# SCHOOL CHOICE, EXAMS AND ACHIEVEMENT

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# School Choice and Diploma Exams: Lessons From Canada

Many have expressed dissatisfaction with the academic achievement of Canadian youth. The Economic Council of Canada, for example, observed in 1992 that:

> International Test results for science and mathematics show that Canadian students in Grade 4 perform at least at the international average; by Grade 8, they are outperformed by students in many other countries; and by the end of secondary school, Canadian results are poor (A Lot to Learn, 1992a, p.7).

Comparisons over time are apparently unfavorable as well. Researchers working on the Economic Council report compared the results of Canadian Test of Basic Skills norming studies in 1966, 1973, 1980 and 1991 and concluded that:

> On the whole, they indicate a deterioration between 1966 and 1973, a minor improvement between 1973 and 1980 and then another decline (to about the 1973 level) between 1980 and 1991 (Newton, de Broucker, McDougall, McMullen, Schweitzer and Siedule, 1992, p. 23).

Concern about standards of achievement have given the long standing policy debates about private school vouchers, accountability and student examinations a new urgency.

Private School Choice: In the United States, proposals for private school vouchers have been very hotly debated. Those who favor them argue that voucher funding of private schools will:

- Force public schools to become more responsive to parents wishes and that this will result in higher standards of achievement,
- Create a more competitive teacher labor market making it easier to remove incompetent teachers and retain talented teachers,
- Bring morality and religion back into the schools and
- Remove the dead hand of bureaucracy from school management. [John Chubb and Terry Moe (1990) argue that privately run schools will always be more effective than public schools because they are not subject to the bureaucratic controls and tight regulation that public schools are.]

Canadian governments are not constitutionally prohibited from subsidizing religious schools, so these institutions receive considerable funding from the public. Indeed in four provinces—Alberta, Newfoundland, Ontario and Saskatchawan—there is a system of Catholic schools (and in Newfoundland a Protestant system as well) that is overseen by local school boards elected by members of the religious faith who live in the community. Historically, these schools were supported by provincial grants and

property taxes paid by people who registered as Catholics and whose children were therefore eligible to attend those schools. The schools run by these religious school boards compete for students with schools run by secular school boards and educate over 15 percent of the nation's students. Are these quasi-private denominational schools doing a better job of teaching mathematics and science than traditional public schools? How good a job are the independent private schools doing? Can any lessons be drawn for the U.S. debate about vouchers from Canadian experience with subsidizing nonpublic schools. This is the first issue that is to be addressed by this paper.

Provincial diploma examinations: In Canada one of the most prominent policy responses to the demand for higher achievement has been to reverse decisions made in the late 1960s and early 1970s to eliminate provincial diploma examinations. British Columbia reestablished its Provincial Examination system in 1983 and Alberta followed one year later. Manitoba started administering rotating provincial examinations in 1991. They examined mathematics in 1991 and 1992, biology and physics in 1993, chemistry in 1994 and social studies in 1995. In 1996 Manitoba stopped rotating its exams and began administering provincial examinations in mathematics and language arts every year. Anglophone New Brunswick had provincial exams in language arts and mathematics throughout most of the 1980s and 1990s but exam grades were not reported on transcripts or counted in final course grades. In 1994 the province started mandating that provincial exam grades be part of the final grade in the course. Provincial exam grades are also now reported on transcripts.

Canada's provincial diploma examinations are a medium stakes version of the curriculum-based external exit examinations found in Britain, Ireland, Australia, and most Asian and Northern European countries. Curriculum-based external exit examination systems (CBEEES) have the following traits. They:

1. **Produce signals of student accomplishment that have real consequences for the student.**
2. **Define achievement relative to an external standard, not relative to other students in the classroom or the school.** Fair comparisons of achievement across schools and across students at different schools are now possible. Costrell's (1994a) analysis of the optimal setting of educational standards concluded that more centralized standard setting (state or national achievement exams) results in higher standards, higher achievement and higher social welfare than decentralized standard setting (ie. teacher grading or schools graduation requirements). School reputations come to depend more on student success on the external exams and less on parent ability and willingness to pay for an Ivy League education. School reputations can have major consequences for administrators and staff especially when students are able to choose which high school they attend.

3. **Are organized by discipline and keyed to the content of specific course sequences.** This maximizes alignment between instruction and assessment and focuses responsibility for preparing the student for particular exams on one (or a small group of) teacher/s. Grades on the external exam should be a part of the overall course grade further integrating the external exam into the classroom culture.
4. **Signal multiple levels of achievement in the subject.** If only a pass-fail signal is generated by an exam, the standard will have to be set low enough to allow almost everyone to pass and this will not stimulate the great bulk of students to greater effort (Kang 1985; Costrell 1994a). Since CBEEES are supposed to measure and signal the full range of achievement in the subject, they contain more difficult questions and problems than minimum competency examinations. This induces teachers to spend more time on cognitively demanding skills and topics.
5. **Cover almost all secondary school students.** Exams for a set of elite schools, advanced courses or college applicants will influence standards in top classes, but will probably have limited effects on the rest of the students. The school system as a whole must be made to accept responsibility for how students do on the exams. A single exam taken by all is not essential. Many nations allow students to choose which subjects to be examined in and offer high and intermediate level exams in the same subject.
6. **Are controlled by the education authority that establishes the curriculum for and funds K-12 education.** When provincial ministry's of education sponsor an external exam, it is likely to be aligned with the province's curriculum. Curriculum reform is facilitated because coordinated changes in instruction and exams are feasible. Tests established and mandated by other organizations serve the interests of other masters. The United State's premier high stakes exams--the SAT-I and the ACT—serve the needs of colleges to sort students by aptitude, not the needs of schools to reward students who have learned what is being taught.
7. **Assess a major portion of what students studying a subject are expected to know and be able to do.** It is, however, not essential that external exams assess every instructional objective. Teachers should have responsibility for evaluating dimensions of performance that cannot be reliably assessed by external means.

What effects do provincial diploma examinations (or CBEEES) have on school policies, teaching and student achievement? Time series data on the student achievement by province is not available, so cross-section evidence will be examined comparing Canadian provinces with and without such exams. This is the second issue addressed by this paper.

## I. The Effects of External Exams on School Priorities and Culture—Anecdotes and Theory.

A theory that has been explicated in full in Bishop (1996, 1998) predicts that CBEEESs influence societal decisions about education spending, administrator decisions about school priorities, teacher decisions about standards and pedagogy and student decisions about studying. Much of the ultimate impact of CBEEESs on student achievement may derive from the changes they induce in school priorities and teacher pedagogy.

