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Education Quarterly Review

2001, Vol. 8, no. 1

- Science and technology: Overview
- Science and technology: Elementary and secondary
- Science and technology: University and beyond

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Culture, Tourism and the Centre for Education Statistics

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From the

Editor-in-Chief

Mission

Education Quarterly Review analyses and reports on current issues and trends in education using information from a variety of statistical sources. It serves as a focal point for education statistics and provides a forum for communication with stakeholders and the public. Our goal is to present information and analysis that are relevant, authoritative, timely and accessible.

We move away somewhat from our tradition of offering a broad cross section of articles on education. This special issue takes a detailed look at science and technology skills – how these skills are acquired and where the demands lie as a constantly changing market place looks increasingly to its workers for innovative solutions for the production and marketing of goods and services.

Science and technology (S&T) skills are generally considered essential to the "new economy". The development of these skills, beginning with the elementary grades and moving through high school, university and into the labour force, is an issue of importance to educators and employers alike. The authors have approached this vast subject in a single study, giving us a better understanding of the determinants of elementary and high school mathematics and science performance, the economic returns of adult literacy, and the diffusion of S&T graduates into the work force.

The study, presented through three articles, brings together several data sources that link together the stages of S&T skills acquisition and their application throughout the lifelong learning process. The first article, "Determinants of science and technology skills: Overview of the study," sets the context, gives an overview of the study, and presents the general conclusions. The second, "Science and technology skills: Participation and performance in elementary and secondary school," describes elementary and secondary school participation and performance in S&T courses. The third, "Science and technology skills: Participation and performance in university and beyond," examines S&T graduates, their postsecondary studies and their early careers. Together, the three articles provide new insights into not only how Canadian students acquire and apply S&T skills, but also into the issue of future demand and supply for these skills.

Predicting skill shortage (or skill over-supply) can be an incredibly challenging activity even for those armed with the best available data. Expert panels and advisors will differ on where a shortfall or surplus of workers might occur in the Canadian labour

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market. In the aerospace industry, to pick one sector of our economy, events of September 2001 had a crucial impact on the projected need for workers ranging from airline pilots to hotel employees to those employed in the tourist industry. The resulting volatility within a number of sectors in the Canadian and global economies illustrated not only the extent to which national economies are interrelated but also how a major event can impact what may have initially been seen as relatively unrelated sectors of the work force.

Obviously unpredictable events such as this cannot be factored into a set of predictions. At the same time they do serve to remind us of the need to constantly revise our conclusions about the mix of skills required a decade or more down the line, and in particular how our youth go about acquiring such skills as they move from the early elementary grades through high school and into college and university.

The rich set of data on which the authors in this issue drew to arrive at their conclusions, including information from the national graduate surveys, the Census of Canada and OECD reports, has in turn enriched the debate on the nature of skill acquisition and requirements in Canada. How we train and retain an equally rich mix of skilled workers for the "new economy" will be one of the major challenges facing Canada in the coming years.

In addition to these papers, please refer to the **Cumulative index** at the back of the report, where we list by title all articles that have appeared in *EQR* since 1994. These articles have been grouped under 11 categories, including 'Education funding,' 'Technology and learning' and 'Accessibility.' These categories are based on education policy issues that were identified in the Centre for Education Statistics' *Strategic Plan*, which reviews the Centre's statistical program and identifies objectives and priorities required to strengthen the program to better address information needs. The *Strategic Plan* is available free of charge at www.statcan.ca/cgi-bin/downpub/freepub.cgi on the Internet.

Highlights

Science and technology: Overview

- Statistics Canada's two innovation surveys consistently identify lack of qualified personnel as a significant barrier to innovation. In the 1996 Survey of Innovation (Services Industry), the services sector identified lack of qualified personnel as the sixth in importance of 13 barriers.

- Similarly, the Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries shows a shortage of skilled workers to be the most prominent obstacle to using new and better building products, building systems and construction equipment.

Science and technology: Elementary and secondary

- The most common reason for not taking mathematics courses was that students found mathematics difficult. Nearly two-thirds of all the students surveyed (63.6%) thought that mathematics was not an easy subject. For those not currently taking mathematics, this figure rose to 72.1%.

- Physics and chemistry were, on the whole, less popular than mathematics: 49.9% of the students liked physics, 55.2% liked chemistry, and 66.2% liked mathematics. However, biological science (71.6%) and earth science (70.9%) were more popular than mathematics. Those who were not enrolled in at least one science course were less likely to like any of the science subjects, especially chemistry and physics.

- Canadian students scored above the international average in all categories: Grade 4 mathematics, Grade 4 science, Grade 8 mathematics and Grade 8 science. In all participating countries, performance in both subjects dropped between grades 4 and 8. In Canada, the decline in performance was more pronounced in science.

- As with elementary schools, Canada ranks above the international average for both mathematics and science. These scores include the performance of those students who have chosen not to pursue mathematics and science courses in upper secondary school.

Science and technology: University and beyond

- The number of computer science graduates increased by 27% between 1993 and 1997, while the number of mathematics graduates decreased by 14% during the same time period. The net supply of new mathematics and computer science graduates only increased by 6% between 1993 and 1997.

- Other than graduates in agricultural and biological sciences, science graduates were more likely to be employed five years after graduation than the overall 1990 graduating cohort. In 1995, the national unemployment rate averaged 9.5%.

- Overall, 77% of the 1995 graduating cohort found jobs that were closely related or somewhat related to their fields of study. Again, graduates in agricultural and biological sciences are singled out, with 36% working in jobs that are unrelated to their fields of study.

- While most graduates with bachelor's degrees are under 25 years of age (except in the health professions), a small number of persons re-enter the education system later in life. A higher proportion of older graduates in one field of study or another would indicate a preference for sciences or non-sciences for these mature students.

EQR

Articles

Determinants of science and technology skills: Overview of the study

The following three articles were written by Michael Bordt, Patrice de Broucker, Cathy Read, Shelley Harris and Yanhong Zhang.

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Introduction

Science and technology (S&T) skills have been central to many discussions about Canada's future economic development, where the ability to produce, market and consume new goods and services is expected to play an even more important role than in the past. Innovation requires research and development (R&D), which in turn requires skilled workers such as scientists, engineers and technicians. A skilled domestic market of literate and knowledgeable consumers will contribute to the successful marketing of this innovation.

The federal government has made a commitment to increase its investment in R&D with the aim of making Canada one of the top five countries for R&D performance by 2010 (Governor General of Canada 2001). The government is also taking action to retain our 'best and brightest' researchers and technicians and to attract new ones from abroad (Minister of Finance 2000). Central to these issues is the need for a better understanding of how S&T skills are formed, why students decide to pursue S&T careers, and how people with S&T skills move between occupations and countries.

Statistics Canada's two innovation surveys consistently identify lack of qualified personnel as a significant barrier to innovation. In the 1996 Survey of Innovation (Services Industry), the services sector identified lack of qualified personnel as the sixth in importance of 13 barriers (Statistics Canada 1999a).

Similarly, the Survey of Innovation, Advanced Technologies and Practices in the Construction and Related Industries shows a shortage of skilled workers to be the most prominent obstacle to using new and better building products, building systems and construction equipment. Forty-four percent of Canadian construction and related firms identified this as a major obstacle during 1999. The shortages identified were most likely in the skilled trades. Other human resource-related obstacles included lack of in-house expertise (21%), inability to train workers in the required time (19%), and workers' resistance to change (20%) (Statistics Canada 2001).

In contrast, the Prime Minister's Advisory Council on Science and Technology (ACST) Expert Panel on Skills found no net shortage of people with technical skills in the five industrial sectors it examined—aerospace, automotive, biotechnologies, environmental technologies, and information and communications technologies: "On the whole, Canada's education and training providers and immigration system appear to be keeping up with the demands of Canadian employers for technically skilled people" (ACST 2000).

However, the panel identified niche areas where skills shortages will likely arise in the near future as a result of retirements or recruitment difficulties. In the automotive and aerospace sectors, for example, a wave of retirements among skilled tradespeople will strain supply channels over the next decade. In other sectors, because of rapid growth or the requirement for extremely specialized skills, some firms may find it difficult to fill positions with fully qualified people.

After identifying an important shortage of technically competent people who also possess communication, teamwork and management skills, the ACST concluded that employers assume graduates in scientific and technical programs will acquire these 'softer' skills on the job. Evidently this does not occur as frequently as hoped, as the ACST has recommended that primary, secondary and postsecondary educators provide students with a greater variety of both technical and non-technical skills.

The different conclusions of the ACST Expert Panel on Skills and the two surveys on innovation are due to their different focuses. The ACST considered the general technical skills that colleges and universities provide. The innovation surveys considered scientific and advanced technical skills mixed with communication, management and teamwork skills (all of which the ACST also found to be in short supply).

Previous studies also found little evidence of overall skills shortages. Roy, Henson and Lavoie (1996) remarked that they could draw no conclusions about the existence of a shortage because so little was known about current or future skills imbalances. They also noted that "employer-based surveys do not provide reliable estimates of market shortage situations." Two years later, Gingras and Roy (1998) concluded that there was no evidence of a broad-based shortage of skills.

Overall, the concern about S&T skills focusses on a time horizon of 6 to 10 years into the future. Students who will graduate from university in the year 2010 are now entering high school. Their choice of courses and performance in them will, to a large extent, determine the nature of their contributions to the economy. Our study examines how Canadians are acquiring and using S&T skills at the elementary, secondary and postsecondary education levels and in the work force.

Data sources

We used two main data sources in this study.

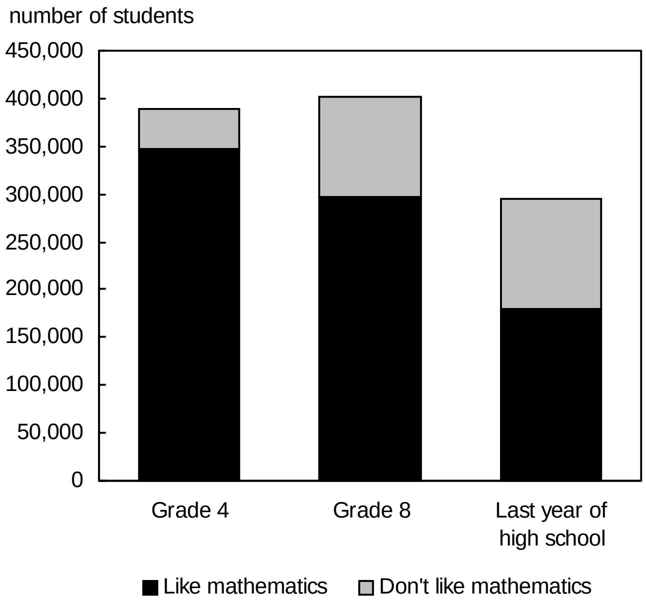
- The 1994–1995 *Third International Mathematics and Science Study* (TIMSS) provides information on the performance of Canadian elementary and secondary students in various grades on international mathematics and science tests. It also supplies information about their school and home background. We used these data to find out when—and why—students' interest and performance in mathematics and science decline through elementary and secondary school, and why participation declines in high school.
- The National Graduates Survey (NGS) follows the progress (in areas such as employment, earnings and job satisfaction) of Canadian postsecondary graduates two and five years after graduation.[1] Using these data, we investigated the movement of postsecondary students in and out of the 'science stream' and looked at the characteristics of graduates of science programs.

We exploited other data sources as necessary, including enrolment statistics, Organisation for Economic Co-operation and Development (OECD) national-level indicators, and the 1996 Census of Population.

Conclusions

Only a small proportion of the students going into the elementary school system ultimately pursue a career in science and technology. Interest in mathematics and science declines between Grade 4 and Grade 8 and continues to drop during high school (Graph 1). Many students in upper secondary school stop taking mathematics and science when given the option. In 1995, only 42% of students were taking both these courses in their last year of high school. Most students find them 'difficult' or 'boring.' Even when they have done well in mathematics and science in the past and believe that the subjects are important to them if they want to succeed in life, many students are unwilling to pursue them.

Graph 1
The diminishing interest in mathematics, Canada, 1995–1996



Sources: *IEA 1998 and Statistics Canada, 1999, Education in Canada.*

The reasons for the drop in interest in mathematics and science between middle and late elementary school are not evident from the data used for this analysis. The fact that this phenomenon is most apparent in Canada and the United States implies that socio-cultural factors beyond the scope of the TIMSS data could be influential. For example, for many secondary school students, the attractiveness of S&T careers may not be sufficient incentive to continue their studies in mathematics and science.

