

# **High School Graduates' Weak Mathematics Skills Put Public Safety and the Protection of the Environment at Risk**

**An Observation**

**The New Brunswick Society of Certified Engineering Technicians and Technologists/  
Société des techniciens et des technologues agréés du génie du Nouveau Brunswick\***

**\*Mandated to help produce the highest standard of graduates possible for  
work in the engineering and applied science technology fields.**

**September 2013**

### Acknowledgement

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There is a warning light flashing on our monitoring panel pointing to a problem that needs to be addressed. The mathematics skills of New Brunswick high school graduates preparing for careers in science and engineering technology at our community colleges are below where they need to be. Over the past decade the scores for New Brunswick high school students on national and international tests were lower in comparison to high school students in other provinces. Over the same time period the scores on provincial administered mathematics assessments show little, if any, improvement. Recently, community college technology instructors rated their students' math-skills as being "somewhat" to "poorly prepared" in order to successfully complete a program of technology study at their campuses. One instructor observed that "Students generally are not prepared in mathematics. As a mathematics teacher, I am assessing their levels of knowledge daily. Unfortunately, the level is low. They are struggling to implement their knowledge." Another instructor stated "The majority of students have difficulty with basic operations, simple calculations and control of the calculator." These insufficient math skills weaken the qualifications of individuals whose training and experience protect public safety and the environment.

The New Brunswick Society of Certified Engineering Technicians and Technologists/ Société des techniciens et des technologues agréés du génie du Nouveau Brunswick is an independent organization founded forty years ago to do two things: generate recognition of the role of certified engineering technicians and technologists and assist the post-secondary training facilities of the province to produce the highest standard of graduates possible for work in the engineering and applied science technology fields. Under the *Engineering Technology Act* legislated in June, 1986 the Society certifies engineering/applied science technicians and technologists who meet established national standards in education and experience. The Society confers the designations Certified Technician (CTech) and Professional Technologist (PTech) which are designations of achievement in engineering/applied science technology. Other designations which have been granted by the Society are Certified Engineering Technician (CET) and Certified Engineering Technologist (CET).

Only upon successful completion of a nationally accredited post-secondary two or three-year applied science or engineering technology program can a graduate in New Brunswick be eligible to join the Society as a “Technology Graduate in Training” (TGIT). This designation recognizes that the graduate has the necessary academic qualifications for possible future certification, but still requires 24 months of discipline specific technical experience in order to gain full membership. Applicants from outside New Brunswick who completed an applied science or engineering technology program accredited by the Canadian Council of Technicians and Technologists (CCTT) must pass the Professional Practice and Ethics Examinations as part of the Society’s certified membership application process. New Brunswick Community College graduates complete the Society’s Professional Practice and Ethics Examinations as part of their program.

Certified Technicians (CTech) or Certified Engineering Technicians (CET) are capable of performing varied technical tasks in specialized fields of applied science or engineering technology. Through a specific combination of academic qualifications, training and experience, Certified Technicians assumes responsibility for many aspects of work within a specialized area of a given field of practice.

Certified Technicians study a nationally standardized set of applied mathematics and science fundamentals deemed essential to their field of concentration. The classroom portion of their college training, usually one or two years long, also includes laboratory and project work amounting to approximately one third of the total program. They generally use a practical approach in solving technical problems based on a detailed understanding of standard methods and techniques. Technicians work under general supervision in areas such as engineering, architecture, building, surveying, forestry, bio-sciences, chemistry, and resource or systems management. Typical activities include testing, troubleshooting, inspection, calibration, design drafting, quality control, maintenance, modelling, data compilation, estimation, sales, surveying, and field supervision. Certified technician are bound by a professional code of ethics and are recognized throughout Canada by either the CTech or CET designations.

The Professional Technologist (PTech) is capable of assuming and exercising independent judgement to develop and manage technology through acquired academic training and related experience. The Professional Technologist is a graduate of nationally accredited technology diploma programs (typically two or three years duration) or equivalent, who have completed two or more years of progressive experience in an area of work directly related to the program and who have received favourable supervisory references.

The Professional Technologist may carry out a wide range of complex analytical work either independently or under general direction in fields such as engineering, architecture, building, surveying, bio-science, chemistry and resource or systems management. Typical activities include design, production, marketing, testing, quality control, estimation, surveying, inspection, diagnostic evaluation, supervision, management, technical sales and teaching. Such activities may be carried out in association with other professionals.

Professional Technologists may assume managerial or administrative responsibility for a wide range of technical endeavours. They may supervise and coordinate a diverse working group and train less experienced technical and professional staff. They are bound by a professional code of ethics, the *Engineering Technology Act of New Brunswick*, and are recognized by the designation throughout Canada and around the world.

The purpose of required discipline-specific technical work experience is to ensure applicants can apply the principles of applied science/engineering technology gained through academic study, and have the minimum experience in practical applications and procedures required in the workplace. Work experience gained while attending a New Brunswick community college technology co-op program may be accepted as a portion of the total twenty-four months requirement. Relevant work experience is essential for individuals whose training protects public safety and the environment.

The Society's caution light blinks because community college instructors must take additional time that could be devoted to work experience to remediate math skills that were expected to have been learned in grade school.