Curriculum-based external exit exam systems can also have profound effects on teacher-student relationships and on the nature of the student peer culture. Teachers who have taught in both environments, as I have, sense the difference. When a proposal was put forward in Ireland to drop the nation's system of external assessments and have teachers assess students for certification purposes, the union representing Ireland's secondary school teachers reacted as follows:

> *Major strengths of the Irish educational system have been:*
>
> *(i) The pastoral contribution of teachers in relation to their pupils*
>
> *(ii) the perception of the teacher by the pupil as an advocate in terms of nationally certified examinations rather than as a judge.*
>
> *The introduction of school-based assessment by the pupil's own teacher for certification purposes would undermine those two roles, to the detriment of all concerned....*
>
> *The role of the teacher as judge rather than advocate may lead to legal accountability in terms of marks awarded for certification purposes. This would automatically result in a distancing between the teacher, the pupil and the parent. It also opens the door to possible distortion of the results in response to either parental pressure or to pressure emanating from competition among local schools for pupils.*[1]

Note how the Irish teachers feared that switching entirely to internal assessment would result in their being pressured to lower standards. In the United States such pressure is a daily reality. Thirty percent of U.S. teachers say they "feel pressure to give higher grades than students' work deserves." Thirty percent also feel pressured "to reduce the difficulty and amount of work you assign"[2]

The other feature of classroom culture that is likely to be affected by the introduction of compulsory end-of-course examinations is nerd harassment. Steinberg, Brown and Dornbusch's recent study of nine high schools in California and Wisconsin concluded that:

> ...less than 5 percent of all students are members of a high-achieving crowd that defines itself mainly on the basis of academic excellence... Of all the crowds the 'brains' were the least happy with who they are--nearly half wished they were in a different crowd.[3]

Why are the studious called *suck ups*, *dorks* and *nerds* or accused of *"acting white"*? In part, it is because many teachers grade on a curve and this means trying to do well in a class is making it more difficult for others to get top grades. When exams are graded on a curve or college admissions are based on rank in class, joint welfare is maximized if no one puts in extra effort. In the repeated game that results, side payments--friendship and respect--and punishments—ridicule, harassment and ostracism--enforce the cooperative "don't study much" solution. If, by contrast, students are evaluated relative to an outside standard, they no longer have a personal interest in getting teachers off track or persuading each other to refrain from studying. Peers should become less supportive of students who joke around in class or try to get the class off track and more supportive of those who cooperate with the teacher. Improved classroom culture should result in students learning more. Does it?

The theory also predicts that school choice and diploma examinations will interact in powerful ways. Private schools are likely to be more sensitive to market pressures, so one would predict that nonpublic schools will respond more radically to an exam system than public schools. Consequently, I hypothesize a positive interaction between curriculum-based exams and non-public schools. Indeed, when there are no external exams to signal student achievement to parents, there may be little reason to expect that private schools will be driven by competition to be better teachers of math, science and language arts than public schools. They might instead market themselves as offering religious instruction and a better disciplinary environment, not better math and science instruction.

In the next section of this paper, the objective is to assess the **total** effect of CBEEESs on achievement. Estimates of the total effects of CBEEESs are obtained from a reduced form model that controls for parental socio-economic status, national productivity levels and national culture, but not for the endogenous administrator, teacher and parent behaviors. Section 3 of the paper the relationships between Canadian diploma exams and the resources devoted to K-12 schooling, administrative policies and priorities and teacher pedagogy and standards. Section 4 examines how the resources devoted to K-12 schooling, administrative policies and priorities and teacher pedagogy and standards differ by who owns and controls the school.

**Literature Review**

Proponents of student and school accountability systems based on external examinations often point to the high achievement of secondary school students in European and East Asian countries with curriculum-based external exit examination systems (CBEEES) as evidence of the positive effects of external examinations taken at the end of secondary school on student achievement. Careful empirical

analysis of data collected by the Third International Mathematics and Science Study on math and science achievement in 1994/95 of students in 40 countries supports this supposition.[4] The study found that students from countries with medium and high stakes CBEEE systems outperform students from other countries at a comparable level of economic development by **1.3** U.S. grade level equivalents in science and by **1.0** U.S. grade level equivalent in mathematics. A similar analysis of International Assessment of Educational Progress data on achievement in 1991 of 13 year olds in 15 nations found that students from countries with CBEEES outperformed their counterparts in countries without CBEEES by about 2 U.S. grade level equivalents in math and about two-thirds of a US grade level equivalent in science and geography. Analysis of data from the International Association for the Evaluation of Educational Achievement's study of reading literacy of 14 year olds in 24 countries found that students in countries with CBEEES were about **1.0** U.S. grade level equivalent ahead of students in nations at comparable levels of development that lacked a CBEEES.[5]

These results are consistent with the causal hypotheses presented in Bishop (1996, 1998). Causation is not proved, however, because other explanations can no doubt be proposed. Other sources of variation in curriculum based exams need to be analyzed. Best of all would be studies that hold national culture constant. Bishop, Mane and Moriarty (1997) have found that, when socio-economic background is held constant, students from New York State, the only US state in the early 1990s with a CBEEES, out perform students in other states on the NAEP math assessment and on the SAT-I. The next section of the paper presents a comparison of math and science achievement of Canadian students living in provinces with curriculum-based diploma examinations to comparable students in provinces without such examinations.

## II. Comparing Canadian Provinces--Achievement

When the Educational Testing Service canvassed countries about participating in the 1991 IAEP, Canada decided to collect sufficient data to allow reliable comparisons between provinces and between the Anglophone and Francophone school systems of the five provinces with dual systems.[1] At the time Alberta, British Columbia, Newfoundland, Quebec and Francophone New Brunswick had curriculum-based provincial examinations in English, French, mathematics, biology, chemistry, and physics during the senior year of high school (U.S.GAO 1993). These exams accounted for 50 percent of that year's final

[1] All French speaking schools in New Brunswick, Saskatchewan and Manitoba were invited to participate and stratified random samples of 105 to 128 secondary schools were selected from the French speaking school systems of Ontario and Quebec and the English speaking school systems in all provinces with the exception of Prince Edward Island.

grade in Alberta, Newfoundland and Quebec and 40 percent in British Columbia. These provincial exams are medium stakes, not high stakes tests. They influence grades and appear on transcripts but passing the examination is not essential for graduation.