It is not possible to ascertain from the data we analysed whether the students who did not like mathematics and science in elementary school were the same ones who opted out of those subjects in secondary school. Additional longitudinal data would likely be necessary to reveal the dynamics of attitudes, participation and performance in elementary and secondary school.

Canadian students are certainly capable of doing well in mathematics and science. Canada's average scores on the TIMSS for all grade levels in both mathematics and science were close to the international average or significantly above, despite the fact that they included the performance of students who had already opted out of upper secondary school mathematics and science courses.

National-level S&T indicators do not explain the differences in student scores between countries. Students in countries with a high public investment in education and S&T do not necessarily score higher than students in countries with a lower investment. The analysis of the following international S&T indicators[2] showed no strong correlations with participation and performance in mathematics and science:

- public spending on education as a percentage of gross domestic product (GDP)
- gross expenditures on R&D as a percentage of GDP
- percentage of population aged 24 to 64 with a university education
- researchers per 1,000 labour force in government
- researchers per 1,000 labour force in education.

Some analysts (for example, Phipps 1999) have suggested that other national factors (such as economic climate, unemployment rate and proportion of immigrants in the population) may be important in explaining national differences in performance.

Most upper secondary school students intend to go on to postsecondary studies. Although we do not have longitudinal data, it appears that most of them follow through on this intention. Those who have dropped science but continue in mathematics are more likely to target studies in business. Those who continue with science largely plan to pursue further studies in health sciences or engineering. The transition from high school to college or university, especially in relation to the development of science skills, deserves more detailed analysis.

At the university level, the science stream is quite stable. There is no evidence of a large-scale movement into or out of science programs between the bachelor's and master's levels or between the master's and doctoral levels. One exception is the large proportion of master's graduates in business who have undergraduate degrees in science. In general, though, university graduates in the sciences who go on to graduate studies stay in the sciences.

Depending on the field of study, between 65% and 95% of the university graduates surveyed were working in jobs that were closely related or somewhat related to their field of study. (The average for all graduates, including those from non-science fields, was 77%.) Graduates in agricultural and biological sciences were the least likely (65%) to be in jobs related to their fields of study.

This study supports the findings of other analysts (for example, Lavoie and Finnie 1997) regarding the underemployment of master's and doctoral graduates. Two years after graduation, more than half of all master's graduates in our study felt that they were overqualified for their job. In the case of science graduates, this means they were not using their S&T skills to full advantage. The reasons and economic impacts of this should be investigated in more detail.

From detailed analyses of two fields of study—dentistry and geology—and one occupation—computer programming—it is obvious that graduates in one field of study often have science skills that are quite different from those in another field. Therefore, rather than study all graduates as a single group, analysts should look more closely at graduates by field of study. These analyses also showed that different fields of study can have different rates of 'diffusion' (graduates finding work in occupations unrelated to their field of study), and that occupations can experience 'concentration' (graduates from many fields of study converging on a specific occupation).

The analysis also points out that complementary skills acquired during postsecondary education (or by other means, such as self-directed learning) can be more important than those relating directly to the main field of study. This echoes the finding of the ACST that many employers are seeking individuals with a mix of science and management skills (ACST 2000). EQR

Notes

1. Data on the 1995 graduates five years after graduation were not available in time for this study.

2. Data used were for 1995 whenever possible. In certain instances, data from the nearest year were used. Countries compared were Australia, Austria, Canada, Denmark, France, Germany, Italy, Norway, Sweden, and the United States. Several other factors besides those listed were considered but were not included in the analysis because of missing data or correlation with the remaining factors.

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Science and technology skills: Participation and performance in elementary and secondary school

Participation

In many countries, students are already targeting specialized career paths in elementary school. In Canada, however, these choices are more limited. Only 16% of Canadian elementary students were in schools where mathematics and science were optional in Grade 8.[1] This proportion is much higher in other countries, where as many as 80% of Grade 8 students have the option of taking mathematics and 100% of taking science (IEA 1999).

Most early high school programs in Canada are mandatory and require both mathematics and science. In later high school, there are fewer compulsory subjects, and students can choose to move directly toward the job market or prepare for university.

Negative attitudes toward mathematics and science appear to emerge in mid elementary school and increase throughout high school (Table 1). In upper high school, many students show their dislike for the subjects by dropping one or both when they have the option to do so.

Table 1
Canadian students' opinions of mathematics and science, 1995

Subject	Grade 4	Grade 8	Final year secondary
	% reporting *like* or *like a lot*		
Mathematics	89	74	61
Science	80	68	...
Biological science	...	...	60
Chemistry	...	...	42
Earth science	...	...	51
Physics	...	...	31

Notes:
... Figures not applicable.
Denominator in these figures includes all students; mathematics and science are required subjects in Grades 4 and 8.
Sources: *IEA 1997a, 1997b and 1998.*

Students' attitudes toward a subject cannot be disassociated from their self-assessments of their performance in that subject (Table 2). A student who is not doing well in a subject is unlikely to enjoy it.

Table 2
Canadian students' self-assessments of performance in mathematics and science, 1995

Self-assessment item	Grade 4	Grade 8	Final year secondary
	% reporting *agree* or *strongly agree*		
I usually do well in:			
Mathematics	94	84	66
Science	88	82	74

Note:
Denominator in these figures includes all students; mathematics and science are required subjects in Grades 4 and 8.
Sources: *IEA 1997a, 1997b and 1998.*

Participation in mathematics and science in upper secondary school

Students who took the upper secondary school[2] performance tests had already made their decisions to continue or drop mathematics and science. It is, therefore, useful to consider the characteristics of those who chose *not* to take one or both of these subjects.

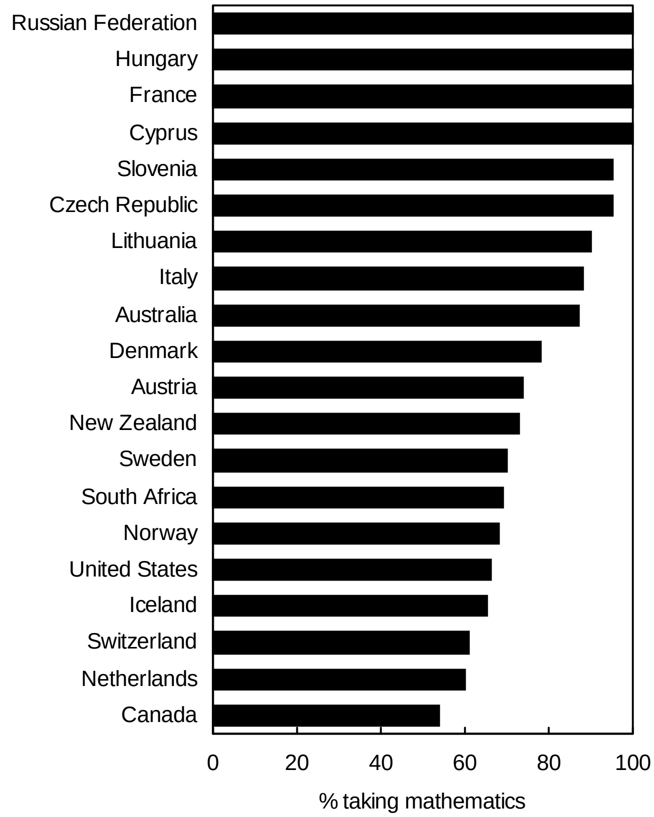
Only 42.2% of the total sample of students in their final year of secondary school were enrolled in both mathematics and science courses[3] (Table 3). Just over one-fifth (20.8%) of all upper secondary students were enrolled in neither mathematics nor science; 37% were taking either mathematics (18.6%) or science (18.4%) but not both. According to the *Third International Mathematics and Science Study* (TIMSS) results, in 1995 Canadian students showed the lowest participation rate in mathematics of all the countries reporting (Graph 1).

Table 3
Enrolment in upper secondary mathematics and science courses, Canada, 1995

	Students taking mathematics	Students not taking mathematics	All students
	%		
Students taking at least one science course	42.2	18.4	60.6
Students not taking science	18.6	20.8	39.4
All students	60.8	39.2	100.0

Source: *TIMMS Population-3 Canada file.*

Graph 1
Upper secondary students currently taking mathematics, by country, 1995



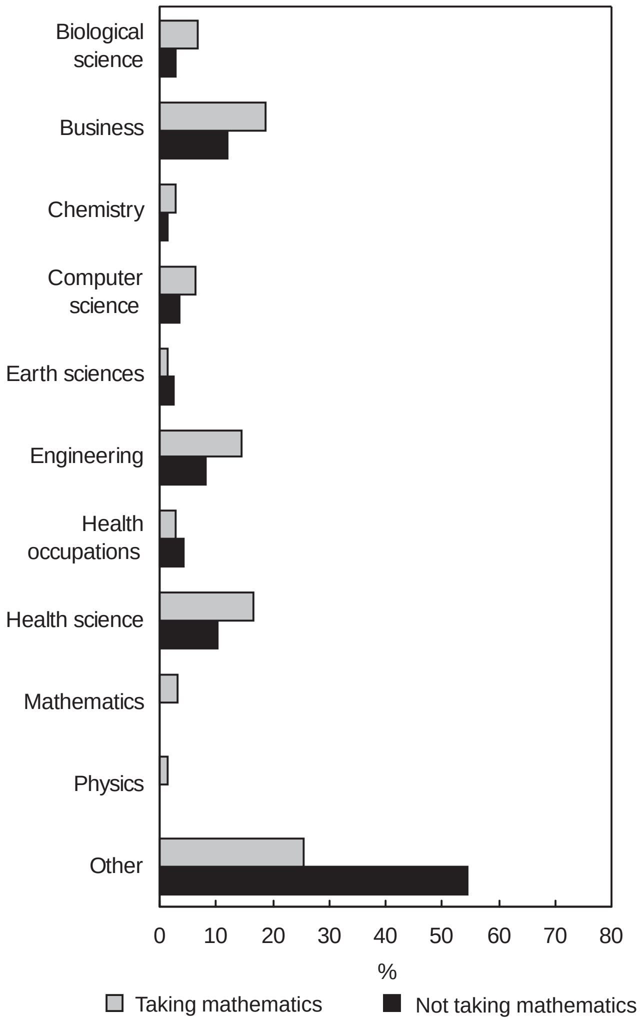
Note: *These figures differ slightly from the analysis of the Canadian TIMSS data because of differences in weighting procedures.*
Sources: *IEA 1999, School contexts for learning and instruction.*

Plans to continue education after secondary school

Almost all students, whether or not they were enrolled in mathematics and science courses, intended to continue their education after secondary school. Overall, 97.1% planned to pursue postsecondary studies. This rate was similar for students who were taking only science (96.3%), only mathematics (95.6%), or neither science nor mathematics (95.6%).

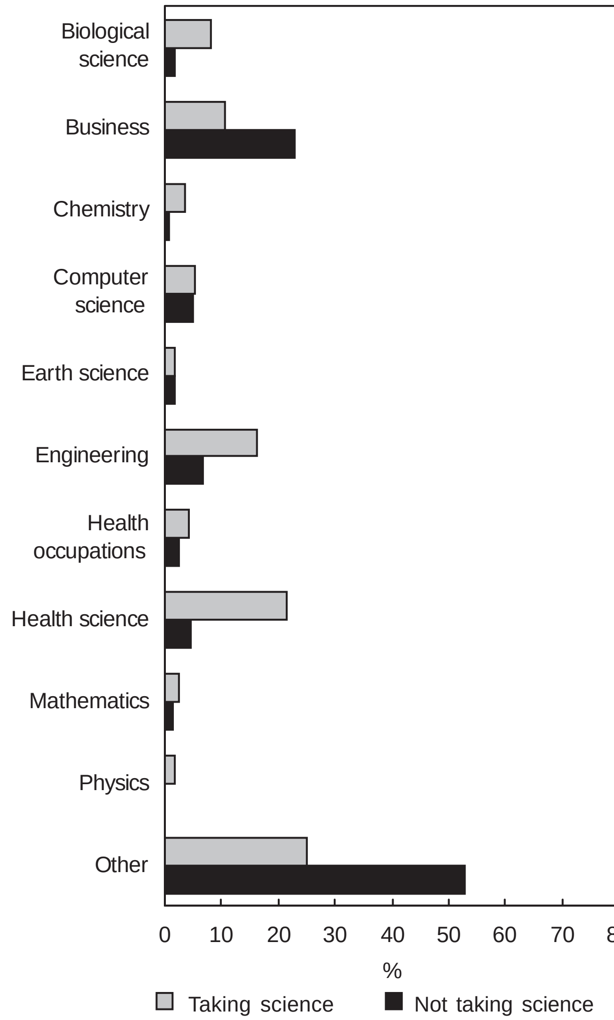
Students not taking mathematics were much less likely to be planning postsecondary education in business, engineering or health science than their counterparts (Table 4 and Graph 2). Those not enrolled in science courses were much more likely to be planning a career in business but less likely to be contemplating studies in engineering or health science than their counterparts (Graph 3).

