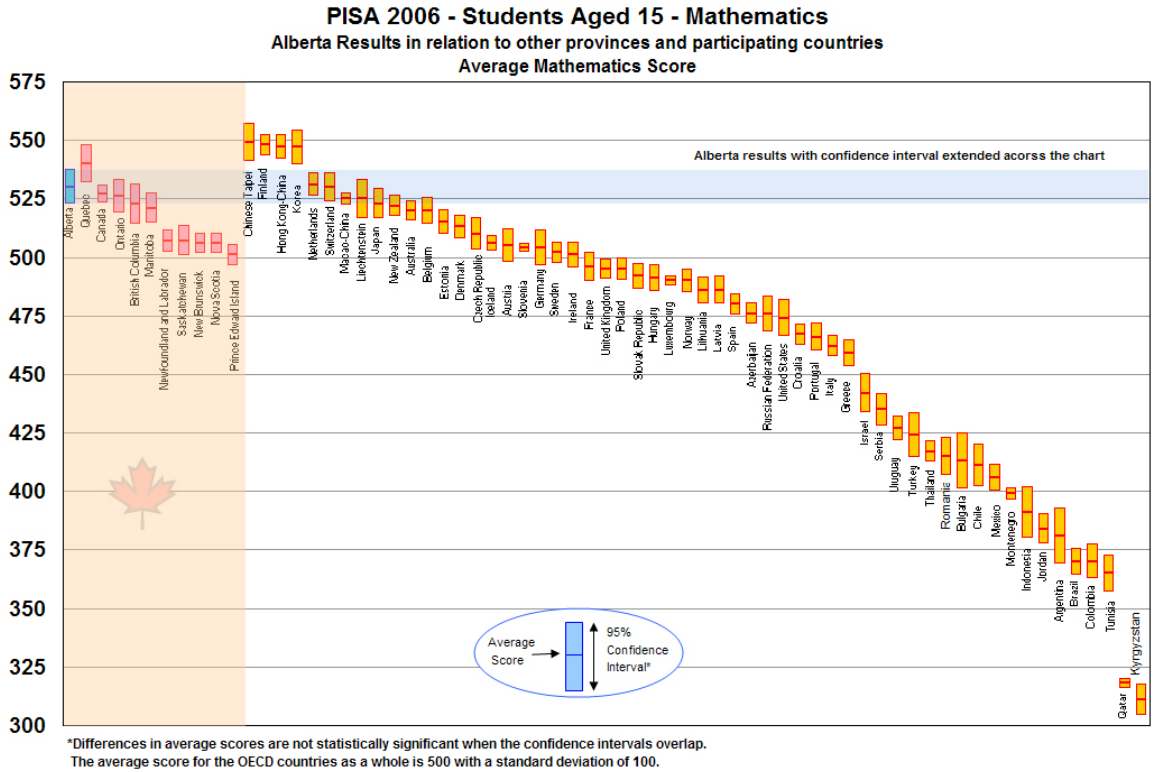
6 June 2010

Dear Ms. DeLorenzo,

As you recall, at the Creighton open house last month we discussed the challenges our children had encountered in our move from Calgary, Alberta to Colorado. I noted that this was not at all a unique experience for families moving from Alberta to the States. Indeed, at meetings of CEOs and HR executives in Calgary, the problems that children of transferees have with the U.S. approach to math is a major source of frustration in a province that routinely ranks among the best in the world – and well above the United States -- on the PISA mathematics test – the gold standard for international comparisons for mastery of mathematical concepts and skills (As described by the US Dept of Education's National Center for Educational Statistics, "PISA is the U.S. source for internationally comparative information on the mathematical and scientific literacy of students in the upper grades at than age that, for most countries, is near the end of compulsory schooling. The objective of PISA is to measure the yield of educational systems, or what skills and competencies students have acquired and can apply in these subjects to real-world contexts by age 15.")



However, following our move from Calgary to Denver earlier this year, this is no longer just a policy issue for me – it has now become personal, as I have observed our children's

transition from the Alberta system, where they excelled at math, to Jeffco, where they have, in a very short period of time, lost their previous enthusiasm for this critical subject.

When we met, you asked me for background materials on the way math is taught in Alberta, so that you could learn more about this issue. I thought then, and still do, that this was exactly the response that you would expect from a professional, whether a doctor, engineer, or educator. However, as I was pulling together materials to send you, my son reported that, after he tried to explain the differences between the way math is taught in Alberta and the way it is taught at Creighton, his teacher bluntly told him that "they don't know how to teach math in Alberta." In light of the utter outrageousness of that comment, I have struggled for the past few weeks with the question of whether to release this story to the Canadian media, as it now embodies so many of the factors that cause the frustration I noted above. To make this clear, consider how the public would react – on either side of the border -- to a Colorado doctor who, despite evidence of Alberta's superior results in treating a particular type of cancer, still insisted that doctors in Alberta "don't know how to treat cancer." I think you get my point.