The other provinces did not have curriculum-based provincial external exit examinations in 1990-91. Ontario had eliminated them in 1967, Manitoba in 1970 and Nova Scotia in 1972. Nova Scotia substituted multiple-choice norm-referenced achievement tests in reading, language usage, proofreading, mathematics, science and social studies that do not influence student grades. Anglophone New Brunswick had provincial exams in language arts and mathematics but exam grades were not reported on transcripts or counted in final course grades. The absence of any stakes attached to performance resulted in many students blowing off the test. Manitoba and Saskatchawan had no such exams in 1990-91. Ontario abolished its provincial examinations in 1967. Some local school districts have established district level exams for core subjects but most have not. Toronto, for example, does not have diploma exams. In any case, one would not expect local district subject exams to have as powerful incentive effects as provincial or national exams.

### *2.1 Effects of Diploma Exams on Achievement*

The effects of curriculum-based provincial exit exams taken by 12th graders on achievement and the behavior of Canadian 13 year olds, their parents, teachers and school administrators were examined by estimating models predicting these behaviors using schools as observations. The data set comprises 1338 Canadian schools. The model contained 11 variables: logarithm of the mean number of books in the home, the mean number of siblings, the proportion of the school's students whose home language was different from the language of instruction, logarithm of the number of students per grade in the school and zero-one indicator variables for secular independent schools and for denominational independent schools, schools with primary grades, schools that include all grades in one building and French speaking schools.[2] Twenty percent of the schools in the study were run by locally elected Catholic (or Protestant) school boards in the provinces of Alberta, Newfoundland, Ontario or Saskatchewan. A separate dummy variable was created for these schools. Location in a province with provincial exit exams was indicated by two dummy variables: one for all schools and the other for "nonpublic" schools only. "Nonpublic" schools included all three types: denominational schools supervised by elected school boards, independent denominational

[2] Students at French speaking schools did considerably better than students at English speaking schools, particularly in mathematics. Principals report fewer absenteeism problems but more discipline problems. Parents and students have more positive attitudes towards math and science, but they do less homework and watch a lot more television. Experiments are more common in science class. Administrators appear to give priority to math teaching. More time is devoted to math instruction but not to science instruction. Specialist math teachers are more common, specialist

schools and secular independent schools.

The metric of the primary dependent variable, achievement, is percent correct with adjustments for guessing. The mean of the mathematics test was .47 and its standard deviation across individuals was .248. For the science test the mean was .541 and the individual standard deviation was .19.

Table 1 presents our estimates of the impact of curriculum-based exams taken in 12th grade on test scores in 8th grade. The first row in each panel present simple regressions containing no controls for school characteristics. Row 1 tells us that students in provinces with exam systems scored 7.0 points higher in math and 3.6 points higher in science. Adding controls for school size and type (includes elementary grades, includes K-11$^{th}$ grade, Francophone school) in row 2 lowers the EXAM effect on public school students to 5.2 points for math and 2.5 points for science. Adding additional controls for three types of non-public schools in rows 3 and 4 lowers the EXAM effect to 4.5 points for math and 3.0 points for science.

Now let us examine what happens in row 5 when controls are added for the demographic background of the school's student body--school means for books at home, number of siblings and proportion of students whose home language is different from the language of instruction.[6] In this model exam systems raised scores of public school students by 4.3 points in math and 3.0 points in science.

The sixth row of each panel has two additional control variables--calculator availability and computer use. Having a calculator at home and using computers for school work is associated with higher math achievement but not higher science achievement. Including these variables in the model lowers the estimated effect of EXAM on math achievement but does not effect EXAM's impact on science achievement. Both of these variables are hypothesized to be influenced by the existence of external exams. Consequently, row 5 presents our best estimate of the <u>total</u> impact (including indirect effects) of having a provincial exam in the subject at the end of secondary school on IAEP test scores at age 13. Provincial exams have large effects on public school students: 18 percent of a U.S. standard deviation (about two-thirds of a U.S. grade level equivalent) in mathematics and 15 percent of a standard deviation (about half a grade level equivalent) in science. For mathematics, exam effects are significantly bigger in non-public schools.

The gains in mean achievement generated by exam systems do not come at the expense of greater inequality. Exam provinces have less variability of achievement across schools. The variance of school mean science achievement is smaller in Alberta, British Columbia and Quebec than in any other province. For math achievement the variance was lowest in New Brunswick, British Columbia, Saskatchewan, Quebec and Alberta. The fourth panel of Table 1 presents regressions predicting the

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science teachers are less common.

standard deviation of achievement among students at a school. Within-public school standard deviations for science achievement are smaller in exam provinces. For mathematics the within-school SDs are unrelated to being an exam province for public schools and are significantly smaller at non-public schools.

### *2.2 Is the EXAM effect causal?*

One possible skeptical response to these findings is to point out that the correlation between EXAM and other outcomes may not be causal. Maybe the people of Alberta, British Columbia, Newfoundland, Quebec and Francophone New Brunswick--the provinces with exam systems--place higher priority on education than the people of Manitoba, Saskatchewan, Ontario, Nova Scotia and Anglophone New Brunswick.[3] Maybe this trait also results in greater political support for examination systems. If so, we would expect that schools in the EXAM provinces should be better than schools in other provinces along all dimensions not just by academic criteria. We would expect, for example, schools in exam provinces to have fewer problems with discipline and absenteeism. Our theory, by contrast, predicts that exam systems may induce students and schools to redirect resources and attention to learning/teaching exam subjects and away from the achievement of other goals such as low absenteeism and good discipline. These competing hypotheses are evaluated in the third panel of Table 1. Consistent with our theory and contrary to the "provincial taste for education" hypothesis, public school principals in EXAM provinces did not report significantly fewer discipline problems and were significantly more likely to report absenteeism problems. Private school principals in exam provinces also reported bigger discipline and absenteeism problems.

## III. Comparing Canadian Provinces—School Priorities, Pedagogy and Home Behavior

### *3.1 Effects of Diploma Exams on Home Behavior and Attitudes.*

Estimates of the effects of diploma exams and non public schools on home behavior are presented in Table 2. Each row represents a separate regression on data from 1230 to 1338 schools. The means

[3] This will seem like a strange idea to Canadians. With the exception of Alberta and British Columbia, these provinces have little in common. Historically they do not seem to have valued education more than the rest of Canada. Adult literacy is lower on average in these four provinces than in the rest of Canada. Newfoundland is quite poor and has significantly lower levels of adult literacy than the rest of Canada. The adult literacy study placed Quebec in the middle of the pack along with Ontario, Nova Scotia and New Brunswick. Two of the top four provinces with respect to adult literacy have exam systems and two do not. Saskatchewan is number one when it comes to adult literacy, yet it's 13 year olds lag substantially behind students from Alberta and British Columbia in mathematics and science.

and standard deviations across schools of each dependent variable are presented in columns 1 and 2. The coefficient on exam province dummy and it's T statistic are presented in column 3. The coefficients and T statistics for the interaction between exam province and non-public school are in columns 4. Coefficients and T statistics on the dummy variables for three types of non-public school governance are presented in columns 5 through 7. Adjusted R squares and Root Mean Square Errors appear in column 8.