Graph 2
Intended field of postsecondary study, by enrolment in mathematics, 1995



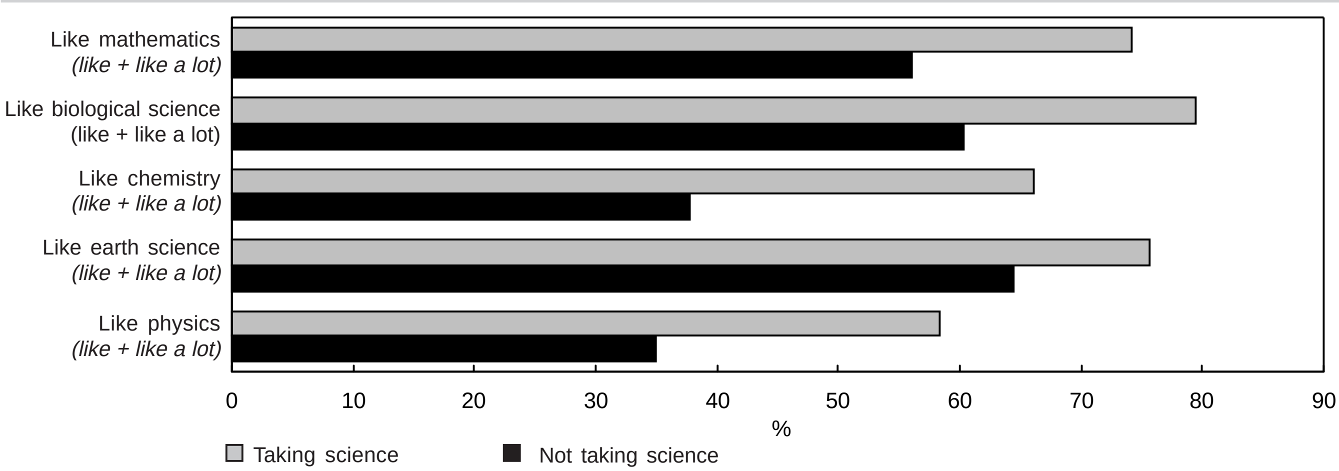
Source: *TIMSS Population-3 Canada file.*

Graph 3
Intended field of postsecondary study, by enrolment in science, 1995



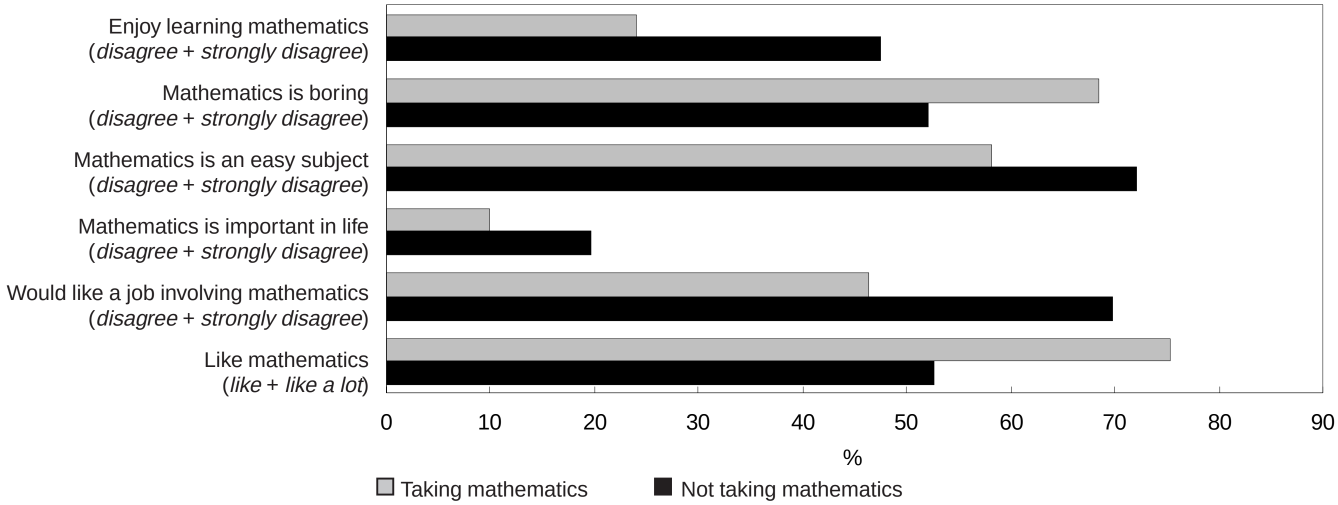
Source: *TIMSS Population-3 Canada file.*

Graph 4
Attitudes toward mathematics and science in upper secondary school, 1995



Source: *TIMSS Population-3 Canada file.*

Graph 5
Attitudes toward mathematics in upper secondary school, 1995



Source: *TIMSS Population-3 Canada file.*

Table 4
Intended field of postsecondary study of upper secondary students, 1995

Intended field of study	Students taking mathematics	Students not taking mathematics	Students taking at least one science course	Students not taking science	Students taking neither mathematics nor science	All students
			% of students			
Biological science	6.9	2.9	7.8	1.5	0.7	5.3
Business	**18.6**	**11.9**	**11.6**	**22.7**	**15.5**	**16.0**
Chemistry	2.8	1.4	3.3	0.6	0.1	2.2
Computer science	6.2	3.5	5.7	4.1	3.4	5.1
Earth science	1.5	2.4	1.8	1.8	3.0	1.8
Engineering	**14.6**	**8.0**	**15.8**	**6.3**	**5.0**	**12.0**
Health occupations	2.9	4.2	4.0	2.5	3.6	3.4
Health science	**16.6**	**10.3**	**20.1**	**4.9**	**2.9**	**14.1**
Mathematics	3.2	0.3	2.3	1.5	0.2	2.1
Physics	1.2	0.4	1.6	0.1	0.1	0.9
Other[1]	25.6	54.6	26.1	53.9	65.6	37.0
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Note:
1. Includes arts, humanities, social sciences and education.
Source: *TIMMS Population-3 Canada file.*

Reasons for not taking mathematics and science courses

The most common reason for not taking mathematics courses was that students found mathematics difficult. Nearly two-thirds of all the students surveyed (63.6%) thought that mathematics was not an easy subject. For those not currently taking mathematics, this figure rose to 72.1%.

Only 13.7% of all students did not believe that mathematics was important in life, compared with 19.6% of those who were not currently enrolled in mathematics courses. And while 55.5% of all students indicated that they would not like a job involving mathematics, the same attitude was expressed by 69.7% of those not currently taking mathematics.

Table 5
Attitudes toward mathematics in upper secondary school, 1995

Attitude item	Students taking mathematics	Students not taking mathematics	All students
		%	
Enjoy learning mathematics (*disagree + strongly disagree*)	24.0	47.5	33.2
Mathematics is boring (*disagree + strongly disagree*)	68.5	52.1	62.0
Mathematics is an easy subject (*disagree + strongly disagree*)	58.1	72.1	63.6
Mathematics is important in life (*disagree + strongly disagree*)	9.9	19.6	13.7
Would like a job involving mathematics (*disagree + strongly disagree*)	46.3	69.7	55.5
Like mathematics (*like + like a lot*)	75.3	52.6	66.4

***Source:** TIMMS Population-3 Canada file.*

Another reason for students not pursuing mathematics is their perception of their previous performance. Of the students who were currently enrolled in mathematics, 80.8% reported that they had usually done well in mathematics. This rate dropped to 59.9% for those who were not enrolled in mathematics (Table 6). Nevertheless, a large proportion of students who believed they had done well in mathematics prior to Grade 12 were not pursuing mathematics at the Grade 12 level.

The reasons for not taking science courses are not as straightforward. Students were asked whether or not they liked individual sciences (biological science, chemistry, earth science and physics) but there is not as much detail on their attitudes toward science in general or the individual sciences.

Physics and chemistry were, on the whole, less popular than mathematics: 49.9% of the students liked physics, 55.2% liked chemistry, and 66.2% liked mathematics. However, biological science (71.6%) and earth science (70.9%) were more popular than mathematics. Those who were not enrolled in at least one science course were less likely to like any of the science subjects, especially chemistry and physics (Table 7).

Students taking neither mathematics nor science may be influenced more by their dislike for mathematics than by their attitudes toward the sciences. In fact, they liked chemistry more than those not taking science did. Their rating of mathematics and physics was much lower.

Table 6
Self-assessments of previous performance in mathematics and science by upper secondary school students, 1995

Self-assessments	Students taking mathematics	Students not taking mathematics	Students taking neither mathematics nor science	All students
		% reporting *agree* or *strongly agree*		
I have usually done well in:				
Mathematics	80.8	59.9	50.9	72.6
Science	81.3	73.1	61.8	78.0

***Source:** TIMMS Population-3 Canada file.*

Table 7
Attitudes toward sciences in upper secondary school, 1995

Subject	Students taking science	Students not taking science	Students taking neither mathematics nor science	All students
		% reporting *like* or *like a lot*		
Biological science	77.6	61.1	62.8	71.6
Chemistry	64.0	38.6	54.0	55.2
Earth science	75.4	63.4	62.3	70.9
Physics	56.9	35.3	30.1	49.9
Mathematics	73.0	55.7	44.3	66.2

Source: *TIMMS Population-3 Canada file.*

As with mathematics, there is a substantial difference in the students' assessments of their previous performance in science between those who are currently enrolled in science and those who are not. For students enrolled in at least one science course, 86.8% reported that they had usually done well in science. This rate dropped to 63.7% for those not currently enrolled in a science course.

Regardless of whether or not they perform well in mathematics and science in lower secondary school, many students choose programs that exclude mathematics or science in the upper secondary grades. Much of the rationale for this appears to be the student's like or dislike of these subjects, which were compulsory in lower secondary grades but optional in higher grades.

Many students rationalized that science was not necessary for further studies in business but felt that mathematics was important. Those taking science courses tended to target further studies in science-oriented disciplines, especially engineering and health science.

Since high school mathematics and science are generally prerequisites for university studies in science fields, dropping them in high school greatly reduces the chances of regaining or building on these skills in the future.

This issue was addressed by Lauzon (2000), who used TIMSS data to provide insights into the educational choices of English-speaking Canadian students in their final year of secondary school. His findings are as follows:

- Boys were more likely to take physics; girls were more likely to take biology; and both were equally likely to take chemistry.
- Having at least one parent with a university degree meant that both boys and girls were more likely to take science courses, and that girls were more likely than boys to take physics or chemistry.
- Overall, girls were less likely than boys to take physics and chemistry.
- The impact of self-assessed ability in science seemed to be stronger for girls than for boys. The home environment (parental education and number of parents at home) and past achievement and perceived ability in science were stronger predictors of participation in science for girls than for boys.

The results for the student background variables—home demographic conditions, engagement in out-of-school activities, attitudes towards mathematics and science, and other information provided by students—were mixed. Girls who believed it took natural talent or ability to do well in science were less likely to take physics, but not other science subjects. Girls who believed it took hard work to do well in science were less likely to take chemistry but more likely to take biology than other girls.

Missing from these data, unfortunately, is information on the qualifications and attitudes of the teachers of the different science courses. Clearly, past and prospective teachers will influence students' decisions regarding what courses to take, and it is possible that teachers influence boys and girls differently.

The cross-sectional nature of the data prevents a direct study of the impact of past achievement on the selection of future courses. However, there is some indication here that girls might be more discouraged than boys by lack of achievement in science. Despite these concerns, the data show that girls are more likely than boys to be influenced by their home environment in their choice of courses. The data also point to the importance of school resources to students' performance in mathematics and science.

Performance

The International Adult Literacy Survey (IALS) tested adult Canadians for three kinds of literacy: quantitative literacy (the ability to balance a chequebook, calculate a tip or complete an order form); document literacy (the ability to understand job applications, transportation schedules and maps); and prose literacy (the ability to understand written texts such as stories and editorials). Analysis from the IALS indicates that quantitative literacy is an important component of overall adult literacy (Statistics Canada 1998). The researchers found a strong link between literacy in general and economic security, but they did not separate the importance of quantitative literacy from the others tested.

