

The Numbers Don't Add Up: Is it the province and not the students failing math in Nova Scotia?

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Students, parents, and the general public in Newfoundland and Labrador are most fortunate among Atlantic Canadians. At the junior high and high school level, they have access to school level data for provincial exam scores and teacher assigned grades for every school in the province. New Brunswick was not far behind until 2002-2003,¹ presenting provincial exam and corresponding teacher assigned grade data at the high school level in both the Anglophone and Francophone sectors.

Meanwhile, in Nova Scotia, the Minister's Report to Parents shows a different and much more limited story.² At the high

¹ After 2002-2003 New Brunswick's Anglophone sector stopped administering provincial exams and stopped collecting the corresponding teacher assigned grades for provincially examined courses. The Francophone sector continued the practice of administering provincial exams and collecting teacher assigned grades in only two subjects instead of the seven they used to monitor.

² Prince Edward Island is similar to Nova Scotia in that no teacher assigned grades are publicly reported at the school level, though they are readily accessible through Freedom of Information requests. In fact, little school level information is currently reported

school level this report includes only provincial and board level results, and only for a centrally marked sample. The province does not publish the results for every exam written as is done in neighbouring provinces. Nor does it publish the comparable teacher assigned grades, again as is done in the rest of Atlantic Canada. The result is a story that is not only incomplete but is not necessarily accurate either.

As an example, consider what the report said about the Grade 12 Academic Math exam. The provincial average mark was only 39 percent on the 2005-2006 Grade 12 Academic Math exam. None of the province's school boards did that much better, with the exception of Conseil scolaire acadien provincial. Most did worse.

publicly and provincial exams are just now in the design and testing stages. It is unclear whether Prince Edward Island will keep pace with its neighbours and make the school level results on those assessments publicly available.

**Figure 1 – Comparison of Board Level Math 12 Results 2005-2006
Central Sample Reported Averages**

Board	Centrally Marked Sample Average
Annapolis Valley	36.2
Cape Breton – Victoria	36.1
Chignecto-Central	36.4
CSAP	50.4
Halifax	43.0
South Shore	38.7
Strait	42.9
Tri-County	35.2

With only these limited results, you can see that the province did poorly and the school boards all did poorly. Knowing this, the next thing you would want to know is how your school, your child's school, or your community's school performed, right?

Unfortunately, as stated previously, you will not find that information in the Minister's Report. Nor will you get it from the province, or the school boards, and likely not from the schools. At least, not until now.

This happens despite the fact that students are educated in schools, and not in school boards. It is the performance of the individual schools that is most relevant to the day to day education of our children. It is to the specific school that you entrust your child and it is the performance of that

school which you should be most well informed about.

By releasing information on high schools at the school level, poorly performing schools do not get to hide behind strong board results. At the same time, high performing schools don't see their performance misrepresented by poorly performing school boards.

Fortunately, school level data have finally been made available thanks to a long *Freedom of Information* request process. Looking at the data on a school by school basis allows us to point out that there are several schools doing reasonably well on the math exam, at least in comparison to the overall results that seem so troubling. Figure 2 below shows those data, school by school.

Figure 2 – School by School Math 12 Results 2005-2006

<i>School Name</i>	<i>Students Enrolled in Math 12</i>	<i>2005-2006 Math 12 Exam Mark</i>
Saint Patrick's High	44	75.0
Dalbrae Academy	30	66.4 *
Sackville High	86	64.2
Charles P Allen	106	62.7
Auburn Drive High School	131	61.9
Liverpool Regional High	34	61.5
Dr. John Hugh Gillis Regional	103	60.6 *
East Antigonish Education Centre	16	57.7 *
Musquodoboit Rural High	22	57.0
Memorial High	184	55.7
Lockview High	138	55.1
Prince Andrew High	197	54.0
Ecole du Carrefour	12	54.0
Rankin Memorial	11	52.9
Richmond Academy	34	52.5 *
Riverview High	148	52.3
Central Kings Rural High	49	52.2
Inverness Education Centre-Academy	15	52.1 *
Breton Education Centre	49	52.0
Strait Area Education-Recreation Centre	31	49.6 *
Bridgewater Junior-Senior High	16	48.8
Queen Elizabeth High	100	47.7
Halifax West High	148	47.3
Horton High	145	47.0
Lunenburg Junior-Senior High	20	47.0
Chedabucto Education Centre-Guysborough Academy	15	46.3 *
Glace Bay High	137	44.0
Millwood High	77	43.7
St. Mary's Bay Academy	24	43.3
Avon View High	92	42.9
Annapolis West Education Centre	29	42.3
Yarmouth Consolidated Memorial High	91	42.0
Holy Angels High	27	42.0
Middleton Regional High	64	41.6
Sir John A Macdonald High	102	41.1
Digby Regional High	24	41.0
Ecole Secondaire Par-en-Bas	18	43.5
Northeast Kings Education Centre	65	40.7
West Kings District High	80	39.3
New Germany Rural High	40	38.4
Cole Harbour District High	108	37.5