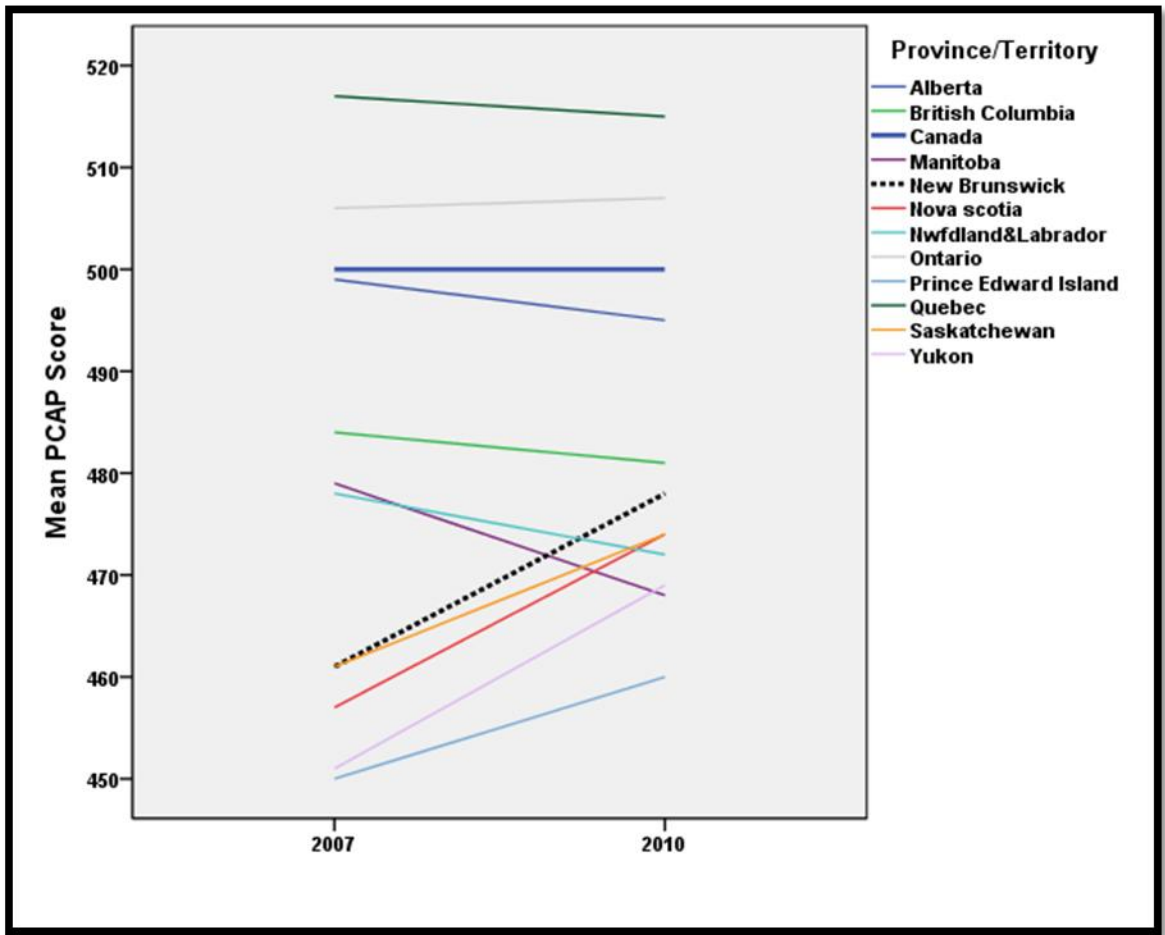
The fact that New Brunswick students are weak in mathematics has been known for the past two decades from their scores on provincial, Canadian and international large-scale testing programs. The reason for testing is best stated by The Organisation for Economic Co-Operation and Development (OECD) “The skills and knowledge that individuals bring to their jobs, and to society, play an important role in determining our economic success and overall quality of life...and governments in industrialized countries have devoted large portions of their budgets to provide high quality schooling. Given these investments, they are interested in the relative effectiveness of their education system.”

The province has been participating in national and international testing since the early 1990’s when New Brunswick students’ lower than average performance in mathematics in comparison to their peers was first noted on the **School Achievement Indicators Program (SAIP)**. This test was introduced by the Council of Ministers of Education, Canada (CMEC) to look at the student achievement of 13- and 16-year-olds in reading, writing, and mathematics in a Canadian context.

Announced in 1989 the **School Achievement Indicators Program (SAIP)** was developed to answer the question: “How well are our schools preparing students for a global economy and for lifelong learning?” The first assessment in mathematics took place in the spring of 1993 and the results showed the performance of both 13-year olds and 16 year-olds in New Brunswick below the Canadian average for both age groups. On the next administration in 2001 the **SAIP** mathematic performance of New Brunswick students was once again below the average of the rest of Canada.

In the spring of 2007 the CMEC replaced **SAIP** with the **Pan-Canadian Assessment Program (PCAP)** limited to 13-year-olds only. This was in order to merge it with another testing program that focused just on 15-year olds. The purpose of **PCAP** was “...to inform Canadians on how well their education systems are meeting the needs of students and society. The information gained from such an all-Canadian assessment gives ministers of education a basis for examining the curriculum and other aspects of their school systems.”

The CMEC’s test designers set the average **PCAP** score at or near 500 making it easier to understand performance differences between and among provinces. Furthermore, scores could now be interpreted in terms of instructional time. For example, 10 points is the equivalent to roughly one month of school. Therefore, a score of 490 for province A in comparison to a score of 500 for province B can be interpreted to mean that the province B (500) was one month ahead of province A(490).



Table

e 1

Source: Council of Minister of Education *PCAP 2007 Report on the Assessment of 13-Year-Olds in Reading, Mathematics, and Science* Council of Ministers of Education, Canada 95 St. Clair West, Suite 1106 Toronto, Ontario M4V 1N6 2008

As seen in the Table 1 the PCAP mathematics scores of New Brunswick 13-year-olds improved by 20 points between 2007 and 2010. It also shows that New Brunswick is about two months behind Canada in mathematics and about four months behind Alberta. When New Brunswick students enter a community college technical program lagging behind in mathematics as the data shows, it is understandable that technology instructors must take work experience course time to bring those skills up to par, unfortunately at the expense of course theory, or practical experience.

When the overall New Brunswick's **PCAP** math performance is reported by language, the scores for Francophone 13-year-olds were about the same as their peers in the English language system in 2007; 462 for the students in the English system and 460 for the students in the French-speaking system as shown in Tables 4.1 and 4.2 taken from the official 2007 **PCAP** Report.