Lars Osberg finds a statistically significant relationship between adult literacy test scores from the IALS and individual earnings for males (Statistics Canada 2000). He also argues that literacy is an inherently complex concept and that the current literacy measures are often subjected to statistical procedures that are inappropriate for treating its complexity. This caution needs to be exercised, as well, in the interpretation of results obtained from TIMSS.

A recent paper by Green and Riddell (Statistics Canada 2001) concludes that each additional year of schooling raises annual income by 8.3%. Literacy accounts for about 3 percentage points of that rate as a result of the combined effects of education on literacy and literacy on income.

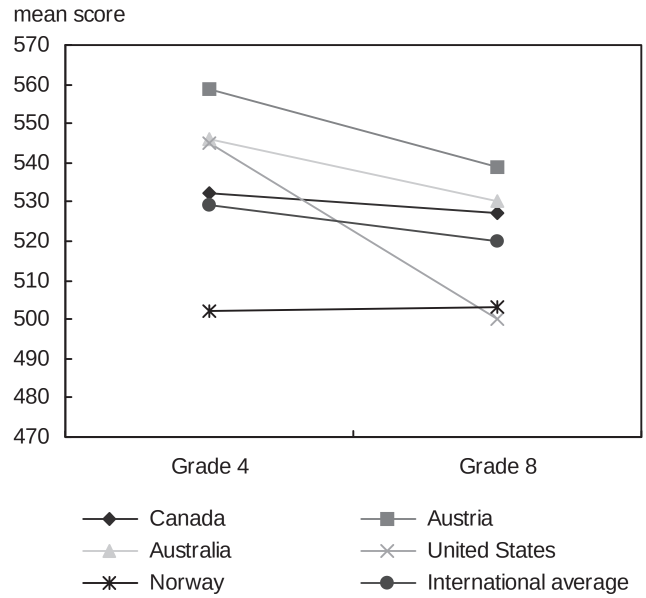
Canadian students generally rank well in international comparisons of mathematics and science skills. Elementary students ranked significantly above the international average in 1995 (Table 8 and Graph 6). In secondary school, Canada ranked eighth in mathematics and fourth in science (Table 9 and Graph 7).

Elementary school

Canadian students scored above the international average in all categories: Grade 4 mathematics, Grade 4 science, Grade 8 mathematics and Grade 8 science. Note that in all participating countries, performance in both subjects dropped between grades 4 and 8. In Canada, the decline in performance was more pronounced in science.

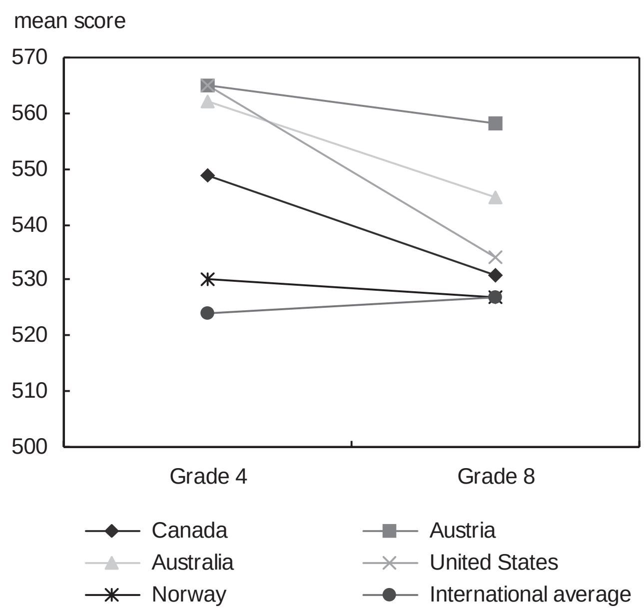
Zhang (2000) investigated performance in Grade 8 mathematics and concluded that socio-economic status and school environment (instructional resources, teacher experience in mathematics and safety of school environment) were important influences.

Graph 6
Mathematics performance in Grades 4 and 8, selected countries, 1995



Sources: *IEA 1997a and 1997b.*

Graph 7
Science performance in Grades 4 and 8, selected countries, 1995



Sources: *IEA 1997a and 1997b.*

Table 8
Mean scores for elementary mathematics and science tests, selected countries, 1995

Country	Mathematics		Science	
	Grade 4	Grade 8	Grade 4	Grade 8
	mean score			
Austria	559	539	565	558
Australia	546	530	562	545
United States	545	500	565	534
Canada	**532**	**527**	**549**	**531**
Norway	502	503	530	527
International average	529	520	524	527

Sources: *IEA 1997a and 1997b.*

Secondary school

As with elementary schools, Canada ranks above the international average for both mathematics and science (Table 9). These scores include the performance of those students who have chosen not to pursue mathematics and science courses in upper secondary school. Given the favourable international ranking, it is possible that many students who choose not to pursue mathematics or science would actually perform well in those subjects in further studies.

Influence of general science and technology climate on performance and participation

Students in participating countries live in different cultures where there may be unique policies and approaches to science and technology. Several national-level indicators were chosen to test the significance of their relationship with the performance scores.

Initially, 15 OECD indicators were selected because of their availability for the countries selected (OECD 1999). A principal component analysis[4] was performed to reduce cross-correlations and to produce a set of factors that could be included in a regression with the performance results.

The principal component analysis resulted in five independent factors:

- public spending on education as a percentage of gross domestic product (GDP)
- gross expenditures on R&D as a percentage of GDP
- percentage of the population aged 24 to 64 with a university education
- researchers per 1,000 labour force in the government
- researchers per 1,000 labour force in education.

Table 9
Achievement in mathematics and science literacy for students in their final year of secondary school, 1994–1995

Country[1]	Mathematics		Science		Mathematics and science combined	
	Mean score	Score rank	Mean score	Score rank	Mean score	Score rank
Sweden	552	1	559	1	555	1
Switzerland	540	2	523	7	531	4
Iceland[2]	534	3	549	2	541	2
Norway[2]	528	4	544	3	536	3
France[2]	523	5	487	10	505	9
New Zealand	522	6	529	5	525	6
Australia[2]	522	7	527	6	525	6
Canada[2]	**519**	**8**	**532**	**4**	**526**	**5**
Austria[2]	518	9	520	8	519	8
Hungary	483	10	471	14	477	10
Italy[2]	476	11	475	13	475	13
Russian Federation	471	12	481	11	476	11
Lithuania	469	13	461	15	465	15
Czech Republic	466	14	487	9	476	11
United States[2]	461	15	480	12	471	14
Cyprus	446	16	448	16	447	16

Notes:
1. *Excludes five countries (Germany, Denmark, the Netherlands, Slovenia and South Africa) with unapproved sampling and/or low participation rates.*
2. *Did not satisfy the guidelines for sample participation rates.*

Source: *IEA 1998.*

Whether for elementary or secondary school performance, there appeared to be no strong relationships between the mean performance score and the national science and technology indicators of a country. This implies that performance cannot be explained by the overall science and technology climate in a country.

Although she was looking at a broader set of outcomes than academic performance, Phipps (1999) suggests that general macro-economic conditions and social context (such as the regional unemployment rate and proportion of immigrants) may be as important as social spending in influencing outcomes. Examining these other factors is beyond the scope of the current study.

Data source: *The Third International Mathematics and Science Study* (TIMSS)

TIMSS is an educational research project sponsored by the International Association for the Evaluation of Educational Achievement (IEA), based in Boston. In 1994–1995, TIMSS was conducted in more than 40 countries, including Canada. Students were tested in mathematics and science at five levels: in grades 3, 4, 7 and 8, and in the final year of secondary school. In addition, extensive information about the teaching and learning of these subjects was collected from students, teachers and school principals. The TIMSS results were released in a series of reports in 1996 and 1997 (IEA 1998).

In 1998–1999, TIMSS was again administered, this time to Grade 8 students only, in about 40 countries, including Canada. This is referred to as TIMSS-R (for TIMSS-Repeat). These results are expected to be released in 2001.

Statistics Canada developed the sampling procedures for all participating countries for TIMSS 1995 and TIMSS-R.

The 1995 TIMSS student questionnaire collected extensive and diverse information, such as the number of books in the home (in ranges); the level of education of the mother and father; the amount of time the student spent on a normal school day watching television or playing video games, reading a book for enjoyment, and studying science or doing science homework; and the number of times the student had skipped a class in the preceding month.

The 1995 principal questionnaire also collected extensive information, such as the school's location (rural or urban); the percentage of final-year mathematics teachers with university certification in mathematics; the number of computers available for mathematics instruction (whether or not there was a shortage); and the number of instructional days for mathematics and science in the school year.

Many factors or combinations thereof may explain student performance on the mathematics and science tests, and cause and effect are often difficult to ascertain from education data. For example, students who like mathematics tend to do better than those who do not. But are they doing well because they like mathematics, or do they like it because they are doing well? The development of longitudinal data, where conditions and performance of the same students are tracked over time, may provide answers to these questions.

Notes

1. The TIMSS performance tests are administered to a sample of students whether or not they are taking mathematics or science.

2. The TIMSS 'upper secondary school' tests were administered to Grade 11 students in Quebec and to Grade 12 students in all other provinces.

3. The questions of mathematics and science are normally analysed with respect to performance, not individually. The original data file for every student contained four separate sampling weights. Each represented the student's weight toward a final performance score for a specific 'booklet' of questions: general literacy, advanced science, advanced physics, or a combination of these. Since most students completed only one booklet, there was no weight representing the students within the overall sample. Although this needs to be further investigated, a synthetic weight was calculated using the maximum weight across all four possible booklets.

4. Data used were for 1995 whenever possible. In certain instances, data from the nearest year were used. The participants were Australia, Austria, Canada, Denmark, France, Germany, Italy, Norway, Sweden, and the United States. Several other factors besides those listed were considered but were not included in the analysis because of missing data or correlation with the remaining factors.

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Science and technology skills: Participation and performance in university and beyond

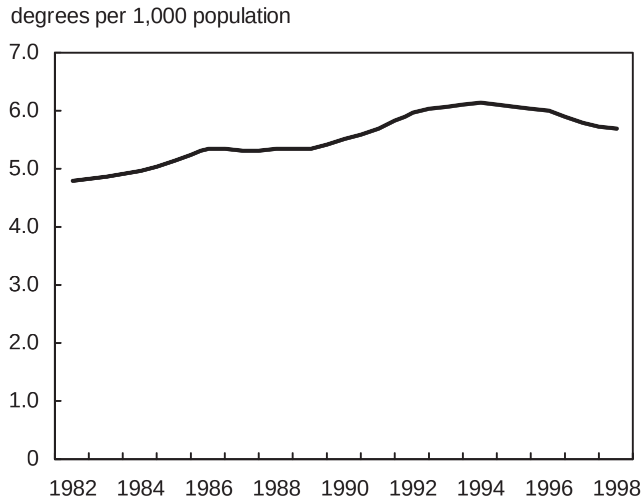
Degrees granted

Throughout the 1990s, obtaining a university degree was increasingly seen as necessary for success in the labour force. According to Lavoie and Roy (1998), the Canadian economy became more and more knowledge-based through the 1980s and 1990s. They conclude that by 1991 only half the occupations in Canada required less than 13 years of education. Gingras and Roy (1998) echo this sentiment by concluding that the minimum entry requirement, even for low-skill jobs, should be a high school certificate. At the same time, Boothby and Gingras (1998) argue that although there is no evidence of the deterioration of the labour market conditions of low-skilled workers, continuation of the recent rapid growth in demand for highly-skilled workers will decrease the demand for low-skilled workers.

Finnie (1999a, b, c and d) has shown that the unemployment rates of university graduates are generally lower than those of non-graduates and that incomes and gender gaps improve significantly within five years after graduation. He also found that many of the science fields (health occupations, engineering and computer science) were among the highest earnings fields. However, one science discipline, agricultural and biological science, was among the lowest earning fields.

The number of degrees per capita granted by Canadian universities has been increasing since 1982, with a downturn in 1997 (Graph 1). In 1997, almost 174,000 degrees were granted (Table 1).

Graph 1
Degrees[1] granted by Canadian universities per 1,000 population, 1982–1998



Note:
1. Includes all levels of university degrees in all disciplines.
Source: *Statistics Canada, 2000,* Education in Canada.

First professional degrees are bachelor's degrees in fields such as law, dentistry, medicine and veterinary medicine, for which the normal prerequisite is another bachelor's degree. They are typically counted with bachelor's degrees.

Science degrees

Between 1993 and 1997, the number of science degrees granted by Canadian universities increased by 14.3%, while degrees in all other fields decreased by 2.4% (Table 2). Major increases in numbers of graduates occurred in biology (+1,575), nursing (+756), engineering (+644) and computer science (+635).