Bridgetown Regional High	17	37.0
Park View Education Centre	69	36.4
Forest Heights Community School	23	35.6
Shelburne Regional High	29	35.0
Dartmouth High	157	34.4
J. L. Ilsley High	92	34.4
Duncan Macmillan High	13	34.3
St. Mary's Academy	15	33.1 *
Drumlin Heights Consolidated	16	32.0
Barrington Municipal High	53	30.0
Cobequid Educational Centre	190	n/a
Northumberland Regional High	143	n/a
Sydney Academy	108	n/a
North Nova Education Centre	96	n/a
Hants East Rural High	73	n/a
Amherst High School	64	n/a
South Colchester Academy	43	n/a
Hants North Rural High	26	n/a
Ecole Secondaire de Clare	22	n/a
Oxford Regional High	17	n/a
Pugwash District High	14	n/a
Ecole NDA	14	n/a
Cape Breton Highlands Academy	11	n/a
Eastern Shore District High	n/a	n/a
Baddeck Academy	n/a	n/a
River Hebert District High	n/a	n/a
Springhill Jr./Sr. High	n/a	n/a
Cabot High	-	-
North Colchester High	-	-
Pictou Academy-Dr T McCulloch	-	-
North Queens Rural High	-	-
Parrsboro Regional High	-	-
Advocate District	-	-
Lockeport Regional High	-	-
Canso Academy	-	-
Islands Consolidated	-	-
Ecole Acadienne de Truro	-	-
Ecole Acadienne de Pomquet	-	-
Ecole Beau-Port	-	-

* – The Strait Regional School Board submitted school by school results as a combined average of Math 12 and Advanced Math 12 exams.

'-' – These schools had fewer than 10 students enrolled in the Math 12 class and therefore their results are not reported.

n/a – data not available³

³ No 2005-2006 Grade 12 Math exam data for schools in the Chignecto Central Regional School Board have been made available by the board. Other schools with an n/a were either missing grade data from their respective school board results or Math 12 enrollment data were not available.



Now based on these results, does it appear that a school like Saint Patrick's High School, with an average provincial exam mark in 2005-2006 of 75 percent, is having the same kind of trouble with math as many other schools? Surely the phones should be ringing off the hook at St. Pat's as their peers from across the province try to learn why and how they are doing so much better than the rest of the province?

Unfortunately the phones at St. Pat's remain quiet because no one knows of its results except the school itself. The phones are equally quiet at the six schools with results in the 60s – Dalbrae Academy, Sackville High, Charles P. Allen, Auburn Drive, Liverpool Regional, and Dr. John Hugh Gillis Regional. While not stellar, these schools' performance is clearly above the provincial average. It would seem to make sense to examine what these schools are doing right and share that knowledge with other schools that are struggling.

Note that four of the five highest performing schools on the Math 12 exam come from the Halifax Regional School Board (HRSB). On the other side of the coin, though, among the lowest performers were HRSB schools Dartmouth High, Duncan MacMillan, and J.L. Ilsley. The South Shore and Strait Regional School Boards likewise have a top performer (Liverpool Regional and Dalbrae

Academy, respectively) and a low performer (Forest Heights and St. Mary's Academy, respectively).

From the perspective of an administrator, would it make sense to pour the same level of resources into improving exam results at St. Pat's and Dartmouth High or Liverpool and Forest Heights or Dalbrae and St. Mary's given the discrepancy in their results? Using only the board results it would.

But looking at school by school results tells you a different story. Following that more accurate and detailed story will allow a board, and a community, to focus collective efforts. It allows everyone to examine where weaknesses exist and what needs work. It also allows everyone to identify strengths to be proud of and celebrate successes where they happen – in schools.

Looking at the Advanced Math results yields a similar story. The reported provincial average of 51 percent and the board averages ranging from 42.9 to 56.9 percent were deemed “better than those for mathematics, but not good”⁴. The fact that four schools had average marks in the 70s – including three schools that also performed well on the Math 12 exam: Charles P. Allen, St. Pat's, and Liverpool Regional – was nowhere to be found in the report.