Column 9 summarizes the hypotheses that were presented in the earlier section of the paper. To the left of the slash, /, is the expected sign (based on a priori reasoning and the literature) of the impact of EXAM on this measure of home or school behavior. A question mark appears here if no hypothesis was generated for this variable. The +, - and 0's appearing to the right of the slash mark summarize the results of regressions using these school characteristics to predict test scores (Bishop 1995). A + indicates that the variable had a significant positive effect on test scores at age 13. A -- implies a significant negative effect. A zero, 0, indicates no significant relationship.

**Home Behavior**: As predicted, public school students in provinces with exams watch 53 minutes (.87 hour) less television a week, and were 7.6 percentage points more likely to report that their parents want them to do well in mathematics and were also more likely to report that their parents have talked to them about what they are learning in school. They were significantly more likely to own a calculator.

Opponents of externally set curriculum-based examinations predict that they will cause students to cut back on learning activities that do not have a direct relationship to the exams. This hypothesis was tested by measuring whether exam systems were associated with less reading for pleasure and less watching of science programs like NOVA and Nature. Neither of these hypotheses is supported. Indeed for private school students the effects are statistically significantly in the opposite direction of those hypothesized by critics of exam systems.

**Attitudes**: Students in exam system provinces were also more likely to say they felt that science was important in everyday life. Parents were more likely to be reported to "be interested in science." Additionally, examination systems did not generate an exclusive focus on the extrinsic rewards for learning. Students in exam provinces were not more likely to think that mathematics or science was important for getting a job. These student attitudes apparently reflect the Canadian reality. Canadian employers apparently seldom use exam grades in hiring. Job applications were obtained from seven large companies in Quebec, a province with a long tradition of exit exams. All of them requested information about degrees and certificates of skills but none requested information on grades in secondary school. School transcripts were asked for in a few cases, but employers reported that this was to confirm

graduation not to screen on grades in school. These practices are not a consequence of legal prohibitions on requesting and using such information. A government approved official Canadian Manpower form obtained from the University of Montreal's College Placement office requests such information. Apparently, the availability of more reliable information on student performance in secondary school has not caused Canadian employers in Quebec (and presumably other provinces with examination systems) to ask applicants to provide information on secondary school grades.

### *3.2--The Effect of Diploma Exams on School Resources and Policies*

Estimates of the effect of exam systems on school resources and priorities are presented in Table 3. The schools in provinces with exam systems are on average twice as large as schools in provinces without exams and are less likely to have primary grades in the building. Since these features of a school influence school policies and resource allocation, it was important to control for these school characteristics.

A most striking effect of the Canadian diploma exams was the increased tendency to have math and science taught by subject specialists and to hire only those who majored in the subject in college for these jobs. In provinces with exam systems, the proportion of public school teachers who had taken courses in their subject at university was 12 percentage points higher for math teachers and 15.6 percentage points higher for science teachers. The percentage of specialist teachers was 16.6 points higher in mathematics and 13 points higher in science. The quality of science labs index was a quarter of a standard deviation higher. In addition, tracking was more common particularly in math.

The hypothesis that public schools in exam provinces would try to hire more experienced teachers (in all subjects not just math and science) receives little support. In fact just the reverse was observed. The other rejected hypotheses are the predictions that exam systems would stimulate reductions in public school class size and increases in teacher preparation time.

As predicted, nonpublic schools were more responsive to the incentive effects of external exam systems than public schools. Their propensity to hire highly qualified specialist teachers rose dramatically when there were external exams. Science labs were also substantially better. Exam systems also induced nonpublic schools to increase classroom instruction hours by one-third in math and by one-fifth in science. Total hours in the school year do not rise so the increase in time devoted to math and science comes at the expense of something else. Nonpublic schools also appeared to employ more experienced teachers and give them more preparation time when they are located in province with exam systems. Public schools did not.

### *3.3 Effects on Teacher Behavior*

Estimates of the effect of exam systems on teaching are presented in Table 4. Proponents of diploma exams predict they will induce teachers to assign more homework, cover more cognitively difficult material, schedule more quizzes and tests, use experiments more frequently in science class, reduce the time that math students spend doing group problem solving and increase the time that students work alone doing math problems.

Opponents of external examinations make opposite predictions: exams will induce teachers to focus on lower cognitive processes like computation in mathematics and facts and definitions in science. Discovery teaching—eg. science experiments--will be cut back. Madeus, for example, points out that "*preparation for high stakes tests often emphasizes rote memorization and cramming of students and drill and practice teaching methods*" and that "*some kinds of teaching to the test permit students to do well in examinations without recourse to higher levels of cognitive activity* (1991 p. 7-8)."

The findings are consistent with the predictions of exam proponents, not their opponents. Emphasis on whole number computation--a skill that should be learned by the end of 5th grade—was significantly lower in exam provinces. Students did more (not fewer) experiments in science class. Teachers also did more experiments in front of the class. Apparently, teachers subject to the pressure of a provincial exam four years in the future adopted strategies that are conventionally viewed as "best practice," not strategies designed to maximize scores on multiple choice tests. Private school teachers also scheduled more in-class time for students to work on mathematics problems by themselves.

Provincial exams were also associated with students doing .82 hours of extra homework per week in all subjects and .19 (.15) extra hours of homework per week in mathematics (science). Public school students reported taking more in class quizzes and tests when they lived in diploma exam provinces. Students in nonpublic schools did not.

The argument cited by Madeus can also be challenged on a priori grounds. It assumes that examinations developed by the committees of teachers working for provincial Ministries of Education are worse than the tests developed by individual teachers. In fact, the tests that teachers develop for themselves are generally of very low quality. Fleming and Chambers (1983) study of tests developed by high school teachers found that four-fifths of the items on teachers' tests tapped the lowest of [Bloom's] taxonomic categories, knowledge (of terms, facts or principles)." Rowher and Thomas (1987) found that only 18 percent of history test items developed by junior high teachers and 14 percent items developed by senior high teachers required the integration of ideas. University instructors, by contrast, required such integration in 99 percent of their test items. Secondary school teachers test low level competencies because that is what they teach. This should be no surprise when one realizes that many are teaching

subjects that they neither majored in nor minored in at university. Provincial diploma examinations, by contrast, get a great deal of high level professional scrutiny. Item writers are generally drawn from the ranks of the most outstanding teachers and all items are pre-tested and checked for bias. Well designed external examinations will induce improvements in instructional practice. Sherman Tinkelman, New York State's Assistant Commissioner for Examinations and Scholarships, describes one such instance:

> For years our foreign language specialists went up and down the state beating the drums for curriculum reform in modern language teaching, for change in emphasis from formal grammar to conversation skills and reading skills. There was not very great impact until we introduced, after notice and with numerous sample exercises, oral comprehension and reading comprehension into our Regents examinations. Promptly thereafter, most schools adopted the new curricular objectives (Tinkelman, 1966 p. 12).

