warn Tyack and Cuban, (1995) since "some enjoy strong political sponsors while others are political orphans" (p.7). This observation is particularly relevant in the case of B.C.'s passing interest in mathematics reform.

Two key events occurred after the B.C. Ministry of Education (2000) research had been completed and ensured that B.C.'s mathematics reform initiative was short-lived. Several months after the report was submitted, the province elected a new government and the deputy minister, whose interest in mathematics reform had prompted the research, was replaced. And, as so often is the case in education, the new government ushered in new priorities and new agendas. A reform agenda predicated on detailed, subject-specific curricular research was supplanted by broader concerns for greater district and school-level accountability.

One final, tragic event sealed the fate of mathematics reform in B.C. In January 2002, the director of the Curriculum Branch, under whose direction the research was conducted, passed away. Within weeks of his passing, his office was cleaned out and most of his files and reports were relegated to the dustbin. Without the support of the deputy minister or the curriculum branch director to sustain the reform efforts, B.C.'s brief courtship with mathematics curricular reform was aborted soon after its conception.

Conclusion

At first glance, the notion of educational reform premised on comparing national and international large-scale assessment outcomes is very appealing and seemingly straightforward. Advocates argue that such assessments can "enhance learning within and across systems of education" (Plomp & Loxley, 1994, p. 176) by enabling policy makers at all levels to initiate reforms based on the practices of more successful jurisdictions (Beaton et al., 1997; Schmidt & Burstein, 1993; Schmidt & McKnight, 1998; Stigler & Perry, 1998). Indeed, researchers have invested much effort into determining the multiple factors which account for differential assessment outcomes across educational jurisdictions. To date, the critical factors include differences in teaching load (McKnight, 1987), teaching qualifications (Robitatille, 1990), and instructional differentiation (Ma & Willms, 1999; Robitaille & Garden, 1989; Stevenson, 1998) – to name but a few. Curricular variation is the latest addition, with Robitaille, Schmidt, Raizen, McKnight, and Nicol (1993) noting that recently there "has been the recognition given to the importance of curriculum as a variable in explaining differences among national school systems and in accounting for differences among student outcomes" (p. 11).

Upon closer examination, however, assessment researchers might be wise to argue more cautiously about the merits of cross-jurisdictional assessment analyses. This case study of British

Columbia's short-lived mathematics reform initiative reminds us that educational reform is dangerous terrain characterized by socio-historical, curricular, administrative and political impediments. In particular, B.C.'s reform initiative first faltered with the departure its advocates, the outgoing deputy minister and the belated Curriculum Branch director. And as Tyack and Cuban (1995) note, the likelihood of educational changes "sticking" is greatly compromised without strong sponsors who will see the reform through to its successful conclusion.

However, strong political sponsorship is not the only factor impeding successful curricular reform. Dewey (1929), Fullan (2000), Harris (2000) and others have noted that successful reforms require collaborative efforts between school districts and state level governments. One can speculate that had such collaboration occurred in B.C., perhaps the mathematics reform initiative would not have faltered so easily.

More importantly, this case study of B.C.'s abandoned mathematics reform effort illustrates what others have asserted: that "national school systems are in part a product of the histories, national psyches, and societal aspirations of the systems in which they develop" (Robitaille & Garden, 1989, p. 22). As this case study illustrated, British Columbia's and Quebec's seemingly superficial curricular differences are solidly rooted in the socio-historical development of each jurisdiction. It is not accidental that British Columbia produced a more behaviorist, socially utilitarian curriculum, the aim of which was to prepare students to function productively in society. As Johnson (1964) has shown, British Columbia's educational architects have been greatly influenced by American educational theorists, beginning as early as 1862. On the other hand, Quebec's curriculum - with its cognitivist, problem-solving focus - is rooted in the province's closer ties to France, with particular emphasis on intellectual development (Gaffield, 1994; Henchey & Burgess, 1987). It is not surprising that with the departure of B.C.'s deputy minister and curriculum branch director there was little appetite among the civil service to delve seriously into curricular reform that would disturb the province's entrenched curricular philosophies and aims. And so, the reform was abandoned. Senior-level decision makers, enticed by the promise of reform premised on large-scale assessment outcomes, would be well advised to consider the powerful role that socio-historical circumstance plays on our education systems.

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