**TABLE 4-1 Pan-Canadian results in mathematics — English**

	Jurisdiction	Mean score and confidence interval
<b>Above Canada English mean score</b>	ONe	508 ± 7
<b>At Canada English mean score</b>	QCe	510 ± 10
	ABe	500 ± 7
	CANe	496 ± 4
<b>Below Canada English mean score</b>	BCe	484 ± 7
	MBe	479 ± 8
	NLe	478 ± 7
	NBe	462 ± 6
	SKe	461 ± 6
	NSe	457 ± 6
	PEe	449 ± 8
	YTe	448 ± 19

Source: Council of Minister of Education *PCAP 2007 Report on the Assessment of 13-Year-Olds in Reading, Mathematics, and Science* Council of Ministers of Education, Canada 95 St. Clair West, Suite 1106 Toronto, Ontario M4V 1N6 2008



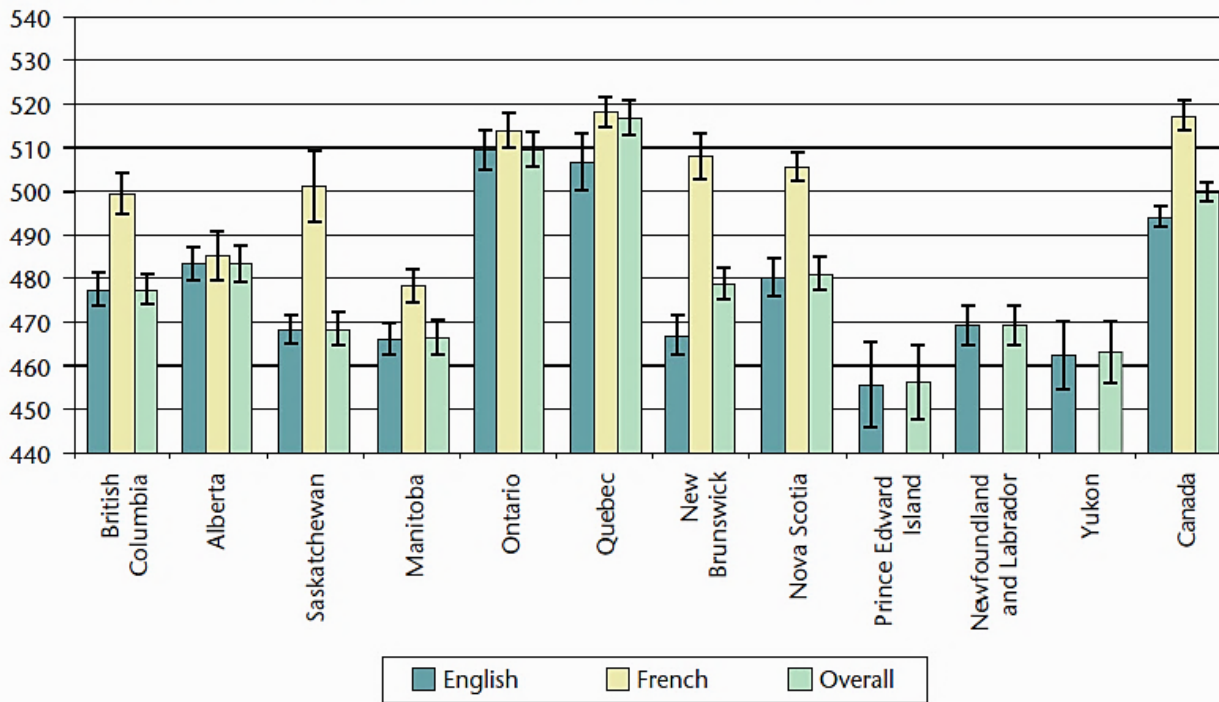
TABLE 4-2 Pan-Canadian results in mathematics — French

	Jurisdiction	Mean score and confidence interval
<b>At Canada French mean score</b>	QCf	518 ± 8
	CANf	512 ± 6
<b>Below Canada French mean score</b>	ABf	478 ± 14
	MBf	474 ± 14
	ONf	471 ± 6
	BCf	467 ± 26
	NSf	464 ± 17
	NBf	460 ± 7

Source: Council of Minister of Education *PCAP 2007 Report on the Assessment of 13-Year-Olds in Reading, Mathematics, and Science* Council of Ministers of Education, Canada 95  
St. Clair West, Suite 1106 Toronto, Ontario M4V 1N6 2008

When **PCAP** was administered again in 2010 the 13-year-olds in the New Brunswick French-speaking school system increased their average score on the problem-solving section (50 percent of the test) by about 40 points, out-performing their peers in the English school system by a margin equivalent to 4 additional months of school. See Chart 3-5 from the official 2010 **PCAP** Report.

CHART 3-5 Problem-solving results by jurisdiction and by language



Source PCAP-2010 Report on the Pan-Canadian Assessment of Mathematics, Science, and Reading  
 Council of Ministers of Education Canada 95 St. Clair West, Suite 1106  
 Toronto, Ontario M4V 1N6. 2011

In provinces where separate scores were produced for English and French-speaking school systems, the French schools outperformed the English speaking schools as shown in Chart 3-5.

The many comparisons on both **SAIP** and **PCAP** over the years showed the math achievement of New Brunswick 13-year-olds was below that of their peers across Canada. What about the math performance of older New Brunswick students? For the answer to that question we can look at the results of an international testing program subscribed to by over 50 nations.

In 2000 New Brunswick, along with the other provinces and territories, agreed to participate in a new and comprehensive international student testing program designed “to measure the extent to which youth, age 15, have acquired some of the knowledge and skills that are essential for full participation in modern societies”. Developed by the Organisation for Economic Co-Operation

and Development (OECD), the **Programme for International Student Assessment (PISA)** was first administered in 2003 and looked at three different areas: mathematics, reading and science.

The OECD defined mathematics as “an individual’s capacity to identify and understand the role mathematics play in the world, to make well-founded judgements and to use and engage mathematics in ways that meet the needs of that individual’s life as a constructive, concerned and reflective citizen.” The Society firmly endorses the OECD’s definition of mathematics, especially the ability to use mathematics to “make well-founded judgements,” a trait that PTech or CTech candidates must demonstrate in order to successfully earn these nationally recognized designations. The ability to use math to make well founded judgements is paramount to safeguarding the public and the environment.

The **PISA** math scores for New Brunswick 15-year-olds over three successive administrations were substantially lower than the math scores for comparable age students in other provinces.