A further benefit of diploma exams is the professional development that teachers receive when they are brought to centralized locations to grade the extended answer portions of the examinations. In May 1996 I interviewed a number of Alberta teachers union leaders about their experience serving on grading committees. Even though they and their union have opposed the examination system for years, they all said that having to discuss and agree with their colleagues about what constituted an excellent, good, adequate, poor, and failing response to essay questions had been "a wonderful professional development activity (Bob, 1996)."

## IV. Effectiveness of Non-Public Schools

As in the U.S., most nonpublic schools in Canada were started by religious denominations. Four-fifths of Canadian non-public schools are run by school boards elected by members of a particular religious faith. These schools account for 20.6 percent of the schools in our sample. These schools have a religious character, but they are parts of quasi-public bureaucracies and are likely to be constrained by the political process—an important disadvantage in Chubb and Moe's view. In 1991 many of these schools were less well funded than the public schools in their province. The parents of students attending schools run by religious school boards were more advantaged, were more concerned about school, more interested in science and more likely to buy their child a calculator (see Table 2). Students were more likely to think that math and science was useful and necessary to get a good job. Homework assignments were greater and discipline was better. However, these schools do not appear to place math and science instruction at the very top of their priority list. They were less likely to have teachers who studied math and science in college and less likely to have specialists teaching math and science. They scheduled less time for teaching science and had lower quality science labs (see Table 3). When background characteristics of

the students are controlled, students in schools run by religious school boards in provinces without external exams scored 5.4 to 3.9 points lower on IAEP math and science tests than public school students in these provinces. On the other hand, their principals were significantly less likely to report discipline problems. Apparently the religious denominations that control these schools and the parents who send their children to them were primarily seeking better discipline and ethical and moral climates consistent with their beliefs, not better math and science teaching. Fewer resources were devoted to math and science teaching and lower achievement resulted.

The other 20 percent of "nonpublic" schools were split pretty evenly between non-sectarian independent schools and sectarian schools controlled by religious denominations. These schools look a lot like American private schools. Parents were more advantaged, were more likely to talk to their child about math class and to be characterized as urging their child to do well in math. Students were assigned 2 to 3 hours more homework per week. Students in the nonsectarian private schools watched 2 to 3 hours less TV per week than public school students. However, where there were no provincial diploma exams, these schools were less likely to hire math and science teachers who majored in the subject in college and scheduled .88 to 1.2 fewer hours of math instruction per week, .46 to 1.07 fewer hours of science instruction than comparable public schools. Their teachers were less experienced and class sizes were larger than public schools in the province. When there were no controls for the family background of students, achievement levels were substantially higher. When the family background of students was controlled, independent school students outperformed public school students in mathematics but not in science.

Comparisons with public schools become more favorable to independent private schools when they are located in provinces with diploma examinations. These private schools had better science laboratories, were more likely to hire teachers who majored in the subject, and scheduled at least as much time for math and science instruction as public schools in the province and gave their teachers more time to prepare lessons. Their teachers tendd to be more experienced that the private school teachers in provinces without diploma exams.

Thus, Chubb and Moe's (1990) theory that, because they operate in a competitive environment, private schools are more effective at producing academic achievement than public schools may need to be amended. Yes, competition tends to force institutions to be more effective, but the salient criterion by which effectiveness is defined may not be student achievement in mathematics and science or in any other subject. In provinces without diploma exams, parents may not have the information available to them that would allow them to pick schools on the basis of academic achievement of pupils. Lacking reliable comparative information on student achievement, parents will judge schools by other criteria -- discipline,

the availability of special instruction programs, and the specific cultural and religious values proclaimed by school management—that are easier to measure. Thus the character, behavior and effectiveness of private schools in a community will depend on how well student achievement is signaled and how the larger society honors and rewards different types of student achievement.

## V. Summary

**School Governance:** The analysis provides a comparison of achievement levels in public and various types of "nonpublic" schools. Twenty percent of the schools in the sample were run by school boards elected by members of a religious denomination. They tended to serve a more advantaged clientele but were clearly less effective at teaching math and science than public schools.

I**ndependent** sectarian and non-sectarian schools accounted for about 5 percent of the schools in the sample. Some but not all receive modest subsidies from the government. All charge tuition. When children from families of comparable socio-economic status are compared, independent school students did not out perform public school students in science. In mathematics, however, they did outperform public school students. The achievement advantage of private independent schools was greatest in provinces with diploma exams.

These findings suggest that it is the independence of private schools not their religious character that makes them more effective than public schools and that this advantage is greatest when student achievement is signaled by curriculum-based external exit examinations.

**Diploma Exams:** The hypothesis that CBEEEs induce students, parents teachers and school administrators to refocus their energies on academic achievement was tested by comparing schools in nations and Canadian provinces with examination systems to schools in nations and provinces without exam systems. Our analysis found that, controlling for GDP per capita and East Asian nation, that middle school students in nations with curriculum-based external exit examination systems had significantly higher achievement in mathematics, science, literacy and geography. There appears to be a non-linear relationship between student achievement and the size of the private school sector. Countries with no private schools had significantly higher average achievement levels than countries where 5 to 25 percent of students attended private schools. Nations with very large private sectors—Hong Kong, Belgium and the Netherlands—also had significantly higher mathematics achievement levels than nations with a small private sector.

Canadian students from diploma exam provinces watched less TV and were more likely to have calculators. Parents were more frequently reported to be interested in science, to care about learning math and more likely to talk to their child about what they were learning at school. In the provinces with

external exams, schools were more likely to:

--employ specialist teachers of mathematics and science
--hire math and science teachers who had studied the subject in college
--have high quality science laboratories
--schedule extra hours of math and science instruction
--assign more homework in math, in science and in other subjects
--have students do or watch experiments in science class and
--schedule frequent tests in math and science class.

Public school students in the exam system provinces were 18 percent of a standard deviation better prepared in mathematics and 15 percent of a standard deviation better prepared in science than comparable students from provinces lacking such exams. When the comparison is made among private school students, those who attended school in diploma exam provinces scored 30 percent of a standard deviation better in math and 14 percent of a standard deviation better in science than private school students from non-exam provinces.