After discussing this situation with a number of people, I have decided not to go to the media at this point, but rather to present you with a body of evidence that refutes, to a clear and convincing standard, the argument made by your math teacher. Throughout this letter, I will refer to a range of documents. To save you the trouble of searching for and downloading them, I will email them to you separately.

Let me begin with why math education, and therefore this discussion, is so important. Today, the world economy faces its greatest crisis since the Great Depression, with government debt/GDP ratios at levels never before seen except during wartime. A country confronted high levels of debt/GDP basically has three choices. First, it can default. Having spent half the 1980s working out bad loans in Latin America, and seeing the "lost decade" of economic growth and heightened human suffering that resulted from widespread defaults, this is not a course of action that anyone would recommend if there were alternative solutions available. Second, an extremely indebted nation can undergo a prolonged period of extreme austerity – cutting various spending programs and raising taxes in order to bring the primary government budget into surplus, and use these funds to pay down debt. In terms of its impact on an economy and society, this approach has only slightly more to recommend it than default. This brings us to the third, and by far the most preferable option: increasing the growth rate of the economy (i.e., GDP growth), while holding government spending as close to constant as possible. In this case, economic growth will naturally increase tax collections and produce a primary surplus and reduction in the ratio of debt/GDP.

How then, are we to increase the growth rate of the economy? In broad terms, economic growth is a function of the rate of labor force growth and the rate of labor productivity growth. It is hard to make significant changes in the former, though at the margin changes in participation rates and immigration can slightly affect the rate at which the

labor force grows. Given this, when it comes to economic growth, the heavy lifting must be done by increasing labor productivity. Broadly, there are two ways to do this. One is by giving each worker more capital (equipment, computers, etc.). However, as most workers can attest, adding more capital usually improves productivity at a declining rate. To cite a school example, when they were first introduced, a mimeograph machine had an impact on productivity that was likely far greater than the addition of one more Smart Board or computer in 2010. The second way to improve labor productivity, and by far the most important, is improving the quality of labor and capital inputs, and the way an organization is structured to use them. Technically, this is known as "total" or "multifactor productivity." Finding ways to improve MFP is the key to growing out way out of the debt problems we confront today across the OECD countries. Two recent studies show that improving math and science performance are critical to improving productivity growth rates. The first is "The High Cost of Low Educational Performance: The Long-Run Economic Impact of Improving PISA Outcomes", just published by the Organization for Economic Cooperation and Development (OECD). The second study is, "Do Better Schools Lead to More Growth? Cognitive Skills, Economic Outcomes, and Causation" by Eric Hanushek and Ludger Woessmann, published in November 2009 by the Institute for the Study of Labor at the University of Bonn (note that this latter study found that both achieving a basic level of skill for all students and nurturing the development of high performers both had independent positive impacts on economic growth).

Of course, this begs the question of how to improve educational performance. On this issue, there is ample evidence that extreme differences in management practices and productivity exist, not just across, but also especially within different sectors of the economy. For more on this, see these two papers: "Why Do Management Practices Differ Across Firms and Countries" by Bloom and Van Reenen, and "Micro-Efficiency and Macro Growth" by Nallari and Bayraktor of the World Bank. Both papers reach the same conclusion: there is an opportunity to substantially increase rates of TFP growth – and therefore economic growth – just by transferring best practice between firms in the same industry. Logically, this should also be true of education (as studies by Dartmouth have found is true for hospital treatment in the United States).

With that in mind, I'll turn to the time series evidence about comparable performance in mathematics. In Canada, performance on the PISA tests is broken down by province. On the 2000 PISA mathematics test, Alberta trailed only Japan. On the 2003 PISA test, it trailed only Hong Kong, and was followed by Finland, Korea, the Netherlands and Japan. On the 2006 PISA test, Alberta had slipped a bit, and trailed Taiwan, Finland, Hong Kong and the Netherlands. On all these tests, the US ranked far behind (the US does not break out separate state PISA scores). We can, however, see how Colorado compares to other states on the 2009 Grade 8 Math NAEP test, which is the gold standard for inter-state comparisons within the United States. Massachusetts ranked highest on these tests, so I'll compare these two states in the following table:

	Average Score	% Below Basic	% Basic	% Proficient	% Advanced
MA	299	15	34	34	17
CO	287	24	36	30	10

Between 2003 and 2009, Colorado's average score on the Grade 8 Mathematics NAEP rose from 283 to 287. During the same period, Massachusetts' score increased from 287 to 299.