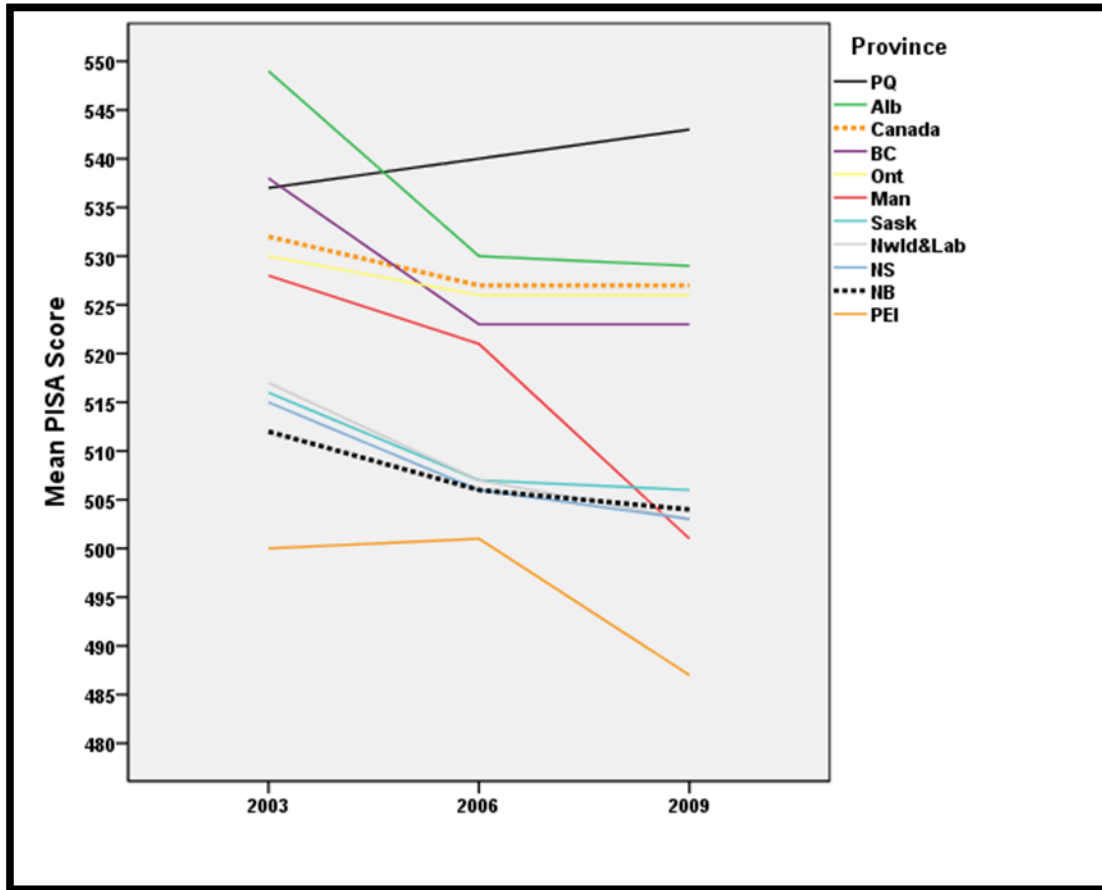


Table 2.

*Source Measuring up: Canadian Results of the OECD PISA Study The Performance of Canada's Youth in Reading, Mathematics And Science 2009 First Results for Canadians Aged 15 Human Resources and Skills Development Canada, Council of Minister of Education, Canada and Statistics Canada*

As seen in Table 2 above, the math scores for New Brunswick 15-year-olds have been below the Canadian average over three administrations. **The typical PISA math performance of New Brunswick students lags about two months behind the rest of Canada and 2.8 months behind their peers in Alberta.**

Over the three administrations of **PISA**, New Brunswick's average mathematics score showed little variation; slipping slightly from 512 in 2003 to 504 in 2009. Although scoring at the international average (500), New Brunswick was consistently below the national average by about 20 points, lagging two months behind Canada.

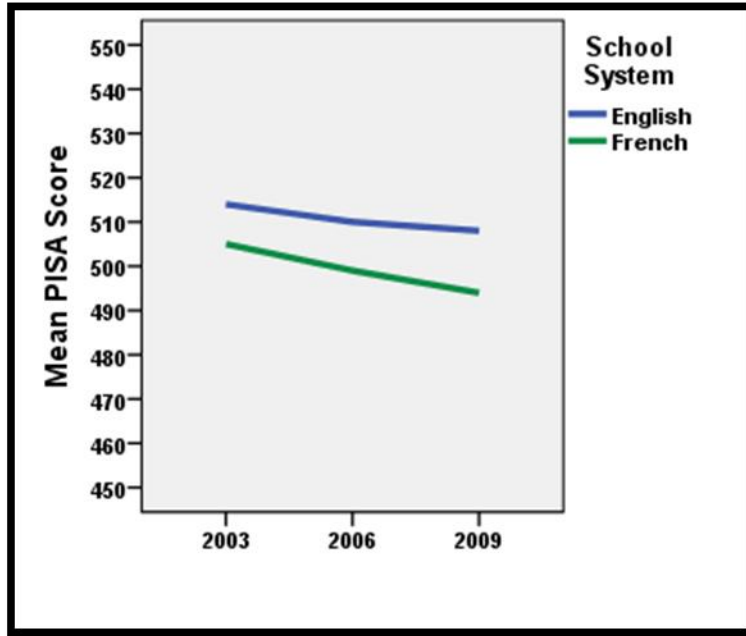


Table 3.

Source PCAP-2010 Report on the Pan-Canadian Assessment of Mathematics, Science, and Reading  
 Council of Ministers of Education Canada 95 St. Clair West, Suite 1106  
 Toronto, Ontario M4V 1N6. 2011

The **PISA** mathematics scores for students in the English- speaking school system were only a few points above the scores for students in the French-speaking school system. Overall, the mathematics performance of 15-year-olds in both systems was weaker than the average performance of 15-year-olds in other Canadian jurisdictions. Mathematics assessments specific to what students are expected to learn in school have been conducted provincially since the late 1970's. Since that time the mathematics curriculum changed and the Department of Education's testing program changed with it to measure what students were expected to learn.