⁴ Nova Scotia Department of Education, “Minister's Report to Parents – 2006 Student Assessment Results”, April 2007

Figure 3 – School by School Advanced Math 12 Results 2005-2006

<i>School Name</i>	<i>Students Enrolled in Advanced Math 12</i>	<i>2005-2006 Advanced Math 12 Exam Mark</i>
Annapolis West Education Centre	19	74.9
Charles P Allen	118	72.1
Saint Patrick's High	70	71.0
Liverpool Regional High	21	70.0
Queen Elizabeth High	108	69.7
Memorial High	58	69.0
Prince Andrew High	85	67.0
Horton High	91	66.6
Auburn Drive High School	104	65.8
Avon View High	67	65.0
Baddeck Academy	20	65.0
Musquodoboit Rural High	13	65.0
Breton Education Centre	57	64.8
Halifax West High	201	64.7
Sackville High	87	64.1
Dartmouth High	104	63.8
Eastern Shore District High	44	63.2
J. L. Ilsley High	88	61.2
Digby Regional High	20	61.0
Dr. John Hugh Gillis Regional	126	60.6 *
Middleton Regional High	68	60.6
Ecole du Carrefour	14	60.0
Bridgewater Junior-Senior High	15	59.9
Riverview High	138	59.7
Northeast Kings Education Centre	86	58.3
East Antigonish Education Centre	16	57.7 *
Lockview High	101	56.9
Millwood High	60	56.5
Cole Harbour District High	67	55.7
Central Kings Rural High	72	54.1
Richmond Academy	35	52.5 *
Inverness Education Centre-Academy	11	52.1 *
Yarmouth Consolidated Memorial High	42	52.0
Barrington Municipal High	29	51.0
Bridgetown Regional High	24	51.0
Sir John A Macdonald High	100	50.8
New Germany Rural High	37	49.7
Strait Area Education-Recreation Centre	30	49.6 *
Park View Education Centre	67	47.3
Holy Angels High	31	46.4



Chedabucto Education Centre-Guysborough Academy	14	46.3 *
Duncan Macmillan High	20	46.1
Shelburne Regional High	14	43.0
Lockeport Regional High	13	43.0
Forest Heights Community School	55	42.0
West Kings District High	73	36.0
St. Mary's Academy	19	33.1 *
Cobequid Educational Centre	125	n/a
Northumberland Regional High	92	n/a
Sydney Academy	81	n/a
North Nova Education Centre	78	n/a
Amherst High School	58	n/a
Hants East Rural High	57	n/a
Glace Bay High	38	n/a
Pictou Academy-Dr T McCulloch	20	n/a
Hants North Rural High	18	n/a
Ecole Secondaire de Clare	17	n/a
South Colchester Academy	17	n/a
Cape Breton Highlands Academy	16	n/a
Pugwash District High	16	n/a
North Colchester High	12	n/a
Parrsboro Regional High	10	n/a
Advocate District	n/a	n/a
Dalbrae Academy	n/a	n/a
Springhill Jr./Sr. High	n/a	n/a
St. Mary's Bay Academy	-	-
River Hebert District High	-	-
Rankin Memorial	-	-
Oxford Regional High	-	-
North Queens Rural High	-	-
Lunenburg Junior-Senior High	-	-
Islands Consolidated	-	-
Ecole Secondaire Par-en-Bas	-	-
Ecole NDA	-	-
Ecole Beau-Port	-	-
Ecole Acadienne de Truro	-	-
Ecole Acadienne de Pomquet	-	-
Drumlin Heights Consolidated	-	-
Canso Academy	-	-
Cabot High	-	-

* – The Strait Regional School Board submitted school by school results as a combined average of Math 12 and Advanced Math 12 exams.

'-' – These schools had fewer than 10 students enrolled in the Math 12 class and therefore their results are not reported.

n/a – data not available⁵

⁵ No 2005-2006 Grade 12 Advanced Math exam data for schools in the Chignecto Central Regional School Board have been made available by the board. Other schools with an n/a were either missing grade data from their respective school board results or Math 12 enrollment data were not available.



Is Sampling Good Enough?

Until the 2005-2006 school year, neither the department of education nor the school boards released high school provincial exam data at the school level. The boards apparently did not collect information on student performance on provincial exams centrally. The boards left individual schools to handle the collection and application of information from a critical, comparable, province wide management tool. Of course, schools only really had access to their own grades, so the comparability and provincial breadth really was never achieved.