I realize that the first objection to any comparison like the one I've just made is that it is invalidated by differences in demographic inputs. I agree that this is critical to take into consideration, and that value added beyond what is predicted by demographic inputs is a very important metric. In this regard, I have not attempted to do a value added analysis, because measurement of the input and output variables differs between the United States and Canada. However, the following table provides evidence that undermines the hypothesis that the observed differences in scores are wholly due to different demographic inputs:

Demographic Inputs Comparison			
Factor	**Alberta**	**CO**	**MA**
Total Population (millions)	3.3	5.0	6.6
Pct of Population that is Foreign Born	16.0%	10.1%	14.2%
Pct 25+ with at least BA degree	20.1%	35.0%	37.9%
Pct without HS Diploma	15.4%	11.1%	11.6%
Median Family Income in USD	$76,698	$69,745	$81,056
Pct Children <18 in Single Parent Family	17.6%	26.0%	27.0%
Pct of Children Below Poverty Line	11.0%	15.0%	12.0%

This raises an obvious question: What other systematic factors could account for the observed differences in performance on mathematics tests?

My hypotheses include the following: (1) Differences in teacher quality; (2) Differences in class size; (3) Differences in school management; (4) Differences in testing and accountability; and/or (5) Differences in school choice; (6) Differences in math standards and curriculum design; (7) Differences in teaching methodology.

There is abundant evidence about the impact of teacher quality (see, for example, the evidence cited by Eric Hanushek in the paper, "Economic Aspects of Improving Teacher Quality", that he delivered at the Harvard conference on teacher merit pay earlier this month). However it is both hard to measure and, more important for my purpose here, I can find no evidence that average teacher quality systematically differs between Alberta and Colorado.

What about differences in class size? The following table (based on the most recent data available) suggests that the systematic differences here can't account for the observed differences in math results:

	Alberta	CO	MA
Avg. Elementary Class Size	20.0	21.2	19.2
Avg. Secondary Class Size	22.7	23.7	19.7

What about differences in school leadership and management? The behavior of a principal, the role of the central office, the approach to innovation, and the quality of relations between school committees, principals and unions are all undoubtedly important, but also hard to measure. In terms of systematic differences, two come to mind. The first is Canada's relatively more collectivist culture, which tends to produce a less adversarial relationship with teachers unions. However, that wouldn't explain the performance difference between Colorado and Massachusetts. So again, the impact of this factor on differential performance doesn't appear to be strong. The second difference that comes to mind is the systematic approach that Alberta Ed has taken to innovation. I've attached two reports, widely separated in time, that give you a flavor for their approach. The first is from 1999, and is the report of the Teaching Practices Project on excellence in teaching math. The closest analogue to it that I've seen in the US is the New York Times article on "Building a Better Teacher" (7Mar10, by Elizabeth Green) that highlighted Doug Lemov's work (and his new book, "Teach Like a Champion"). The second Alberta report is from two years ago: "Improving Math Learning in Alberta". These two reports only scratch the surface of what has been a very systematic and evidence based approach to educational innovation in Alberta, that has not only enabled the Province to pilot a lot of new ideas, but also to quickly terminate the ones that don't deliver promised results (i.e., they kill them before they can develop strong political constituencies) while also aggressively rolling out the ones that do meet this test. My instinct is that these are systematic factors that have a significant impact on the observed differences in math results.

When it comes to testing and accountability, I don't believe there are significant systematic differences between Alberta, Colorado and Massachusetts.

On the other hand, there are significant differences in school choice between Alberta and the two U.S. states. As a result of decisions made following the British conquest of Quebec, Canada has historically had a system where tax money follows the student, regardless of whether he or she attends a public, religious, or independent school. Similarly, Canada has charter schools that report to public boards of education (school boards) and are sponsored by religious organizations. I realize that this is a very substantial difference from U.S. practice, and at variance with the historical development of educational funding in this country. However, the point here is that the school choice environment is a systematic factor that could be having a statistically significant impact on the observed differences in math test scores.