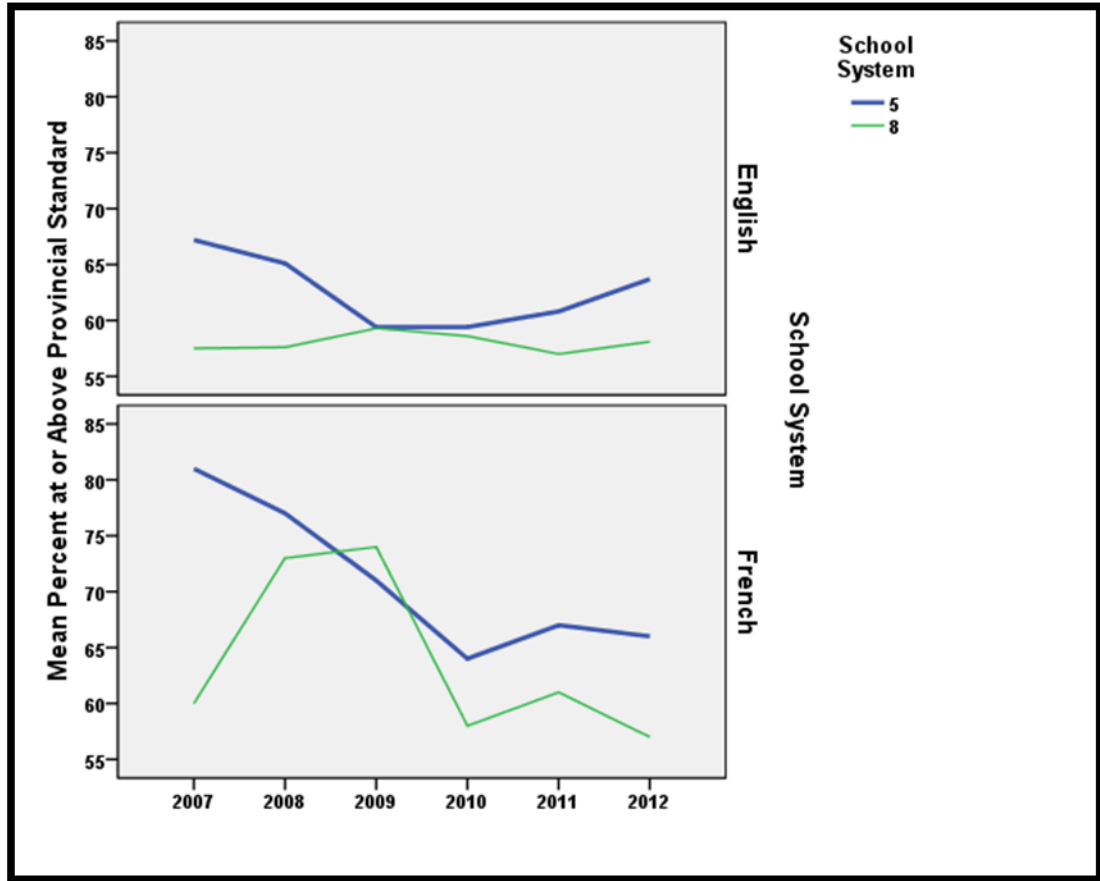


Table 4.

Source: Provincial Department of Education and Early Childhood Development.

The results of the most stable set of provincial mathematics assessments, 2007 through 2012, can be seen above in Table 4 on the left. The lines represent the percent of students who met or exceeded the provincial standards set for grades 5 and 8. The average percentage of grade 5 students in the English- speaking schools at or above the provincial standard was 63 percent over the six years. For grade 8 students it was 58 percent. The percentage of grade 5 students in the French-speaking schools at or above the provincial standard from 2007 to 2012 was 71 percent. For grade 8 students it was 63 percent.

**Because students in the English and French school systems follow different math programs, they write different provincial tests and caution should be used in making any direct**

**comparisons between the two groups. This is not so with the SAIP, PCAP or PISA assessment results which are directly comparable.**

In summary, provincial, national and international testing programs conducted over the past 13 years show New Brunswick public school students consistently struggling with mathematics, and more so for the English speaking system. Students in the French-speaking system earned somewhat higher scores than students in the English speaking system on both the **SAIP** and **PCAP** mathematics assessments, but again those scores were below the Canadian average.

Test data suggests that New Brunswick students’ math difficulties begin at an early age and accrue throughout their entire public school experience and in turn impact on their post-secondary education and training. This data corroborates the answer given by community college technology instructors to the question “How well do you believe New Brunswick high schools have prepared students in **mathematics** in order to successfully complete a program of technology study at your campus?” Technology instructors classified their students’ math skills as ranging from “somewhat prepared” to “very poorly prepared”. None placed students in either the “very well prepared” or “well prepared” categories. See Table 5.

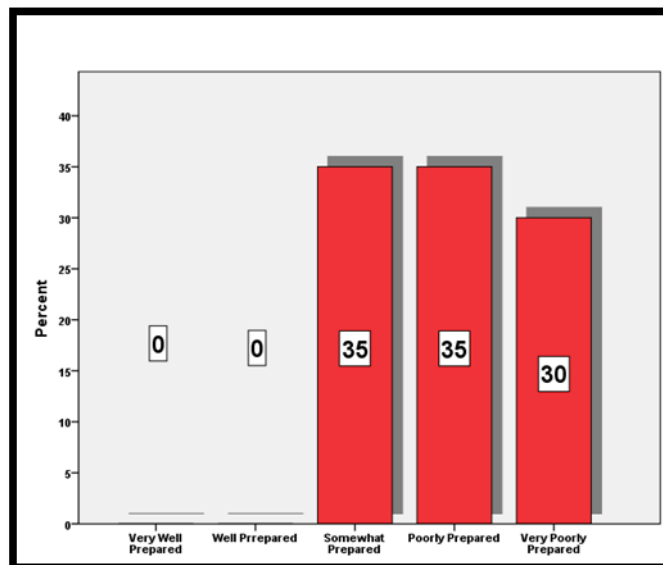


Table 5.

Of the instructors who rated their students as “*somewhat prepared*”, one remarked “the only math I do with students involves fractions...but there are always a few who need extra help.” Another claimed “some students have trouble with basic equation manipulations. Also, some have difficulties with scientific notation.”

Yet another instructor commented “...students coming into NBCC thinking that math is a subject to be learned for its’ own sake...it is a tool that should be learned like reading and writing.” and went on to state ... “math should be taught in an integrated way with physics, materials and economics.”

Another instructor said “La majorité des étudiants éprouvent de la difficulté avec operations de base; calculs simples; maîtrise de la calculatrice; et autres.”

“Avec un peu de revision sur les sujets prérequis, les nouveaux concepts mathématiques sont assez bien compris” was put forth by another technology instructor.