The number of computer science graduates increased by 27% between 1993 and 1997, while the number of mathematics graduates decreased by 14% during the same time period. Given the overlap between the two subjects and the booming job market in computer science in the late 1990s, it is apparent that some students who might have chosen mathematics chose computer science instead. Therefore, the net supply of new mathematics and computer science graduates only increased by 6% between 1993 and 1997.

Table 1
Number of university degrees[1] granted, 1982–1998

	Bachelor's and first professional degree	Undergraduate certificate	Master's degree	Graduate certificate	Earned Doctorate	Total	Degrees per capita
	number of degrees						
1982	87,106	16,711	13,110	1,504	1,715	120,146	4.8
1983	89,770	16,115	13,925	1,654	1,821	123,285	4.9
1984	92,586	16,190	14,568	1,796	1,878	127,018	5.0
1985	97,551	16,521	15,208	1,615	2,004	132,899	5.1
1986	101,670	18,288	15,948	1,642	2,220	139,768	5.4
1987	103,078	17,568	15,968	1,673	2,375	140,662	5.3
1988	103,606	19,235	16,320	1,635	2,418	143,214	5.3
1989	104,981	19,922	16,750	1,883	2,573	146,109	5.4
1990	109,777	20,815	17,653	1,877	2,673	152,795	5.5
1991	114,820	21,791	18,033	2,215	2,947	159,806	5.7
1992	120,745	23,316	19,435	2,240	3,136	168,872	6.0
1993	123,202	24,044	20,818	2,430	3,356	173,850	6.1
1994	126,538	24,341	21,292	2,351	3,552	178,074	6.1
1995	127,331	23,472	21,356	2,191	3,716	178,066	6.1
1996	127,989	22,293	21,558	2,348	3,928	178,116	6.0
1997	125,796	20,501	21,319	2,355	3,966	173,937	5.8
1998	124,861	18,821	22,206	2,392	3,976	172,256	5.7

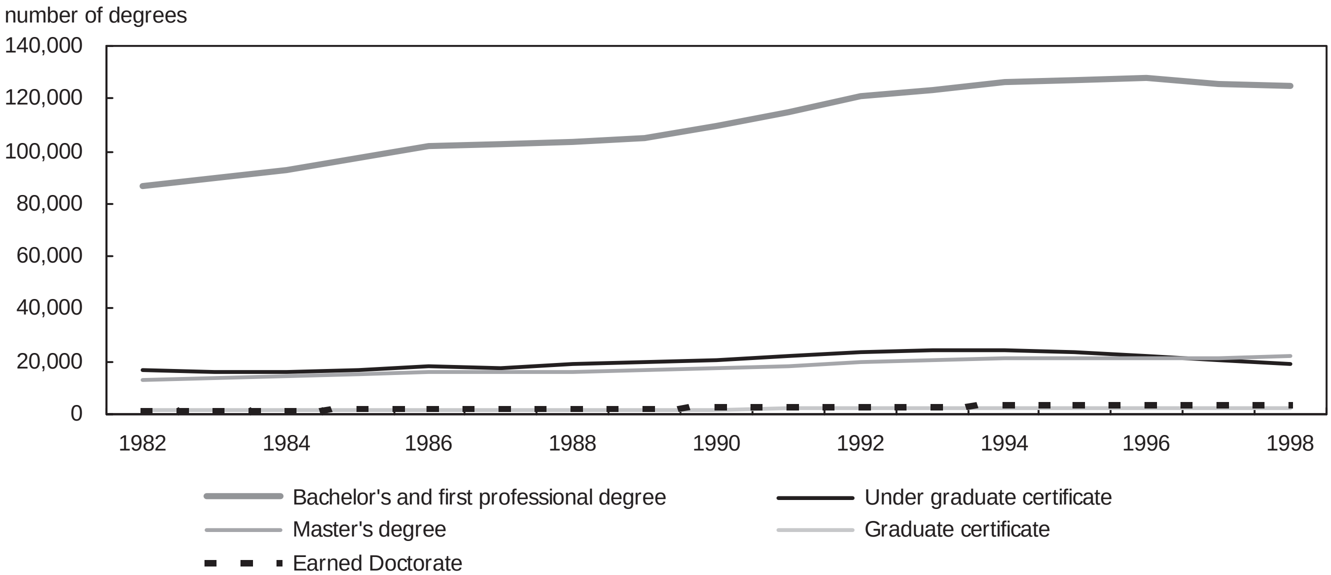
Note:
1. All disciplines.
Source: *Statistics Canada, 2000,* Education in Canada.

Table 2
Bachelor's and first professional degrees granted by Canadian universities, 1993 and 1997

Group	Field of study	1993	1997	Change
		number		%
Agriculture and biological sciences	Agriculture	529	612	15.7
	Biology	4,508	6,083	34.9
	Household science	1,144	989	-13.5
	Veterinary medicine	288	296	2.8
	Zoology	318	367	15.4
	Other	935	1,317	40.9
	Total	**7,722**	**9,664**	**25.1**
Engineering and applied sciences	Architecture	485	573	18.1
	Landscape architecture	86	81	-5.8
	Engineering	7,476	8,120	8.6
	Forestry	262	364	38.9
	Total	**8,309**	**9,138**	**10.0**
Health professions	Dental studies/research	437	432	-1.1
	Medical studies/research	2,170	2,193	1.1
	Nursing	2,975	3,731	25.4
	Pharmacy	772	689	-10.8
	Rehabilitation medicine	1,143	1,328	16.2
	Other	281	464	65.1
	Total	**7,778**	**8,837**	**13.6**
Mathematics and physical sciences	Chemistry	921	1,066	15.7
	Geology	346	402	16.2
	Mathematics	2,286	1,957	-14.4
	Computer science	2,377	3,012	26.7
	Physics	631	633	0.3
	Other	19	21	10.5
	Total	**6,580**	**7,091**	**7.8**
Sciences	**Total**	**30,389**	**34,730**	**14.3**
All other	Social sciences	47,844	47,751	-0.2
	Humanities	16,721	15,014	-10.2
	Education (incl. physical)	21,064	20,638	-2.0
	Fine and applied arts	4,049	4,105	1.4
	Total	**89,678**	**87,508**	**-2.4**
Not reported		3,135	3,558	13.5
Grand total		**123,202**	**125,796**	**2.1**

Source: *Statistics Canada, 1999,* Education in Canada.

Graph 2
Degrees[1] granted by Canadian universities, 1982–1998



Note:
1. All disciplines.
Source: *Statistics Canada, 2000,* Education in Canada.

Another issue affecting the domestic supply of science graduates is that many science programs require a high degree of specialization which limits migration between science careers. For example, a dissatisfied or unemployed Bachelor of Nursing graduate may be able to become a computer programmer by taking a few extra courses, but to become a nurse, a computer science graduate would almost have to start all over again. Thus it is not meaningful to discuss science or science and technology (S&T) graduates as one group. The same is true in discussions of the so-called 'brain drain' (net inflows and outflows of educated workers).

Overall, greater numbers of master's degrees and doctorates are being awarded. Between 1993 and 1997, the total number of master's degrees in science increased by 5.1%, and the number of earned doctoral degrees in science increased by 19.5% (Table 3).

Table 3
Master's degrees awarded and doctorates earned, Canada, 1993 and 1997

	Master's degrees		Doctorates	
Field of study	1993	1997	1993	1997
	number			
Agriculture and biological sciences	993	993	397	475
Engineering and applied sciences	2,111	2,167	552	686
Health professions	1,399	1,602	400	492
Mathematics and physical sciences	1,301	1,340	615	694
Sciences subtotal	**5,804**	**6,102**	**1,964**	**2,347**
All other (arts, social sciences, etc.)	15,014	15,217	1,392	1,619
Overall (includes social sciences, etc.)	**20,818**	**21,319**	**3,356**	**3,966**

Source: *Statistics Canada, 1999,* Education in Canada.

Switching fields of study while at university

There are two main times when students switch fields of study at university:

- at the halfway point, and
- after the completion of a degree.

This gives rise to a number of questions: How many students begin a bachelor's degree in the sciences and then switch to another field midway though the degree, or vice-versa? How many drop out of university altogether and/or continue with S&T studies at the community college level? Statistics Canada currently has no data on the dynamics of changing fields of study during the university program. Data will be available within the next few years when Statistics Canada's Enhanced Student Information System (ESIS) is fully implemented.

Under ESIS, a single survey replaces several postsecondary enrolment and graduate surveys of universities, community colleges and trade/vocational institutions. Postsecondary institutions report annual enrolment information by student for each 12-month period, along with information about the institution's programs and course offerings.

ESIS will enable Statistics Canada to track students over time within and between institutions and provinces. The data will build a comprehensive picture of postsecondary education, including ongoing non-credit and continuing education. It will also serve as the sampling frame for the National Graduates Survey (NGS). However, ESIS will not link elementary, secondary and other postsecondary student information.

We used data from the NGS to assemble a picture of the extent of degree switching at university. The survey asks respondents about their most recent field of study and all past degrees awarded.

For most people who obtained a bachelor's degree in the sciences in 1995, this was their first university degree. There is an exception in the health professions, where a first professional (bachelor's) degree in medicine typically follows another bachelor's degree in the sciences.

A master's degree in the sciences is most likely to follow a bachelor's degree in the sciences (Table 5). However, there appears to be some flexibility in switching from a non-science field to the health sciences at the master's level.

What is more interesting is that 30% of Master of Business Administration graduates had taken their previous degree in science, switching from a science to a non-science field.

There is also some flexibility in switching from a non-science to a health science field. Overall, though, there is little evidence of switching fields at the next degree level once someone is on a particular career path.

Not all science graduates continue on to the next level. In the case of a bachelor's degree, the reason for not continuing with the master's may be inadequate standing. The NGS surveyed master's graduates on why they chose not to continue with a doctoral program (Table 7).

Another type of attrition in science careers can be seen when university science graduates do not obtain or otherwise follow through with an occupation requiring a degree in the sciences. The following section examines this trend and discusses suitable careers for science graduates of all levels.

After graduation

Unemployment and salaries

Graduating from university is only the first step in launching a science career. In order to cement and build on S&T skills, graduates must find suitable employment. The road to a science career may also end with the graduate not finding full-time—or any—employment.

Other than graduates in agricultural and biological sciences, science graduates were more likely to be employed five years after graduation than the overall 1990 graduating cohort (Table 8). In 1995, the national unemployment rate averaged 9.5% (Statistics Canada 1997).

Job-seeking master's graduates have mostly fared worse than their bachelor's degree counterparts (Table 9). The high degree of overqualification for master's graduates was among the reasons for this discussed in *A Dynamic Analysis of the Flows of Canadian Science and Technology Graduates into the Labour Market* (Statistics Canada 1998). Entry-level jobs require a bachelor's degree and the employer expects to train the new employee. Doctoral graduates are hired for the expertise that they can bring to the firm. Master's graduates are in the middle ground, often accepting jobs for which only a bachelor's degree is required.

Recipients of doctorates in the sciences are more likely to be working—both full time and overall—than their counterparts with bachelor's or master's degrees (Table 10).

Table 4
Prior degrees of 1995 bachelors' graduates

Specialization of 1995 bachelor's degree	Prior university degree in the sciences	Prior university degree in a single other field	Prior university degree in an interdisciplinary field or with no/unknown specialization	No prior university degree
		%		
Agriculture and biological sciences	2	1	1	96
Engineering and applied sciences	6	2	1	91
Health professions	14	5	7	75
Mathematics and physical sciences	5	3	1	91
All other major groups	2	12	2	84
Education	4	34	5	56
Business	1	3	1	95
Law	4	55	6	35

Source: *1995 National Graduates Survey.*

Table 5
Prior degrees of 1995 masters' graduates

Specialization of 1995 master's degree	Prior university degree in the sciences	Prior university degree in a single other field	Prior university degree in an interdisciplinary field or with no/unknown specialization	No prior university degree
		%		
Agriculture and biological sciences	78	7	13	2
Engineering and applied sciences	88	6	5	1
Health professions	68	15	12	6
Mathematics and physical sciences	84	7	9	1
All other major groups	13	77	6	3
Education	10	77	5	8
Business	30	59	8	3
Law	1	90	1	8

Source: *1995 National Graduates Survey.*

Table 6
Prior degrees of 1995 doctoral graduates

Specialization of 1995 doctoral degree	Prior university degree in the sciences	Prior university degree in a single other field	Prior university degree in an interdisciplinary field or with no/unknown specialization	No prior university degree
		%		
Agriculture and biological sciences	91	3	6	-
Engineering and applied sciences	89	3	8	-
Health professions	78	10	8	4
Mathematics and physical sciences	90	3	7	1
All other major groups	6	90	3	1

Note:
- Nil or zero.
Source: *1995 National Graduates Survey.*

In a pattern similar to employment, the earnings of science graduates, other than those in the agricultural and biological sciences, exceed the average of the cohort (Table 11). As well, salaries tend to increase with degree of qualification. There are some interesting anomalies in the earnings profiles. For example, the average salary for women with doctorates in agricultural and biological sciences is lower than for those with master's degrees in those areas.