The department meanwhile only collected data on the exams they actually marked, or rather re-marked. You see, the department only marks a sample of the exams written. That sample is randomly selected after the exams are already marked and the grades assigned to the students. The provincial sampling and marking has nothing to do with the final grade that the students receive. It is also not done in an effort to assess the appropriate application of the marking guidelines developed by the teams of teachers and consultants that worked so hard to design and test the exams. Simply put, the sample is not large enough to validly compare difference in

grades assigned by teachers and those assigned by the team marking the selected sample centrally.

The explicit and only purpose of the provincial centrally marked sample is to generate board level summaries of the average performance on the various exams. This is not the average grade assigned (remember, these two are created separately), but the average grade that, in the opinion of the team marking the central sample, should have been assigned had the marking guidelines been accurately followed.

This gives rise to another reporting problem – differences in results reported and actual results awarded to students. As shown in Figure 3, at the provincial level, the average exam result for Math 12 was 39.0 percent. Using the school level data from the school boards, which includes all provincial exams written by all students, the average score awarded to students in Nova Scotia was 47.8 percent,⁶ a difference of 8.8 percentage points. A similar story emerges for Advanced Math, with a school level reported average 4.5 percentage points higher than the reported average for the centrally marked sample.

⁶ This average is based on the average for all school boards except the Chignecto-Central Regional School which has not yet made the 2005-2006 data available.

**Figure 4 – Comparison of Provincial Level Math 12 and Advanced Math 12 Results
Central Sample Reported Average vs. All Results, 2005-2006**

Course	Students Enrolled	School Board Reported Average*	Centrally Marked Sample Average	Difference between Board and Sample Results
Math 12	4229	47.8	39.0	+8.8
Advanced Math 12	3477	55.5	51.0	+4.5

* - The School Board Reported Average is weighted by the number of students enrolled in the course where the exam was written.

Repeating this calculation for the school board level, Figure 5 and Figure 6 show the calculated Math 12 and Advanced Math 12 averages for each board compared to the averages reported in the Minister's Report determined using the centrally marked sample. For the Math 12

exam, teacher marked scores ranged from 0.8 percentage points less than the sample average to 14.4 marks higher than the reported average. Advanced Math 12 differences were less than those in Math 12, ranging from 0.1 to 8.4 percentage points higher than the average reported in the Minister's Report.

**Figure 5 – Comparison of Board Level Math 12 Results 2005-2006
Central Sample Reported Averages vs. All Results**

Board	Students Enrolled	School Board Reported Average*	Centrally Marked Sample Average	Difference between Board and Sample Results
Annapolis Valley	541	43.7	36.2	+7.5
Cape Breton – Victoria	674	50.5	36.1	+14.4
Chignecto-Central	698	n/a	36.4	n/a
CSAP	71	50.8	50.4	+0.4
Halifax	1521	49.6	43.0	+6.6
South Shore	209	43.3	38.7	+4.6
Strait	273	55.9	42.9	+13.0
Tri-County	242	34.4	35.2	-0.8

* - The School Board Reported Average is weighted by the number of students enrolled in the course where the exam was written.



**Figure 6 – Comparison of Board Level Advanced Math 12 Results 2005-2006
Central Sample Reported Averages vs. All Results**

Board	Students Enrolled	School Board Reported Average*	Centrally Marked Sample Average	Difference between Board and Sample Results
Annapolis Valley	500	57.4	49.0	+8.4
Cape Breton – Victoria	431	60.9	52.4	+8.5
Chignecto-Central	518	n/a	46.3	n/a
CSAP	41	58.3	61.6	+3.3
Halifax	1370	59.6	56.9	+2.7
South Shore	210	50.4	42.9	+7.5
Strait	270	54.8	54.7	+0.1
Tri-County	137	51.4	47.3	+4.1

* - The School Board Reported Average is weighted by the number of students enrolled in the course where the exam was written.

Given the differences in the reported and actual averages at the board level, one has to ask which results tell the real story of what is happening where it matters – in schools. Unfortunately in this scenario the answer is neither. The provincial results are based on a sample size which is only large enough to ensure results are statistically valid at the board level, and not at the school level.

The exam results determined by the course teachers, while including all students writing the provincial exams, can nonetheless be skewed in much the same way that teacher assigned grades can be inflated to make up for poor exam grades, as described in AIMS' recent Commentary on grade inflation, "*Setting them up to fail?*"⁷ The pressure to have students get high marks,

whether deserved or not, can lead to extra marks being awarded on an exam to students who may have performed poorly but have done well in the rest of the course.