Another instructor would like to see schools “teaching basic arithmetic skills and how to find an area or a volume, and working with fractions”.

The following comments were made by instructors who classified their students’ public school mathematics preparation as “*poorly prepared*” or “*not prepared*” to fully grasp and apply technology course content. One believed that “many students cannot accomplish simple mathematical tasks such as calculating percentages and ratios... are too dependent on the use of a calculator...unable to formulate solutions to word problems and cannot do long-hand division.”

Another instructor who rated students as poorly prepared claimed “Les étudiants en general sont peu préparé en mathématiques. Étant professeur de mathématiques, je suis en mesure d’évaluer quotidiennement leurs niveaux de connaissance. Malheureusement, leur niveau est faible. Ils ont de la difficulté à metre en application leur connaissance.”



Another instructor stated that “I found my students’ trigonometry and algebra somewhat acceptable but calculus and putting problems into words are very much lacking.”

**An interesting comment about older students was made by one instructor who claimed “the 40 year old students usually have noticeably better math skills even if they haven’t used them in 20 years.”**

Another community college instructor who felt that students were poorly prepared claimed “I teach them first year math... many are given so much accommodation during high school that they have not been prepared to work independently or without direct assistance.” This does not bode well for the Professional Technologist (PTech) candidate who is required to assume and exercise independent judgement in developing and managing modern and future Technology.” The instructor went on to say...” they have no depth of the subject of engineering application and feel we demand too much!” This is not the attitude expected of a Professional Technologist.

Some community college technology instructors feel that their students rely too heavily on calculators and that “this leads to a blind trust in calculator results due to no mental math skills.”

More than one instructor noted that “too many students lack problem-solving skills.” Hopefully students’ poor performance on mathematical problem-solving in engineering technology will not lead community college departments or instructors to dilute mathematical problem-solving or simply remove it from the technology curriculum. That action would impact public safety and protection of the environment.

At no time did community college instructors pass the blame for their students’ poor math skills on to public school teachers. In many instances they praised them saying that they have a very difficult task covering the math curriculum that requires students to understand mathematical

concepts and how they are interconnected. For those students at the higher end of the ability curve it is easier to make those connections and to understand the concepts deemed important by the curriculum designers. For students with less math-ability it's much more difficult, if not impossible to make connections, and understand the concepts, no matter of how hard their teachers try.

With regard to math curriculum, New Brunswick, along with many of the other English-speaking educational jurisdictions follows the Western and Northern Canadian Protocol (WNCP) Common Curriculum Framework for K-9 Mathematics (2006). The WNCP was developed by the provincial governments of Alberta, British Columbia, Manitoba, Northwest Territories, Nunavut, Saskatchewan and Yukon Territory in collaboration with teachers, administrators, parents, business representatives, post-secondary educators and others. It relies heavily on national and international research conducted the National Council of Teachers of Mathematics (NCTM). The NCTM, according to Wikipedia, is the world's largest organization concerned with mathematics education, having more than 80,000 members across the USA and Canada, as well as internationally. The WNCP advocates a fundamental set of beliefs about mathematics along with specific student outcomes and suggested ways for teachers to judge student achievement. It is worth noting that 15-year-olds in the French-speaking school systems in British Columbia, Saskatchewan, Manitoba and New Brunswick do not follow the WNCP curriculum and earned substantially higher scores on the **PCAP** 2010 math problem-solving section than their cohorts in the English- speaking school systems.

The WNCP Math Curriculum as followed by the New Brunswick English-speaking schools is arranged into four “sections” called strands. Strands are not intended to be discrete units of instruction and according to WNCP philosophy they are integrated into outcomes that will make mathematical experiences meaningful to students as they make the connections between concepts both within and across strands.

STRAND	GRADE	K	1	2	3	4	5	6	7	8	9
<b>Number</b>  <b>Patterns and Relations</b> <ul style="list-style-type: none"> <li>• Patterns</li> <li>• Variables and Equations</li> </ul> <b>Shape and Space</b> <ul style="list-style-type: none"> <li>• Measurement</li> <li>• 3-D Objects and 2-D shapes</li> <li>• Transformations</li> </ul> <b>Statistics and Probability</b> <ul style="list-style-type: none"> <li>• Data Analysis</li> <li>• Chance and Uncertainty</li> </ul>	<b>GENERAL OUTCOMES</b>  <b>SPECIFIC OUTCOMES</b>  <b>ACHIEVEMENT INDICATORS</b>										
	<b>MATHEMATICAL PROCESSES – COMMUNICATION, CONNECTIONS, REASONING, MENTAL MATHEMATICS AND ESTIMATION, PROBLEM-SOLVING, TECHNOLOGY, VISUALIZATION</b>										

**NATURE OF MATHEMATICS**

Change  
Constancy  
Number Sense  
Patterns  
Relationships  
Spatial Sense  
Uncertainty

Source: Department of Education Educational Programs and Services: *New Brunswick Grade One Curriculum Guide*  
Title Code: 848. 4390 200

The curriculum places great importance on concept development while assigning rote calculation, drill and practice to the back burner. The curriculum informs teachers that “problem-solving, reasoning and connections must be integrated throughout the program since they contribute to increasing student mathematical fluency.” It attempts to “balance mental mathematics and estimation, paper and pencil exercises, using technology- including calculators and computers, use models to introduce new concepts. The curriculum moves from the specific to the abstract and advocates that “classroom activities should stem from a problem-solving approach... be based on mathematical processes... and lead students to an understanding of the nature of mathematics through specific knowledge, skills and attitudes among and between strands. It is essential that the mathematics curriculum reflects current research in mathematics instruction.”

The New Brunswick math curriculum expects students to master seven processes “that will help them achieve the goals of mathematics education and encourage lifelong learning in

mathematics.” These include communication (being able to express understanding of mathematical concepts and ideas), connecting mathematical ideas, fluency with mental mathematics and estimation and problem-solving just to mention three. The seven elements are integral to teaching and learning mathematics.

It would appear that the math curriculum is extremely comprehensive and very prescriptive with respect to instructional techniques and methodologies to monitor student achievement.

If schools follow the provincial curriculum as prescribed and it is being taught as recommended, why are New Brunswick students having difficulty in mathematics? While it is commendable to set the expectation bar high, low math scores suggest that when the bar is too high, a good number of students neither reach it nor get over it.