Table 7
Reasons why 1995 master's graduates in the sciences did not pursue a doctorate

Reasons	%
No perceived value to doctorate	22
No requirement for a doctorate in occupation	18
Time requirements too long	16
Financial costs too high	12
Personal or family reasons	10
Other reasons	23

Source: *1995 National Graduates Survey.*

Appropriateness of employment to field of study

Another potential reason to exit the road to a science career is when graduates find employment that is not in their field. Overall, 77% of the 1995 graduating cohort found jobs that were closely related or somewhat related to their fields of study (Table 12). Again, graduates in agricultural and biological sciences are singled out, with 36% working in jobs that are unrelated to their fields of study. Newly graduated engineers and health professionals (such as physicians and nurses) find work in an appropriate field more readily than those in the other sciences. This may be because health programs are geared toward specific jobs and that there is a high demand for graduates to fill these jobs.

Over 55% of master's graduates are working in jobs for which they feel overqualified, illustrating the phenomenon, first pointed out by Lavoie and Finnie (1997), of the 'underemployment' of master's graduates (Table 13).

Examples of specific S&T skills

To shed more light on the suitability of employment obtained by science graduates, the occupations of 1995 graduates in a few sample fields of study were examined.

Dental studies

Dentistry is one of a number of health science fields (such as medicine, nursing and optometry) that could be considered to have a single target occupation—in this case, dentist.

Table 8
Labour force status of 1990 bachelor's graduates[1] in the sciences, June 1995

Field of study	Working[2]	Working full time	Unemployed	Not in the labour force	Unemployment rate[3]
			%		
Agriculture and biological sciences	79	71	8	13	10
Engineering and applied sciences	93	91	4	**	4
Health professions	95	81	**	**	**
Mathematics and physical sciences	89	85	5	6	6
Overall (includes social sciences, etc.)	89	80	6	5	6

Notes:
*** These numbers have a coefficient of variation greater than 25% and are therefore not reliable enough to be released.*
1. Includes recipients of first professional degrees, undergraduate degrees and undergraduate certificates.
2. Includes full time and part time.
3. The proportion of those in the labour force who are currently unemployed.
Source: *1995 National Graduates Survey.*

Table 9
Labour force status of 1990 master's graduates in the sciences, June 1995

Field of study	Working[1]	Working full time	Unemployed	Not in the labour force	Unemployment rate[2]
			%		
Agriculture and biological sciences	79	72	9	12	10
Engineering and applied sciences	87	84	9	**	9
Health professions	85	75	**	10	**
Mathematics and physical sciences	78	72	11	12	12
Overall (includes social sciences, etc.)	88	79	6	6	7

Notes:
*** These numbers have a coefficient of variation greater than 25% and are therefore not reliable enough to be released.*
1. Includes full time and part time.
2. The proportion of those in the labour force who are currently unemployed.
Source: *1995 National Graduates Survey.*

Table 10
Labour force status of 1990 doctoral graduates in the sciences, June 1995

Field of study	Working[1]	Working full time	Unemployed	Not in the labour force	Unemployment rate[2]
			%		
Agriculture and biological sciences	95	92	**	**	**
Engineering and applied sciences	94	92	**	**	**
Health professions	95	91	**	**	**
Mathematics and physical sciences	96	94	**	**	**
Overall (includes social sciences, etc.)	94	88	5	**	5

Notes:
*** These numbers have a coefficient of variation greater than 25% and are therefore not reliable enough to be released.*
1. Includes full time and part time.
2. The proportion of those in the labour force who are currently unemployed.
Source: *1995 National Graduates Survey.*

Table 11
Estimated median annual earnings of 1990 university graduates working full time, June 1995

Field of study		Bachelor's	Master's	Doctorate
			$	
Agriculture and biological sciences	Men	35,000	42,000	50,000
	Women	35,000	40,000	38,000
	Total	**35,000**	**40,000**	**48,000**
Engineering and applied sciences	Men	45,000	50,000	59,000
	Women	42,000	48,000	..
	Total	**45,000**	**50,000**	**58,000**
Health professions	Men	52,000	49,000	54,000
	Women	43,000	50,000	56,000
	Total	**45,000**	**50,000**	**55,000**
Mathematics and physical sciences	Men	42,000	46,000	50,000
	Women	40,000	45,000	51,000
	Total	**41,000**	**46,000**	**50,000**
Overall (includes social sciences, etc.)	Men	40,000	52,000	55,000
	Women	37,000	50,000	53,000
	Total	**38,000**	**50,000**	**54,000**

Note:
.. Figures not available.
Source: *1990 National Graduates Survey.*

Occupations are coded in the NGS according to the 1980 Standard Occupational Classification (SOC) (Table 14). This table involves a very small sample and the actual percentages have a high degree of variance. The data reveal at least two types of underemployed dental studies graduates:

- bachelor's graduates working as dental hygienists or assistants, and
- doctoral graduates working as dentists.

It should be noted, however, that two years is a short time frame for assessing the career outcomes for such individuals.

From the data, the target occupation for a doctoral graduate in dentistry—or in any other field—appears to be university teaching.

Table 12
Relationship of job to field of study for 1995 university science graduates employed full time, June 1997

Field of study	Job closely related to field of study	Job somewhat related	Job not at all related
	% of graduates		
Agriculture and biological sciences	38	27	36
Engineering and applied sciences	58	32	9
Health professions	79	16	6
Mathematics and physical sciences	59	28	13
Overall (includes social sciences, etc.)	53	24	23

Source: *1995 National Graduates Survey.*

Geology

Geology is different from dentistry in that it is not as closely linked to a particular profession.

While it may appear that the target occupation for geology graduates is geologist, Table 15 shows that they may be suitably employed in a number of occupations, such as manager, chemist, professional engineer and teacher.

Note also that the 'geologist' occupation includes graduates with bachelor's-, master's- or doctoral-level qualifications.

While industry of employment is not specifically addressed in Table 15, geology graduates are clearly employed in a variety of areas, including research and development (R&D), education and mining.

Table 13
Relationship of job requirements to education level for science graduates, two years after graduation, 1997

Relationship of job requirements to education level	Bachelor's	Master's	Doctorate
	% of graduates		
No education requirement specified	7.4	4.8	1.4
Graduate had more education than required in job	26.4	55.5	34.6
Graduate had the same education as required in job	59.1	38.7	64.0
Graduate had less education than required in job	7.1	0.9	0.0
Total	**100.0**	**100.0**	**100.0**

Source: *1995 National Graduates Survey.*

Table 14
Occupational distribution of employed 1995 dentistry graduates, 1997

	Certification level		
Occupation (1980 SOC)	Bachelor's	Master's	Doctorate
	% of graduates		
University teaching and related occupations	-	-	67
Physicians and surgeons	-	4	-
Dentists	86	75	33
Supervisors: nursing therapy and related assisting occupations	5	-	-
Dental hygienists and dental assistants	1	4	-
Occupations n.e.s. (e.g., uncoded)	8	17	-
Total	**100**	**100**	**100**

Note:
- Nil or zero.
Source: *1995 National Graduates Survey.*

Two years after graduation, the majority of working geology graduates appear to be in occupations that require one or more university degrees (Table 15). Statistics Canada's SOC is not organized to indicate multiple degrees, partly because of the nature of occupational classification. Certain occupations, such as dentistry, require a specific university degree, along with membership in a professional association. Other occupations, such as chemist, may require a degree but not necessarily a particular specialization—a geology graduate may become a chemist, for example. Also, the level of university certification (bachelor's, master's, doctorate) is frequently not evident from SOC occupational titles. Finally, for occupations such as manager or administrator, a university degree may be advantageous but it is not necessarily required or even the critical factor. For example, interpersonal and management skills may be more important than a university degree.

Computer programming

Computer programming was studied in reverse to determine which fields of study can lead to this S&T skill.

Computer programming is a field with varying entry requirements (Table 16). This also demonstrates one of the problems inherent in coding occupational titles, which are imprecise. For example, are trades graduates actually computer technicians?

Table 17 shows that at least one S&T skill, computer programming, may be acquired from a variety of fields of study at the bachelor's level, not just computer science or even science. Computer programming is likely to be an exception to the rule in this regard.

Getting back into the 'science stream'

After having been in the labour force, people may find the need for upgrading basic skills or returning to university to obtain specific scientific skills. In general, Canadians are less likely to engage in adult education than are people in most other OECD countries (Baran et al. 2000). Boothby and Gingras (1998) note that the likelihood of participating in formal education or training decreases with age.

Table 15
Occupational distribution of 1995 geology graduates, 1997

Occupation	1980 SOC group	Bachelor's	Master's	Doctorate
		% of graduates		
Managers, administrators and related occupations (auditors, government, business, etc.)	Major group 11	8	8	3
Geologists	2112	21	51	33
Chemists and physicists	2111, 2113	1	-	3
Physical science technologists and technicians (support for physical scientists)	2117	8	1	3
Professional engineers (civil, electrical, mining, petroleum, etc.)	2143-5, 2153-9	7	9	3
Occupations in mathematics, statistics, systems analysis and related fields	218	3	3	3
University teaching and related occupations	271	3	3	32
Other teaching (elementary, secondary, technical, etc.) and related occupations	273	9	3	4
Mining and quarrying, incl. oil and gas field occupations	771	5	-	3
Occupation not stated	9999	-	2	-
All other occupations	Various	9	3	6
Graduate not working in previous week (reason not specified in this variable)	9996	27	17	9
Total		**100**	**100**	**100**

Note:
- Nil or zero.
Source: *1995 National Graduates Survey.*

While most graduates with bachelor's degrees are under 25 years of age (except in the health professions), a small number of persons re-enter the education system later in life. A higher proportion of older graduates in one field of study or another would indicate a preference for sciences or non-sciences for these mature students. There are no major age differences between science and other graduates (Table 18) other than the high proportion of older graduates in health professions. Further investigation would be required to explain this, but one reason could be the upgrading of qualifications for nurses.

Table 16
Level of education of 1995 postsecondary graduates employed as computer programmers, 1997

Trades	Community college	Bachelor's	Master's	Doctorate	Total
		% of all computer programmers			
6	34	50	9	1	100

Source: *1995 National Graduates Survey.*

Table 17
Field of study of 1995 bachelor's graduates employed as computer programmers, 1997

Field of study	%
Computer science	46
Engineering (all types)	19
Mathematics	8
All other sciences (chemistry, geology, physics, biology, nursing, etc.)	5
Commerce, business, management	9
Teaching, social sciences and humanities	13
Total	**100**

Source: *1995 National Graduates Survey.*

The brain drain

Another way that Canada loses science graduates is through the emigration of highly skilled workers. In fact, there is a small net loss of knowledge workers (about 0.1% of all tax filers) to the United States (Drew, Murray and Zhao 2000). Although the loss is more evident in some specific knowledge occupations, this rate never exceeds 1% of the stock of workers in any occupation. The most prominent outflow is that of physicians (0.78% of the work force emigrated in 1996–1997), natural scientists (0.39%), nurses (0.33%), engineers (0.27%), postsecondary teachers (0.13%), managerial workers (0.12%), computer scientists and mathematicians (0.07%).

Offsetting these losses is an influx of university graduates from other countries. For every university degree holder emigrating to the United States, Canada receives four from the rest of the world.

Table 18
Age of 1995 bachelor's graduates upon graduation

Field of study	<25	25 to 29	30 to 39	40+	Total
			% of graduates		
Agricultural and biological sciences	82	12	4	2	100
Engineering	67	21	11	1	100
Health professions	42	26	18	14	100
Mathematics and physical sciences	66	18	11	5	100
Education	52	21	15	12	100
All other (arts, etc.)	62	18	12	8	100

Source: *1995 National Graduates Survey.*

Statistics Canada is actively improving the data from which estimates of emigration and immigration are made. Projects planned or underway include:

- improving the 'reverse record check' (the follow-up of non-respondents to the 2001 Census of Population);
- conducting a comparison of Canadians living in the United States and Americans living in Canada; and
- investigating income tax and other data in more detail.