In the case of math, the nature of the subject may limit the inflation effect. The final answer for most questions will be quantitative and therefore fewer subjective

criteria come into play. The differences in results from the centrally marked sample and the actual exam marks at the provincial and board level, however, show that some of this effect must be coming into play.

Additionally, as the difference between the sample and actual results varies widely from board to board, the board by board comparisons of teacher graded results become more questionable. If one board is inflating grades by 14 marks and another board actually deflating grades, are the exam grades truly an objective assessment of the curriculum, as the exam is intended to be?

⁷ The analysis in the grade inflation commentary was done for New Brunswick and Newfoundland only. Similar analysis for Nova Scotia is not possible until three years of consistent data are available for each school.

The government's solution has been sampling. As we noted earlier, the province does not centrally mark all provincial exams. Classroom teachers mark the exams for their students, and this result is what the student receives for their grade. The province then selects a subset of these exams to re-mark. The purpose of the re-marking is not to reassess students, though. In fact, as stated earlier it has no impact on the final marks received by the students. The number of exams selected for the sample yields an average result that is only statistically valid at the board level.

This is not the right choice because as we have shown samples do not allow a school level comparison to truly show where the strengths and weaknesses of the system are. Board level averages only serve to mitigate the differences between the highs and lows. In other words, it makes all the schools appear to be at the same level – everyone looks good or everyone looks bad. That does not mean, however, that all schools within the boards are achieving at the same level. Areas of weakness are missed, as are high performing schools that potentially have solutions for struggling schools.

So what can be done? As a starting point, collecting and reporting results at the school level for all students writing the exam will identify exactly which schools are struggling and which schools may already have best practices that can be used in other schools. Additionally, this provides a better measuring stick not only for students and parents, who can compare their results with other schools in the province, but for principals and the school community, who can compare the school results achieved with other schools –rather than school boards or the province – to better assess the performance of the school.

While reporting these results at the school level as currently marked will lead to better conclusions, the problem with inflated exam marks still has the potential to skew the real results. Having all exams centrally marked would go an important and necessary step further in ensuring an objective evaluation that truly allows a comparison among all schools and all boards.

This is the current practice in New Brunswick. In the Francophone sector, the day after exams are administered, all exams are marked in a centralized scoring session. Exams are marked by teams of teachers, consultants, and in some cases, Faculty of Education students. All receive training for scoring the exams using a standardized scoring guide. In addition, all are checked periodically to ensure consistency. The results of the centralized scoring session are the results that students are awarded for the exam.

While New Brunswick's Francophone sector has fewer students than Nova Scotia, the New Brunswick Anglophone sector, with a larger number of students, used a central marking session until it stopped administering provincial exams at the high school level in 2003. All exams were marked during a session in the summer months to determine school level results reported publicly in the New Brunswick Anglophone School Districts Report Card.

The cost for the central marking session is roughly \$5 per student for math and science exams, and about double that for language arts exams. In Nova Scotia, 7,876 wrote the Math 12 and Advanced Math 12 exams. At \$5 per student this would yield a total cost for this type of central scoring system, for the Math 12 and Advanced Math 12 exam **combined**, of less than \$40,000. To include the science (1,599 students) and English

(12,009 students) exams in addition to math, the total cost of central scoring sessions would be less than \$170,000.

To put this in perspective, in 2006-2007, the total education spending by school boards in Nova Scotia was \$1.15 billion or \$8,217 per student. The total increase in spending since 2001-2002 was \$223 million. So it would cost $\frac{3}{4}$ of one percent of the *increase* in public spending on education over the past five years to implement this system. Put another way, at \$20 per student for the three exams, the cost would be one quarter of one percent of the total spending per student on education in the province.

Much of that \$223 million increase was supposed to fix the problems with math and literacy already present in the education system. Had a tiny percentage of that increase been spent on putting in place a system that would actually determine not only what the problem was and where the problems were, but even if there really was a problem at all, that \$223 million could have been spent far more wisely.

When pressed for an answer to the question of what is the problem with Nova Scotia's math results, the Minister of Education indicated that if we knew exactly what the problem was, it would likely be fixed by now or at least a solution would be much closer. Given the deficiencies in reporting the results that are considered the problem, it would be more accurate to suggest that it is impossible to even tell whether there is a problem.

We need to commit the resources to get the reporting right. Without the proper reporting, there is no way to know what is happening in schools. Until that happens, no amount of money thrown at the problem will

render a solution. Then again it might, but nobody will ever know.

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