While the mathematics curriculum has undergone change over the past decade mathematics has not. The same math that is here today has been around for hundreds of years. It is the math teaching methods that have changed, and according to the WNCPC they are backed by research. According to an Anna Stokke, a professor in the mathematics and statistics department at the University of Winnipeg “many of these new teaching methods are based on studies that fail to conform to proper statistical research study protocols (small sample sizes, lack of randomization, missing or improper control groups).” Professor Stokke claims whenever she hears the term "research shows" in regard to math teaching methods she has some doubts. So do many others.

When elementary students do not learn math concepts properly, it makes it difficult for them to learn more advanced concepts. In a recent Globe and Mail commentary on mathematics education, Margaret Wentz stated, ***“The trouble is that math is built on fundamentals. If you miss a building block you’re likely to become progressively confused.”***

Over the past several years, results of the provincial mathematics tests show a higher proportion of grade 5 students meeting the provincial standard in comparison to grade 8 students. With only about 60 percent of grade 5 students meeting the provincial standard, it is reasonable to expect

that problems with math did not start at the grade 5 level. They started earlier when students should have learned the *basics* so they can move on to more difficult concepts. When students are promoted forward from grade to grade through the schools without mastering early concepts, the resulting accumulated deficit impacts upon their potential post-secondary education. In the Society's case, community college technology instructors must take time away from teaching nationally accredited course content to help their students master the mathematics that they should have learned during grade school.

The New Brunswick math curriculum places "less importance on rote calculation, drill and practice in order to make more time available for concept development." Without the memorizing of number facts and without drill many students will fail mathematics at an early age and respond negatively to the subject claiming, "I am not good at math." Without memorized facts, students will become stuck with simple concepts when they are trying to solve more difficult problems.

The New Brunswick math curriculum places little emphasis on drill and memorization of number facts. Students puzzle over complicated "horizontal" methods to solve simple arithmetic problems. They use repeated addition:  $6+6+6+6+6$  to multiply  $6 \times 5$ . While understanding mathematical concepts is important, it is not a substitute for basic competencies. Requiring students to understand mathematical concepts and make connections among them is surfing on the higher end of the ability bell-curve. The terms intelligence (IQ) and bell-curve are no longer fashionable terms with educators, academics and others in the politically-correct crowd, so let's call it the math-ability curve. For those students at the higher end of the curve it is easier to make connections and to understand the concepts deemed important by the curriculum designers. For others with less math-ability it's much more difficult or impossible to make connections and understand the concepts no matter of how hard they try, or their teachers help or their parents support them.

Professor Stokke stated, “We would not discourage a child from practising the piano or from memorizing piano scales since we know that this is the only way that they can become competent piano players.” She goes on to say “children need to practise arithmetic skills and memorize times tables in order to become proficient in math.” One of the most important things elementary schools can do to ensure later success in math is to build a solid foundation in arithmetic for students. Memorizing the times tables is a skill that can be mastered by most elementary students all along the math-ability continuum, while seeing relationships and developing individual strategies to solve problem, as expected by the current New Brunswick math curriculum skills lie along the higher end of the ability curve.

Warning lights flashed in Manitoba several years ago. The province’s average **PISA** math score in 2003 was 528, twenty points above the New Brunswick average and comparable to the Canadian average. In 2009, six years later, the Manitoba **PISA** math score fell to 501, two points lower than New Brunswick and 26 points below the Canadian average. The second light flashed when Education Minister Nancy Allan, while campaigning door to door in 2011 “heard from parents that their kids were lacking basic arithmetic skills.”

Manitoba parents are not the only ones worried about their children’s struggle with WNCP math. The following voice the concerns of Ontario parents whose children, like those in New Brunswick, also follow WNCP math \*

Janet M wrote...

“My son's teacher in Grade 1 commented that he was obviously a "math kid" -- but frankly that was only because he had learned so many basic math skills in Montessori pre-school. Fast forward two years and I'm talking to his teacher about his average math marks, asking why he isn't doing better when he seems so adept at math in life and at home and never has problems doing calculations. He can do all sorts of math in his head. Her explanation? Math in elementary school is really all about your writing skills, explaining in words various ways to solve a math problem, or writing "stories" to demonstrate how a math problem applies in real life. She showed me his answers on one assignment, which boiled down to: "I know that 7 groups of 5 is 35, because 7X5 equals 35." This answer was wrong. A good answer was some little essay about how if seven people hold up both hands with five fingers each, you can group them into three people equals 30 and one more person's hand with five fingers.... etcetera... So basically his

math mark is all about creatively dreaming up some scenario to explain how he figured out an answer that he actually just knew because it was patently obvious. I can only hope the curriculum-creators know what they're doing and he's developing some sort of more flexible mathematical mind with all of this, because from my perspective as a non-expert in education it seems ridiculous."

Another parent, "eg94" stated...

"The new curriculum is ridiculous. My daughter entered school knowing how to do addition, subtraction, multiplication and division. By Grade 3, she was counting on her fingers to do basic addition: "The Teacher Taught Us to Do It This Way". She isn't given math problems to do in terms of solving them: she's given "Write How To Solve The Problem Three Ways Actual Answer Not Required". Tons of "manipulatives" in class, and they all started using calculators in Grade 4. After seeing a Level 2+ on her Gr 3 EQAO Math assessment, we had her privately tested, and her math skills were measured at Grade 1 level - in Grade 3 - yet, she had A's and B's on her report card. At an "excellent school". Three years in Kumon, and she a) never uses a calculator; b) can do mental math easily c) is flying through all of the school curriculum and d) is excited, engaged and confident in math. Fortunately, we had the money to have her privately taught. The new curriculum is daft. They are expecting kids to do high level math without giving them the basic skills; and a kid who needs a calculator to do basic multiplication and division (as her classmates do) are slower and less productive, and, they never develop the mental agility to manipulate more complex equations. Fractions for my kid are easy - she tells me other kids are breaking down in tears and unable to figure out how to reduce the fractions as they don't "get" the lowest common denominator concept (easy for a kid who has all of the multiplication tables mastered up to 14x14). Two of her friends went to their parents and asked to go to Kumon with her ... as they are envious of how easy math is for her. Not saying Kumon is for everyone (it's not) - but, the rote learning of basic math skills are standing her in good stead going forward."