There is no evidence that external exams caused any of the undesirable effects that opponents of external exams have predicted. Canadian students in provinces with exit exams did not watch fewer science programs on TV and reading for fun went up, not down as opponents predict. Contrary to the predictions of exit exam opponents, mathematics teachers decreased their emphasis on low level skills like computation and science teachers arranged for students to do more, not fewer, experiments.

**Policy Recommendations**

Historically, most Canadian provinces have funded schools partly from local property taxes and partly from provincial grants.[7] Negotiations over teacher salaries have often, however, been handled at the provincial level. During the past decade provinces have been taking over the property tax and assumed complete responsibility for funding K-12 schooling. As a result, school funding in most of Canada will soon be based purely on enrollment—linearly in some provinces and for some expenditure categories and in discrete jumps in other provinces and for other expenditure categories. Generally students may attend public school outside their local school district if space is available and parents assume transportation costs. This phenomenon is likely to increase the positive impact of diploma exams on teaching and learning.

The clear implication of the empirical findings is that provinces that do not currently have diploma exams should develop them. Not all diploma exam systems are equal, however. The success of the system will depend in part on the process by which they are developed and implemented. What can we learn about the process of developing and implementing diploma exams from the experience of Alberta, Manitoba and New Brunswick? The comments below are a distillation of what I learned from extensive

conversations with teachers, union activists, school principals and officials in charge of testing and assessment in these three provinces.

**If a province wants to introduce Curriculum-Based Examinations (whether at 12th or lower grades), How should it go about deciding what kind of exams to develop and building support for the exams as the development process proceeds?**

1. Specify what students in each course are expected to learn and be able to do at the end of the course (or sequence of courses) that is to be examined.

* This Curriculum Framework should be developed primarily by teachers.

* Involve teachers from many different backgrounds and school districts.

* Involve the teachers union in the selection of classroom teachers to help develop curriculum frameworks and content standards.

* Do not the let desires to externally assess outcomes drive decisions about curricular emphasis.

* BE cautious about trying to simultaneously implement major changes in curriculum and a new examination system to force teachers to implement the new curriculum. An incremental approach to changing curriculum is probably desirable.

2. Classroom teachers and assessment specialists in New Brunswick, Alberta and Manitoba are convinced that most upper secondary students will not put effort into an assessment if it is not part of their final grade in the course. This is particularly true for more authentic types of assessment such as writing an essay.

3. Once the curriculum frameworks have been established: Decide which skills, competencies and knowledge can be feasibly and fairly examined externally. Take the time required to write and grade the assessment into account in making that decision. Manitoba decided that writing and reading process skills would be externally assessed. This implied that other elements of the curriculum--listening, speaking skills and knowledge of literature--were to be solely assessed by the teacher. Knowledge of literature was not assessed externally because the province did not want to specify a set of books and readings that all teachers would be required to assign.

4. How large an impact on final course grades should the external assessment have?

* Decide: What weight should the skills and knowledge that can be externally assessed have in students' overall final grade in the course?

* Decide: What share of the grade for these skills should be determined by the external exam and what share should be determined by continuous assessment by the teacher? Give the external assessment a very low weight at first. When the kinks have been ironed out and teachers have adapted to it, the weight should be raised. In my view the weight given to external assessment probably needn't ever rise above 50 percent.

* Some outcomes cannot be assessed by external assessors in a way that fairly and reliably compares students and schools at a reasonable cost. For example, the RAND evaluation of Vermont's

effort to compare school districts by sampling portfolios found that external evaluations of portfolios have low reliability and are very costly. If the curriculum calls for students to develop portfolios, the classroom teacher or a locally recruited set of judges should probably be the evaluators. Guidance can be provided by developing scoring rubrics and publishing examples of work exemplifying performance at specified levels.

5. Involve classroom teachers in developing the external assessments. Phase the development process so that provincial/state assessment staff are not overburdened. Consider forming a consortium with other provinces/states to share costs.

6. Pilot test all questions and tasks and ask for feedback from teachers regarding the items and tasks that were piloted in their classes. Pay teachers and their districts for the time they put into piloting the assessment. Develop multiple parallel versions of the assessment.

7. Inform all teachers about the structure of the exam and the topics that are being assessed.

8. Offer teachers professional development in how to best teach their students the skills being assessed.

9. Exams must be graded quickly. This is essential because exam grades are part of the final course grade and because students who fail the course or do poorly in the exam should have th opportunity to retake the course and the exam during the summer

10. Bring teachers from the province together in a central location to grade the exams. Each paper should get at least two reads. Involve as many of the provinces teachers in the grading as possible. The teachers I interviewed in Alberta and Manitoba said that grading the exams with their colleagues was the best professional development experience they had since entering the profession. Once the system has been operating a few years, classroom teachers who have done centralized grading might be allowed to do the first read/grade of their own student's papers.

11. Try to schedule the grading for semester break or a vacation so that substitutes do not have to be hired while the grading proceeds. If that is not possible, local district should be reimbursed for hiring subs. Since the course material that is not going to be externally assessed can be covered after the external exam, it may be possible to schedule the exam a month or more before the end of the semester to give extra time for grading.

12. Pay teachers an honorarium for their grading work. British teachers boycotted new authentic exams over this and other issues. Their boycott was ruled legal because grading the exams was a change in conditions of employment that was not part of the teacher contract.

13. Give students who do poorly on the exam an opportunity to retake the course (or attend summer school) to try to bring up their grade in a retest in August or January.

14. Do not force teachers to hand out grades that have the same means as the external assessment.

15. Do not publish school-by-school results for the initial administration of the exam. When school results are published, include contextual information on the socio-economic background of the students and the proportion of the students doing the assessment. Rules need to be established about who is required to take the exam.

16. Encourage provincial universities to incorporate diploma exam grades into their admissions decisions

and to drop the use of SAT-1 tests for evaluating students from their own province.