Much of this work could also benefit the investigation of skills.

Data source: The National Graduates Survey

The National Graduates Survey (NGS), conducted by Statistics Canada in partnership with Human Resources Development Canada (HRDC), is specifically designed to obtain information on the relationship between education/training and labour market activities as well as on the long-term labour market experiences, employment, earnings, occupations, and additional educational experiences and qualifications of graduates. Every four years, a cohort of new graduates is surveyed. Each cohort comprises 40,000 graduates on average.

In 1978, Statistics Canada conducted the first survey on the labour market experiences of 1976 graduates of universities and community colleges in Canada. In 1984, a similar survey, the National Graduates Survey of 1982 graduates, was sponsored jointly by the Secretary of State and Employment and Immigration Canada and conducted

Table 19
Annual emigration to the United States as a percentage of the Canadian work force in selected knowledge-based occupations, 1996–1997

Knowledge-based occupations	Emigrants	Employed work force	Emigrants as proportion of work force
	number		%
Teachers – except postsecondary	267	416,970	0.06
Computer scientists and mathematicians	124	168,385	0.07
Managerial workers	2,263	1,927,760	0.12
Teachers – postsecondary	192	146,235	0.13
Engineers	458	172,415	0.27
Nurses	825	246,800	0.33
Natural scientists	174	44,630	0.39
Physicians	460	59,340	0.78

Source: *Drew, Murray and Zhao 2000.*

Table 20
Ratio of recent immigrants to Canadian-born, by highest level of educational attainment, 1996

Highest level of educational attainment	Recent immigrants	Canadian-born	Ratio of recent immigrants to Canadian-born
	%		ratio
Less than high school	35.8	35.0	1.0
Secondary school graduate	14.2	14.9	1.0
Completed non-university	16.6	24.8	0.7
Some postsecondary	10.4	11.0	0.9
Bachelor’s degree or higher	23.2	14.3	1.6
Bachelor’s degree	18.0	12.2	1.5
Master’s degree	4.0	1.9	2.2
Doctorate	1.2	0.3	4.3

Source: *Drew, Murray and Zhao 2000.*

by Statistics Canada. This survey expanded on the content of the previous survey and extended the population base to include graduates of trade/vocational programs in addition to those from community colleges and universities.

To date, four cohorts of graduates have been surveyed. All surveys have a longitudinal dimension:

Graduation year	Survey years
1982	1984, 1987
1986	1988, 1991
1990	1992, 1995
1995	1997, 2000

The survey’s key data objectives are

- to obtain information for labour market analysis of a given group of young people at a given time, focussing on education, training, employment, occupations, and geographic mobility. The data and analysis will be useful for policy development with respect to education, training, and the labour market;
- to obtain information on the relationship between education/training and labour market experiences and the exposure of graduates to additional learning opportunities;
- to extend available information required to improve occupational supply and demand projection models for various occupational categories, and to conduct related studies of supply–demand imbalances in the labour market;
- to obtain data regarding longer-term market experiences of graduates, with special emphasis on employment and occupations, for use in counselling on career and postsecondary education course selection;
- to obtain information on labour market experiences of members of target groups (such as women, visible minorities, Native people and disabled people), which permits longitudinal and comparative analysis useful in the formulation of job equity policies;
- to gain a better understanding of school-to-work transitions and returns to human capital;

- to gain a better understanding of postsecondary education financing; and
- to obtain more detailed information on knowledge and skills.

HRDC uses the survey data to identify potential occupational supply shortages and to provide basic input for job and career counselling with Canada Employment Centre clients. These programs will also benefit from analyses of data collected on labour market experiences as they relate to development of careers and respondents' subjective assessments of their jobs and of the relevance of their training. In such analyses, it will be possible to compare completers of trade/vocational programs with other graduates during the two years following graduation. Moreover, job equity programs will receive important labour market-related longitudinal information on designated groups such as women, Native people, disabled people, and visible minorities.

In particular, HRDC will use NGS data to update the occupational supply and demand models and the student flow model. These models project supplies of labour by occupation and industry, especially in categories requiring highly skilled and highly qualified workers. The models are used by HRDC in consultation with provincial governments to develop and implement labour market programs and policies.

The survey will aid postsecondary education course selection and career counselling by providing concrete information regarding graduates' labour market experiences and career development during the two years following graduation. The data are used at all levels of government and within the educational system for occupational career counselling to help young Canadians make appropriate career and employment choices.

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Data availability

announcements

Data releases

In the section "Data releases" we provide the titles of data released by the Centre for Education Statistics since the publication of the previous issue of Education Quarterly Review. *Details on each release can be accessed free-of-charge from Statistics Canada's website* www.statcan.ca. *Click on "The Daily" and "Previous issues".*

- Participation in postsecondary education and family income, 1998 (released December 4, 2001)
- Measuring up: The performance of Canada's youth in reading, mathematics and science (released December 4, 2001)
- Knowledge and skills for life: First results from the OECD Programme for International Student Assessment (released December 4, 2001)
- University enrolment, 1999–2000 (released November 8, 2001)
- Education Price Index, 1999 (released September 10, 2001)
- Adult education participation in North America: International perspectives, 1994–1998 (released September 7, 2001)
- University tuition fees, 2001–2002 (released August 27, 2001)

EQR

Current data

Data series	Most recent data: Final[1]	Most recent data: Preliminary or estimate[2]
A. Elementary/secondary		
Enrolment in public schools	1998–1999	1999–2000[e] 2000–2001[e]
Enrolment in private schools	1998–1999	1999–2000[e]
Enrolment in minority and second language education programs	1998–1999	
Secondary school graduation	1998–1999	
Educators in public schools	1998–1999	1999–2000[e] 2000–2001[e]
Educators in private schools	1997–1998	1998–1999[e] 1999–2000[e]
Elementary/secondary school characteristics	1998–1999	1999–2000[e]
Financial statistics of school boards	1998–1999	
Financial statistics of private academic schools	1995–1996	1996–1997[p]
Federal government expenditures on elementary/secondary education	1998–1999	1999-2000[p]
Consolidated expenditures on elementary/secondary education	1998–1999	1999-2000[p]
Education Price Index	1999	
B. Postsecondary		
University enrolments	1999–2000	discontinued
University degrees granted	1998	discontinued
University continuing education enrolment	1996–1997	discontinued
Educators in universities	1998–1999	1999–2000[e]
Salaries and salary scales of full-time teaching staff at Canadian universities	1999–2000	
Tuition and living accommodation costs at Canadian universities	2001–2002	
University finance	1998–1999	1999–2000[p]
College finance	1998–1999	1999–2000[p]
Federal government expenditures on postsecondary education	1997–1998	1998–1999[p] 1999–2000[e]
Consolidated expenditures on postsecondary education	1997–1998	1998–1999[p] 1999–2000[e]
Community colleges and related institutions: enrolment and graduates	1998–1999	1999–2000[e]
Trade/vocational enrolment	1998–1999	1999–2000[e]
College/trade teaching staff	1997–1998	1998–1999[p]
International student participation in Canadian universities	1998–1999	

See notes at end of this table.

Current data (concluded)

Data series	Most recent data Final[1]	Preliminary or estimate[2]
C. Publications[3]		
Education in Canada (2000)		
South of the Border: Graduates from the class of '95 who moved to the United States (1999)		
After High School, the First Years (1996)		
Participation in postsecondary education and family income (1998)		
A report on adult education and training in Canada: Learning a living (1998)		
International student participation in Canadian education (1993–1995)		
Education Price Index – methodological report		
Handbook of education terminology: elementary and secondary level (1994)		
Guide to data on elementary secondary education in Canada (1995)		
A Guide to Statistics Canada Information and Data Sources on Adult Education and Training (1996)		
A Statistical Portrait of Elementary and Secondary Education in Canada – Third edition (1996)		
A Statistical Portrait of Education at the University Level in Canada – First edition (1996)		
The Class of '90: A compendium of findings (1996)		
The Class of '90 Revisited (1997)		
The Class of '95: Report of the 1997 National Survey of 1995 Graduates (1999)		
Education indicators in Canada: Report of the Pan–Canadian Indicators Program (1999)		
Education at a Glance: OECD Indicators (2000)		
In Pursuit of Equity in Education: Using International Indicators to Compare Equity Policies (2001)		
Literacy, Economy and Society (1995)		
Literacy Skills for the Knowledge Society (1997)		
Literacy in the Information Age (2000)		
International Adult Literacy Survey Monograph Series		
Benchmarking Adult Literacy in North America: An International Comparative Study (2001)		
Measuring up: The performance of Canada's youth in reading, mathematics and science (2000)		
Growing Up in Canada: National Longitudinal Survey of Children and Youth (1996)		
Children and youth at risk: Symposium report		

Notes:
1. *Indicates the most recent calendar year (e.g., 1993) or academic/fiscal year (e.g., 1993–1994) for which final data are available for all provinces and territories.*
2. *Indicates the most recent calendar year (e.g., 1995) or academic/fiscal year (e.g., 1996–1997) for which any data are available. The data may be preliminary (e.g., 1995^p), estimated (e.g., 1995^e) or partial (e.g., data not available for all provinces and territories).*
3. *The year indicated in parentheses denotes the year of publication. Some of these publications are prepared in co-operation with other departments or organizations. For information on acquiring copies of these reports, please contact Client Services, Culture, Tourism and the Centre for Education Statistics. Telephone: (613) 951-7608, toll free 1 800 307-3382; Fax: (613) 951-9040) or E-mail: educationstats@statcan.ca.*

Education
at a glance

This section provides a series of social, economic and education indicators for Canada and the provinces/territories. Included are key statistics on the characteristics of the student and staff populations, educational attainment, public expenditures on education, labour force employed in education, and educational outcomes.

Table 1
Education indicators, Canada, 1981 to 1999

Indicator[1]	1981	1986	1991	1992	1993	1994	1995	1996	1997	1998	1999
	thousands										
Social context											
Population aged 0–3	1,448.7	1,475.0	1,573.4	1,601.7	1,610.6	1,596.1	1,595.1	1,578.6	1,560.7	1,550.7	1,453.9
Population aged 4–17	5,480.3	5,204.7	5,395.4	5,437.7	5,484.7	5,536.4	5,620.7	5,691.4	5,754.0	5,795.7	5,725.6
Population aged 18–24	3,493.1	3,286.3	2,886.1	2,869.2	2,869.6	2,852.0	2,823.4	2,816.8	2,833.0	2,865.4	2,895.9
Total population	24,900.0	26,203.8	28,120.1	28,542.2	28,940.6	29,248.1	29,562.5	29,963.7	30,358.5	30,747.0	30,553.8
Youth immigration[r]	42.8	25.9	61.2	61.2	73.1	68.3	65.9	66.3	70.4	61.2	..
	%										
Lone-parent families	16.6	18.8	15.3	14.4	14.8	14.9	15.1	14.8	14.9	..	..
Economic context											
GDP: Real annual percentage change	4.0	3.1	-1.8	-0.6	2.2	4.1	2.3	1.5	..	..	..
CPI: Annual percentage change	12.4	4.2	5.6	1.5	1.8	0.2	2.2	1.7	1.7	1.0	1.9
Employment rate	60.0	59.6	59.7	58.4	58.0	58.4	58.8	58.5	59.0	59.7	60.6
Unemployment rate	7.6	9.7	10.3	11.2	11.4	10.4	9.4	9.7	9.1	8.3	7.6
Student employment rate	..	34.4	38.0	35.1	34.0	34.2	33.3	34.8	32.5[2]	..	..
Families below low income cut-offs:											
Two-parent families	10.2	10.9	10.8	10.6	12.2	11.5	12.8	11.8	12.0	..	..
Lone-parent families	48.4	52.5	55.4	52.3	55.0	53.0	53.0	56.8	51.1	..	..
Enrolments	thousands										
Elementary/secondary schools	5,024.2	4,938.0	5,218.2	5,284.1	5,327.8	5,362.8	5,441.4	5,414.6	5,386.3	5,483.9[e]	5,524.9[e]
	%										
Percentage in private schools	4.3	4.6	4.7	4.9	5.0	5.1	5.1	5.2	5.3	5.3[e]	..
	thousands										
College/trade/vocational, full-time[3]	..	238.1	275.9	266.7	306.5	298.5	269.1	266.4[e]	264.5[e]	..	..
College/postsecondary, full-time	273.4	321.5	349.1	364.6	369.2[r]	380.0[r]	391.3[r]	397.3[r]	398.6	403.5[r]	409.4[e]
College/postsecondary, part-time[4]	..	96.4[e]	125.7[e]	106.6[e]	98.4	90.8	87.7	87.1	91.6	91.4	..