Let me move on to standards and curriculum design. There are significant differences in this area between Alberta, Colorado and Massachusetts. I have tried to approach this issue from a number of perspectives. At the state level, I have found a ranking by the Thomas Fordham Foundation of state math standards that was published in 2005. It gave Colorado's standards a "D" grade in 1998, 2000, and 2005. The Fordham report noted that Colorado's math standards "remain vague and confusing, with a plethora of time wasting activities and odd development of key mathematical skills." By comparison, Massachusetts' math standards received an "F" grade in 1998, a "D" grade in 2000, but an "A" grade in 2005. In terms of comparison with Alberta, I'm attaching Alberta Education's most recent standards and curriculum guide. As you can see, it is quite different from the Colorado state standards. I also realize that at Creighton, Jeffco standards are perhaps more important than the state standards. I have attached what I believe to be the most recent Jeffco standards (based on what I could find on the county website). As you can see, there are significant differences between Jeffco and Alberta in this area.

Finally, let me say a few words about teaching methodology. While I am not an expert in this area (despite having been raised in a family of teachers), I have seen major differences between Alberta and Colorado that I strongly suspect have a statistically significant impact on the observed differences in math scores. First, Alberta attempts to involve parents in their children's education in a consistent and systematic way. For example, I've attached the Parent Curriculum Handbook for Grade 8, and the Parent Curriculum Handbook for math. I have yet to find similarly comprehensive documents at either the Colorado state or Jeffco level, where approaches to parental involvement seem much more ad hoc. Second, math homework is a radically different experience in Colorado than it was in Alberta. I would characterize the role of Grade 8 math homework that I have observed in Colorado as "teaching swimming by the case method." In my experience, students are routinely sent home with 3+ hours of homework per night. In the math area, they are expected to learn new concepts while doing their homework, which is then reviewed (and frequently graded) the next day. Needless to say, this leads to an extremely stressful experience for both students and parents. The contrast with Alberta couldn't be more stark. To begin with, Alberta has taken to heart the substantial volume of research findings about the role and appropriate amount of homework (I'm attaching examples of this research, including the Government of Queensland Parliamentary Research Report on "Homework for the 21st Century", Cameron and Bartel's study of "Homework Realities" published by the University of Toronto, "Does Homework Improve Academic Achievement?" by Harris Cooper, and "The Case for and Against Homework" by Marzano and Pickering). In Alberta, students get less homework (which enables them to participate in other activities without sacrificing enormous amounts of critical sleep), it is used to reinforce concepts that have already been taught, and it is graded much less frequently (full disclosure: my wife coached the Math Olympiad team at our children's middle school in Calgary). As a result, homework in Colorado is a much more stressful experience for parents and students. In terms of systematic factors that help to explain the observed differences in math test scores, I have no doubt whatsoever that the

different approache to homework is statistically significant.

So let me conclude. In this letter, I hope I have demonstrated for you that (a) improving total factor productivity is critical to the economic wellbeing of all OECD countries; (b) that improving math and science education are critical to improving TFP; (c) that transfer of best practice can help produce those gains in a short time frame; (d) that there is clear and convincing evidence that Alberta significantly outperforms Colorado in math education; (e) that the observed differences between Alberta and Colorado aren't due to demographic differences; (f) that certain systematic factors likely account for them; and (g) that some of these systematic factors can be improved via the transfer of best practice between Alberta and Colorado.

Most of all, I hope that I've convinced you that your colleague is dead wrong when she tells my son that, "they don't know how to teach math in Alberta." On the contrary, all the evidence points to Alberta math teachers being among the best in the world in meeting this critical challenge. However, if your colleague would prefer to persist in her belief despite the evidence I've presented, then I would be very happy to arrange for her to debate this point with Alberta educators in a public forum.

Sadly (but realistically), having spent the majority of my career turning around failing organizations around the world, I do not expect that your colleague will change her approach to teaching math, even when confronted with the evidence I have presented in this letter. I understand all-too-well the limitations of human nature when it comes to change. More importantly, I have also watched as our oldest child, who scored in the 98th percentile in this year's Alberta Provincial Achievement Test for Grade 9 math, arrived in Grade 8 at Creighton and in three short months lost his previously high enthusiasm for this subject. I will not let this happen again with our other children, who are also in the G&T program at Creighton. As the old saying goes, "fool me once, shame on you; fool me twice, shame on me."

Given this, as soon as possible, we need to discuss how our two other children can avoid the math teacher in question while still participating in Creighton's G&T program, and while still receiving an excellent education in math that enhances their enthusiasm for this critical subject. I have no doubt that such alternatives exist – you and I and my wife, Susan Miller, just need to work together to identify and implement them.

I look forward to further discussing these issues with you at your convenience.

Very truly yours,

Tom Coyne