17. Encourage employers to ask for a high school transcript when young people apply for jobs at their firm.

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**Table 1--Effects of Canadian Provincial Diploma Exams and School Governance on Student Achievement**

| | Diploma Exam | NonPublic ExamProv | Religious Sch.Board | Indep Relig Sch. | Indep Non Sectarian | LnBooks in Home | **Elem, K-11 Size,French** | Adj $R^2$ |
|---|---|---|---|---|---|---|---|---|
| **Math** | | | | | | | | |
| 1 | .070*** (9.53) | | | | | | | .0666 |
| 2 | .052*** (6.87) | | | | | | X | .1012 |
| 3 | .045*** (5.22) | | -.054*** (6.00) | .157*** (7.05) | .089*** (3.82) | | X | .1717 |
| 4 | .045*** (5.22) | .003 ( .13) | -.056*** (4.56) | .155*** (6.20) | .086*** (3.13) | | X | .1710 |
| 5 | .043*** (5.29) | .028 (1.63) | -.054*** (4.65) | .094*** (3.98) | .042 (1.57) | .141*** (14.12) | X | .3126 |
| 6. | .034*** (4.32) | .044*** (2.63) | -.075*** (6.45) | .081*** (3.51) | .027 (1.03) | SchDemog Calc,Comp | X | .3533 |
| **Science** | | | | | | | | |
| 1 | .036*** (6.68) | | | | | | | .0335 |
| 2 | .025*** (4.52) | | | | | | X | .0586 |
| 3 | .031*** (5.78) | | -.052*** (8.02) | .017 (1.07) | .042** (2.49) | | X | .1664 |
| 4 | .033*** (5.37) | -.010 ( .76) | -.048*** (5.42) | .023 (1.30) | .050** (2.51) | | X | .1661 |
| 5. | .030*** (5.24) | -.004 ( .31) | -.039*** (4.75) | -.020 (1.22) | .014 ( .80) | .116*** (16.65) | X | .3461 |
| 6. | .030*** (5.17) | .000 ( .02) | -.042*** (5.06) | -.025 (1.53) | .011 ( .59) | SchDemog Calc,Comp | X | .3486 |
| **Principal Report of Problems with:** | | | | | | | | |
| Absenteeism | .109** (2.15) | .137 (1.30) | -.062 ( .86) | -.507*** (3.54) | -.465*** (2.76) | -.406*** (7.14) | X | .1317 |
| **Discipline** | -.072 (1.49) | .244*** (2.40) | -.243*** (3.51) | -.490*** (3.58) | -.365** (2.24) | -.277*** (5.03) | X | .0828 |
| **Within School Standard Deviation** | | | | | | | | |
| Math | .0047 (1.21) | -.0165** (2.08) | .005 ( .96) | -.007 ( .68) | -.020 (1.54) | Bks, StdBk Lang,Sibs | X | .0576 |
| Science | -.007** (2.10) | .0024 ( .37) | -.0018 ( .41) | .0061 ( .69) | -.0171* (1.67) | Bks, StdBk Lang,Sibs | X | .0322 |

Within-school standard deviations had means (standard deviations) of .22 (SD=.050) for math and .17 (SD=.040) for science. The school problem indexes range from 0 = "no problem" to 3 for "serious". The means (standard deviations) were .78 (SD=.72) for discipline and .82 (SD=.77) for absenteeism.

**Table 2--Effects of Canadian Provincial Diploma Exams and School Governance on Student Attitudes and Behavior**

| | Mean | StdDev | Exam Prov. | NonPub Exam | Relig. SchBrd | Indep Relig | Indep NonSect | Adj. $R^2$ | Hyp |
|---|---|---|---|---|---|---|---|---|---|
| **Student & Parent Behavior** | | | | | | | | | |
| TV-Sch. Avg Hrs/wk | 14.7 | 2.85 | -.873<br>(5.09) | .878<br>(2.47) | .399<br>(1.62) | -.402<br>(8.09) | -3.590<br>(6.43) | .289<br>2.32 | -/- |
| Read for Fun Index | 1.85 | .28 | .013<br>( .68) | .145<br>(3.64) | -.071<br>(2.58) | -.053<br>( .96) | -.080<br>(1.28) | .141<br>.261 | -/0 |
| Watch NOVA, Nature | .97 | .38 | .023<br>( .86) | .172<br>(3.11) | .005<br>( .14) | -.203<br>(2.62) | -.045<br>( .52) | .132<br>.361 | -/0 |
| Have a Calculator | .88 | .13 | .043<br>(4.69) | -.047<br>(2.44) | .074<br>(5.63) | .019<br>( .69) | .041<br>(1.38) | .087<br>.125 | ?/+ |
| Parents talk with me about Math class | .62 | .17 | .043<br>(3.47) | .005<br>( .20) | .032<br>(1.83) | .027<br>( .75) | .063<br>(1.57) | .041<br>.166 | +/? |
| Parents talk with me about Science Class | .47 | .17 | .055<br>(4.37) | .026<br>(1.00) | .001<br>( .07) | -.027<br>( .76) | .063<br>(1.54) | .056<br>.169 | +/? |
| Parents wants me to do well in Math | 2.53 | .22 | .076<br>(4.94) | -.087<br>(2.72) | .139<br>(6.31) | .122<br>(2.72) | .238<br>(4.76) | .105<br>.208 | +/+ |
| Parents are Interested in Science | 1.67 | .34 | .072<br>(2.98) | -.055<br>(1.10) | .127<br>(3.68) | .039<br>( .56) | .124<br>(1.57) | .059<br>.328 | +/+ |
| Math “Useful for Solving everyday problems” | 2.04 | .35 | .034<br>(1.54) | -.044<br>( .97) | .132<br>(4.18) | .032<br>( .50) | .085<br>(1.19) | .085<br>.298 | +/+ |
| Science “Useful in Everyday Life” | 1.93 | .33 | .078<br>(2.93) | -.072<br>(1.30) | .203<br>(5.29) | .025<br>( .33) | .160<br>(1.84) | .117<br>.362 | +/+ |
| Math Important to get a Job | 2.56 | .21 | .025<br>(1.67) | -.094<br>(2.97) | .143<br>(6.55) | .052<br>(1.18) | .153<br>(3.07) | .075<br>.207 | +/+ |
| Science Important to get a Job | 1.93 | .33 | -.028<br>(1.23) | -.033<br>( .68) | .214<br>(6.48) | -.030<br>( .45) | .034<br>( .46) | .141<br>.312 | +/+ |

Source: Analysis of IAEP data on 1338 Canadian schools. Control variables not shown included: logarithm of the mean number of books in the home, the mean number of siblings, the proportion of the school's students whose home language was different from the language of instruction, logarithm of the number of students per grade in the school and dummies for French Speaking School, schools with primary grades and schools that include K through $11^{th}$ grade in one building.