\*Submitted on-line as replies to an article in the August 30, 2013 edition of the **Globe and Mail** regarding students low test scores.

Heeding falling test scores and parental concerns, in September 2013, Manitoba goes back to placing emphasis on basic math skills, the procedures older generations learned in grade school until the WNCP math curriculum, currently in use in New Brunswick English-speaking schools, stated otherwise. Vertical multiplication and long division have been put back in the revised

Manitoba curriculum along with specific requirements for students to memorize times-tables. Under the WNCP framework education consultants and education faculties encouraged teachers to avoid introducing these practices. The 2013 revised Manitoba curriculum document now speaks positively of practice and pencil-and-paper math unlike the original that spoke unfavourably of those activities. Manitoba's **Kindergarten to Grade 8 Mathematics Curriculum Framework 2013 Revisions** now states "Learning math facts is a developmental process where the focus of instruction is on thinking and building number relationships. Facts become automatic for students through repeated exposure and practice. When a student recalls facts, the answer should be produced without resorting to inefficient means, such as counting. When facts are automatic, students are no longer using strategies to retrieve them from memory."

In June 18, 2013 Nick Martin wrote in the Winnipeg Free Press that "children from kindergarten to Grade 8 will learn to do arithmetic before they use a calculator, parents will have a website helping them understand the math their kids are learning, and future teachers, while still in high school themselves, will be expected to complete the same math courses they'll later have to teach to children".

Manitoba's revision to their public school math curriculum echoes the old cliché that you cannot build a house without a foundation. New Brunswick students struggle with math throughout their public schooling and beyond without that foundation. Having children invent their own methods and requiring them to think through the details of a mathematical problem rather than using conventional methods to find the answer does not appear to have worked here very well. Efforts of community college technology instructors to bring their students up to the point where they will be able to master the intended course material is proof of the larger problem and unfortunately comes at the expense of the course material itself or time taken from the hands-on portion of the technology program.

New Brunswick might be wise to follow Manitoba's lead but not jump to hasty conclusions. This happens too often in education when decisions based on what seems intuitively the "best



thing that could happen” fail to produce desired outcomes and result in costly and harmful unintended consequences, such as the disastrous Foundation Years Program in the mid 1990’s. Before changing the current math curriculum and making it mandatory across the province, it should be determined through experimental research if the changes produce the desired results. Will changing from horizontal to vertical algorithms improve student’s math skills? Will memorizing times tables improve student’s math performance? Intuitively these changes make sense, but do they in reality and at what costs? These questions and others are best answered through evaluation research following established procedures.

Running a course on a trial basis is exactly what will occur during the 2013-2014 school year at Fredericton High School. Last June Minister of Education Jody Carr, reversed a decision to cancel a special advanced mathematics class at Fredericton High School. He has allowed it continue for the 2013-2014 school year, but will evaluate the class and require the findings to be included in the provincial government's high school renewal initiative. In referring to his action to allow the class to continue Minister Carr stated “Students have asked for an enhanced opportunity to learn mathematics, and we encourage this drive for achievement.” The Society welcomes Minister Carr’s decision and any others to follow that support the teaching and learning of mathematics.

Improving the math performance of New Brunswick high school graduates goes beyond helping just those enrolling in community college technology programs. High achievement has the potential to be of economic importance to the province. It will have long term economic benefit to society as a whole claim the authors of **The High Cost of Low Educational Performance: The Long-Run Economic Impact of Improving PISA Outcomes**, a 2010 report published by the OECD. The report was written by researchers using economic modeling to examine the association between academic skills, as measured by performance on **PISA** and other international test instruments, and economic growth. They found that relatively small increases in the skills of a nation’s labour force can have a very large impact on future GNP. The report estimates that raising the average Canadian **PISA** score by 25 points would increase the nation’s

GNP by 3,743 billion dollars (US). Achievement is the key issue and its importance cannot be overstated. The report emphasized that the number of years of schooling does not affect economic growth unless they yield greater achievement.

Improving students' math skills can be accomplished in the provinces' grade schools by simply revising the current curriculum and at far less cost in terms of dollars and people in comparison to the province's efforts over the past decade to raise the adult literacy level. In December 2009 a government document entitled **Adult Literacy: An Adult Literacy Strategy for New Brunswick Be Part of It**, stated, *“When it comes to improving literacy levels, governments cannot act alone. We recognize that across New Brunswick, community literacy organizations are doing great work, reaching out to many adults who need help, but further co-operation, collaboration and investment is needed to provide learners with a range of options that respond to their diverse needs and to provide a cohesive network of support in their communities .”*

Dealing with the issue of low adult literacy in New Brunswick has been an ongoing and expensive initiative over the past decade or more. According to the 2009 report “Over half of the adult population in New Brunswick has literacy skills that are considered to be below the level that enables them to function adequately at home, at work and in their communities, and to deal with the demands of a knowledge-based economy. Higher literacy rates are also associated with better economic conditions according to that 2009 document. Low literacy rates may be linked to poor math scores on national and international tests. It has been suggested that New Brunswick's poor math performance on **PISA**, **PCAP** and **SAIP** may be due partly to students' not understanding the test questions because of poor reading skills. This is more so in the French-speaking system since their **PISA**, **PCAP** and **SAIP** reading scores have been consistently lower than the reading scores of students in the English-speaking system.

How did half of the New Brunswick adult population graduate from grade school with inadequate literacy skills? That is an issue for another time, but it is parallel to the issue raised here about improving the math skills of high school graduates. Over the past decade far more time, resources and effort have been put into improving literacy, but it is time to shift some of the

resources and effort to improve math. Improving students' math skills would better enable them to take their place in a knowledge-based economy, and specifically in our case, to keep the highest standard of graduates possible for work in the engineering and applied science technology fields by allowing community college instructors to spend more valuable time on teaching technology course content than remediating weak math skills.

The Society questions the present math curriculum and the practice of advancing students through grade school without sufficient mastery of fundamental math skills. Over the next several years a large number of certified engineering technicians and technologists will retire or leave to work in other provinces. Students now taking community college technical courses are not qualified to complete the programs, and therefore, threaten the sustainability of the public's safety and protection of the environment.

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