**Table 3--Effects of Canadian Provincial Diploma Exams and School Governance on School Policies**

| | Mean | Std Dev | Exam Prov. | NonPub Exam | Relig. SchBrd | Indep Relig | Indep NonSect | Adj. $R^2$ | Hyp |
|---|---|---|---|---|---|---|---|---|---|
| **Administrator Behavior** | | | | | | | | | |
| Math Specialist Teacher | .45 | .50 | .166 | .072 | -.228 | .028 | .013 | .280 | +/+ |
| | | | (5.53) | (1.17) | (5.39) | ( .33) | ( .13) | .422 | |
| Sci. Specialist Teacher | .46 | .50 | .129 | .089 | -.143 | -.061 | -.066 | .280 | +/+ |
| | | | (4.29) | (1.23) | (3.38) | ( .72) | ( .67) | .423 | |
| Math Tchrs-Math major | .66 | .39 | .119 | .209 | -.214 | -.191 | -.135 | .136 | **+/0** |
| | | | (4.46) | (3.79) | (5.70) | (2.55) | (1.55) | .362 | |
| Science Tchrs were Science majors | .69 | .38 | .156 | .160 | -.244 | -.131 | -.084 | .204 | **+/0** |
| | | | (6.16) | (3.05) | (6.83) | (1.81) | (1.02) | .345 | |
| Hrs. Math Instruction | 3.98 | .89 | .057 | 1.244 | -.492 | -.875 | -1.204 | .187 | **+/0** |
| | | | ( .94) | (9.80) | (5.75) | (5.14) | (6.06) | .821 | |
| Hrs Science Instruction | 2.92 | .82 | .029 | .611 | -.634 | -.463 | -1.069 | .152 | +/+ |
| | | | ( .56) | (5.59) | (8.62) | (3.16) | (6.24) | .707 | |
| Science Lab Quality | 1.95 | .95 | .179 | .453 | -3.04 | -.209 | -.019 | .281 | +/+ |
| | | | (3.15) | (3.84) | (3.78) | (1.30) | ( .10) | .802 | |
| Track 8th Grade Math | .13 | .32 | .135 | -.128 | .004 | .185 | .119 | .056 | **+/0** |
| | | | (5.95) | (2.71) | ( .12) | (2.88) | (1.57) | .320 | |
| Track 8th Grade Science | .06 | .23 | .030 | -.003 | -.023 | .094 | .035 | .039 | **+/0** |
| | | | 1.84 | ( .10) | ( .99) | (2.03) | ( .65) | .231 | |
| Proportion New Tchrs | .16 | .15 | .032 | -.088 | .048 | .085 | .055 | .082 | **-/0** |
| | | | (2.93) | (3.93) | (3.00) | (2.80) | (1.57) | .147 | |
| Prop. Experienced Teachers | .59 | .24 | -.043 | .077 | -.048 | -.106 | -.063 | .093 | **+/0** |
| | | | (2.45) | (2.17) | (1.92) | (2.22) | (1.13) | .232 | |
| Teacher Prep Time | .31 | .17 | -.011 | .055 | -.014 | .032 | .049 | .225 | +/- |
| | | | (1.02) | (2.48) | ( .91) | (1.07) | (1.41) | .145 | |
| Class Size | 24.8 | 6.2 | -.244 | .397 | 2.891 | 2.207 | 6.13 | .369 | -/+ |
| | | | ( .68) | ( .53) | (5.68) | (2.17) | (5.16) | 4.92 | |

Source: Analysis of IAEP data on 1338 Canadian schools. Control variables not shown included: logarithm of the mean number of books in the home, the mean number of siblings, the proportion of the school's students whose home language was different from the language of instruction, logarithm of the number of students per grade in the school and dummies for French Speaking School, schools with primary grades and schools that include K through 11th grade in one building.

**Table 4--Effects of Canadian Provincial Diploma Exams and School Governance on Teaching**

| | Mean | StdDev | Exam Prov. | NonPub Exam | Relig. SchBrd | Indep Relig | Indep NonSect | Adj. $R^2$ | Hyp |
|---|---|---|---|---|---|---|---|---|---|
| **Teacher Behavior** | | | | | | | | | |
| Total Homework Time | 4.41 | 1.62 | .818<br>(7.61) | -.794<br>(3.56) | 1.036<br>(6.71) | 2.331<br>(7.47) | 3.135<br>(8.95) | .171<br>1.46 | +/+ |
| Math Homework Time | 1.66 | .64 | .185<br>(3.95) | .071<br>( .73) | .124<br>(1.84) | .125<br>(.92) | .190<br>(1.25) | .051<br>.634 | +/+ |
| Science Homework Time | 1.04 | .47 | .149<br>(4.36) | .082<br>(1.17) | .113<br>(2.32) | .087<br>( .88) | -.048<br>( .43) | .063<br>.461 | +/+ |
| Emphasize Whole Number Operations | 1.68 | .49 | -.061<br>( .17) | -.123<br>(1.70) | .041<br>( .84) | -.035<br>( .36) | -.035<br>( .31) | .036<br>.475 | -/? |
| Math Quiz Index | 1.62 | .52 | .160<br>(5.45) | -.282<br>(4.62) | .039<br>( .93) | .303<br>(3.55) | .556<br>(5.81) | .422<br>.398 | +/? |
| Science Quiz Index | .89 | .38 | .115<br>(4.97) | -.099<br>(2.06) | -.050<br>(1.50) | .143<br>(2.13) | .098<br>(1.30) | .242<br>.313 | +/? |
| Math Do Problems Alone in class | 3.22 | .37 | .006<br>( .22) | .122<br>(2.24) | .052<br>(1.38) | .007<br>( .09) | 1.07<br>(1.25) | .067<br>.358 | +/+ |
| Math—Problems Solved in Groups | | | -.047<br>(1.12) | .022<br>( .25) | .079<br>(1.29) | -.223<br>(1.81) | -.202<br>(1.46) | .143<br>.575 | -/0 |
| Science Do Experiments | 1.52 | .63 | .302<br>(7.02) | -.096<br>(1.08) | .191<br>(3.10) | -.115<br>( .92) | .090<br>( .64) | .155<br>.583 | +/+ |
| Science Watch Experiments | 2.42 | .47 | .129<br>(4.00) | .088<br>( 1.32) | .067<br>(1.44) | -.112<br>(1.19) | -.143<br>(1.36) | .119<br>.438 | +/+ |

Source: Analysis of IAEP data on 1338 Canadian schools. Control variables not shown included: logarithm of the mean number of books in the home, the mean number of siblings, the proportion of the school's students whose home language was different from the language of instruction, logarithm of the number of students per grade in the school and dummies for French Speaking School, schools with primary grades and schools that include K through $11^{th}$ grade in one building.

## Endnotes

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[5] John H. Bishop, "Are National Exit Examinations Important For Educational Efficiency?" Swedish Economic Policy Review, Vol. 6, #2, Fall 1999, 349-401.

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