See notes at end of this table.

Table 1
Education indicators, Canada, 1981 to 1999 (concluded)

Indicator[1]	1981	1986	1991	1992	1993	1994	1995	1996	1997	1998	1999
	thousands										
Full-time university	401.9	475.4	554.0	569.5	574.3	575.7	573.2	573.6	573.1[r]	580.4	..
Part-time university	251.9	287.5	313.3	316.2	300.3	283.3	273.2	256.1	249.7	246.0	..
Adult education and training	..	..	5,504	..	5,842	..	..	..	6,069	..	..
	%										
Participation rate	..	..	27	..	28	..	..	..	26	..	..
Graduates	thousands										
Secondary schools[5]	..	..	260.7	272.9	281.4	280.4	295.3	300.2[r]	296.4[r]	300.8[e]	..
College/trade/vocational[6]	..	145.0	159.7	158.8	163.9	151.1	144.2	141.5[e]	138.7[e]	..	..
College/postsecondary	71.8	82.4	85.9	92.5	95.2	97.2	100.9	105.0	105.9[e]	..	..
University/Bachelor's	84.9	101.7	114.8	120.7	123.2	126.5	127.3	128.0	125.8	124.9	..
University/Master's	12.9	15.9	18.0	19.4	20.8	21.3	21.4	21.6	21.3	22.0	..
University/Doctorate	1.8	2.2	2.9	3.1	3.4[e]	3.6	3.7	3.9	4.0	4.0	..
Full-time educators											
Elementary/secondary schools	274.6	269.9	302.6	301.8	295.4	295.7[e]	298.7[e]	294.4[e]	296.8[e]	295.9[e]	295.9[e]
College/postsecondary/trade/ vocational	26.8[7]	30.6[7]	31.7[7]	31.8[7]	32.2[7]	31.0[7]	30.9[r]	31.5[r]	31.0[r]	32.1[e]	..
University	33.6	35.4	36.8	37.3	36.9	36.4	36.0	34.6	33.7	33.7[e]	..
	ratio										
Elementary/secondary pupil–educator ratio	17.0	16.5	15.5	15.7[e]	16.1[e]	16.1[e]	16.1[e]	16.3[e]	16.3[e]	16.5[e]	16.6[e]
Education expenditures	$ millions										
Elementary/secondary	16,703.2	22,968.0	33,444.9	34,774.5	35,582.3	35,936.0	36,424.7	36,744.7	36,973.1[p]	37,453.8[e]	37,498.9[e]
Vocational	1,601.2	3,275.1	4,573.8	5,380.9	5,631.2	6,559.0	6,185.2	5,301.8	5,896.9[p]	5,903.4[e]	6,229.6[e]
College	2,088.1	2,999.0	3,870.7	4,075.3	4,105.9	4,207.1	4,531.8	4,477.9	4,642.0[p]	4,808.9[e]	5,261.7[e]
University	4,980.7	7,368.7	11,254.8	11,569.8	11,736.8	11,857.9	11,802.0	11,600.7	12,255.4[p]	12,660.5	12,874.9[e]
Total education expenditures	25,373.2	36,610.8	53,144.2	55,800.5	57,056.2	58,560.0	58,943.7	58,125.1	59,767.4[p]	60,826.6	61,865.1
	%										
As a percentage of GDP	7.1	7.3	7.9	8.1	8.0	7.8	7.6	7.1	6.9	6.8	..

Notes:
.. Figures not available.
r Revised figures.
e Estimated figures.
1. *See 'Definitions' following Table 2.*
2. *The figure is for April 1997.*
3. *The enrolments have all been reported as full-time based on a'full-day' program, even though the duration of the programs varies from 1 to 48 weeks.*
4. *Excludes enrolments in continuing education courses, which had previously been included.*
5. *Source: Canadian Education Statistics Council. (Excludes adults for Quebec, Ontario and Alberta equivalencies.)*
6. *The majority of trade and vocational programs, unlike graduate diploma programs which are generally two or three years' duration, are short programs or single courses that may require only several weeks. A person successfully completing these short-duration programs or courses is considered a completer, not a graduate. These completers do not include persons in part-time programs.*
7. *Figures have been revised to include a complete count of staff in trade programs.*

Table 2
Education indicators, provinces and territories

Indicator[1]	Canada	Newfound-land	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario
	%						
Social and economic context							
Educational attainment,[2] 1999:							
Less than secondary diploma	26.8	38.4	35.7	30.8	32.9	33.0	24.1
Graduated from high school	19.3	14.1	15.1	14.0	19.9	15.8	21.0
Some postsecondary	6.9	4.8	5.5	5.6	4.5	5.4	7.2
Postsecondary certificate, diploma or university degree	47.0	42.6	43.8	49.5	42.8	45.7	47.6
Labour force participation rates by educational attainment, 1999:							
Total	66.0	58.5	65.7	60.8	60.8	63.4	66.9
Less than secondary diploma	40.0	34.5	47.0	36.2	36.2	37.5	40.2
Graduated from high school	69.6	64.4	73.7	66.8	69.1	70.1	68.8
Some postsecondary	71.8	63.0	71.4	70.0	67.9	70.3	72.1
Postsecondary certificate, diploma or university degree	78.5	77.8	77.0	73.4	75.1	79.0	78.9
Unemployment rate, 1999	6.3	15.1	13.4	7.8	8.9	8.1	5.0
Costs							
Public and private expenditures on education as a percentage of GDP, 1994–1995	7.0	9.9	7.6	7.6	7.4	7.6	6.8
Public expenditures on education as a percentage of total public expenditures, 1994–1995	13.6	16.9	10.8	9.7	11.2	13.8	14.2
Elementary/secondary pupil–educator ratio, 1997–1998	16.4 r	14.6	17.2	17.5	17.6	14.6 r	16.7 r
Educational outcomes							
Secondary school graduation rates, 1996–1997	73.4	80.2	85.6	80.7	86.0	75.9[3,4]	72.0
University graduation rate, 1997–1998	35.2 r	31.4 r	21.0 r	53.5 r	32.9 r	41.8 r	36.7
Unemployment rate by level of educational attainment, 1999							
Less than secondary diploma	10.4	25.4	23.6	13.0	15.7	12.7	7.7
Graduated from high school	6.3	16.7	15.3	6.6	8.9	8.4	5.1
Some postsecondary	7.1	9.2	5.7	5.8	5.9	9.8	6.6
Postsecondary certificate, diploma or university degree	5.0	10.7	8.1	6.6	6.5	6.2	4.1

See notes at end of this table.

Table 2
Education indicators, provinces and territories (concluded)

Indicator[1]	Manitoba	Saskatchewan	Alberta	British Columbia	Yukon	Northwest Territories
	%					
Social and economic context						
Educational attainment,[2] 1999:						
Less than secondary diploma	30.9	31.4	21.6	20.5	..	..
Graduated from high school	18.3	18.8	19.9	22.6	..	..
Some postsecondary	6.8	7.9	8.2	8.8	..	..
Postsecondary certificate, diploma or university degree	44.0	41.9	50.3	48.1	..	..
Labour force participation rates by educational attainment, 1999:						
Total	66.8	67.5	73.1	65.8	..	..
Less than secondary diploma	44.5	44.6	50.4	39.8	..	..
Graduated from high school	72.1	77.5	75.4	66.5	..	..
Some postsecondary	75.9	73.5	77.5	69.0	..	..
Postsecondary certificate, diploma or university degree	78.9	79.1	81.2	76.0	..	..
Unemployment rate, 1999	4.6	4.8	4.4	7.2	..	..
Costs						
Public and private expenditures on education as a percentage of GDP, 1994–1995	7.8	7.4	5.4	6.5	11.3	16.6
Public expenditures on education as a percentage of total public expenditures, 1994–1995	12.9	13.8	13.2	12.2	10.4	12.0
Elementary/secondary pupil–educator ratio, 1997–1998	16.3	17.3	17.8 r	17.5	13.2	13.1
Educational outcomes						
Secondary school graduation rates, 1996–1997	78.1	78.8	64.7	70.5	37.3	24.6
University graduation rate, 1997–1998	31.3 r	34.1 r	26.8 r	24.5 r	..	..
Unemployment rate by level of educational attainment, 1999						
Less than secondary diploma	6.8	7.9	5.6	12.8	..	..
Graduated from high school	4.2	3.9	3.9	8.1	..	..
Some postsecondary	4.7	5.6	5.2	7.3	..	..
Postsecondary certificate, diploma or university degree	3.8	3.7	3.9	5.6	..	..

Notes:
.. Figures not available.
r Revised figures.
1. See 'Definitions' following Table 2.
2. Parts may not add up to 100% due to rounding.
3. Starting in 1995, Quebec graduate data for regular day programs include individuals over the age of 20 who graduated from regular day programs.
4. Excludes "Formation professionnelle."

..

Definitions

Education indicators, Canada

Table 1.

Year references are as follows: (1) *population* refers to July of the given year; (2) *enrolment* and *staff* refer to the academic year beginning in September of the given year; (3) *graduates* refers to number of persons graduating in the spring or summer of the given year; (4) *expenditures* refers to the fiscal year beginning in April of the given year.

1. **Youth immigration**
The number of persons aged 0 to 19 who are, or have been, landed immigrants in Canada. A landed immigrant is a person who is not a Canadian citizen by birth, but who has been granted the right to live in Canada permanently by Canadian immigration authorities.

2. **Lone-parent families**
The number of lone-parent families expressed as a percentage of the total number of families with children. A lone parent refers to a mother or a father, with no spouse or common-law partner present, living in a dwelling with one or more never-married sons and/or daughters. Sources: Statistics Canada, 1971 to 1986: *Lone-parent families in Canada*, Catalogue no. 89-522-XPE; 1991 to present: Small Area and Administrative Data Division.

3. **Gross domestic product**
The unduplicated value of production originating within the boundaries of Canada, regardless of the ownership of the factors of production. GDP can be calculated three ways: as total incomes earned in current production; as total final sales of current production; or as total net values added in current production. It can be valued either at factor cost or at market prices. Source: Statistics Canada, Industry, Measures and Analysis Division.

4. **Consumer Price Index**
The Consumer Price Index (CPI) is an indicator of changes in consumer prices. It is defined as a measure of price change obtained by comparing, over time, the cost of a specific basket of commodities. Figures are annual averages.

5. **Employment rate**
The number of persons employed expressed as a percentage of the population 15 years of age and over, excluding institutional residents. Figures are annual averages.

6. **Unemployment rate**
The number of unemployed persons expressed as a percentage of the labour force.

7. **Student employment rate**
The number of persons aged 15 to 24 attending school on a full-time basis who were employed during the calendar year (excluding May through August), expressed as a percentage of the total number of full-time students 15 to 24 years of age.

8. **Families below low income cut-offs**
Low income cut-offs are a relative measure of the income adequacy of families. A family that earns less than one-half of the median adjusted family unit income is considered to be in difficult circumstances. The set of low income cut-offs is adjusted for the size of the area of residence and for family size. Source: Statistics Canada, *Low Income Persons, 1980 to 1995*, December 1996, Catalogue no. 13-569-XPB/XIB.

9. **Adult education participation rate**
The number of persons 17 years of age or over participating in adult education or training activities, expressed as a percentage of the total population 17 years of age or over. Excludes regular full-time students who are completing their initial schooling.

10. **Elementary/secondary pupil–educator ratio**
Full-time equivalent enrolment (enrolment in grades 1 to 12 [including Ontario Academic Credits] and ungraded programs, pre-elementary enrolment in provinces where attendance is full time, and half of the pre-elementary enrolment in other provinces) divided by the full-time equivalent number of educators.

11. **Education expenditures**
Includes expenditures of governments and of all institutions providing elementary/secondary and postsecondary education, and vocational training programs offered by public and private trade/ vocational schools and community colleges.

Education indicators, provinces and territories

Table 2.

The methodologies used to derive the indicators in Table 2 may differ from those used in other statistical tables of this section.

12. Educational attainment and labour force participation rates

Refers to the population aged 25 and over. Source: Statistics Canada, Labour Statistics Division.

13. Secondary school graduation rate

Source: Statistics Canada, 2001, Centre for Education Statistics, *Education in Canada 2000*, Catalogue no. 81-229-XPB.

14. University graduation rate

Number of degrees awarded at the undergraduate level, as a percentage of the population aged 22.

15. Unemployment rate by level of educational attainment

The number unemployed with a given level of education expressed as a percentage of the labour force with the same education for the population aged 25 and over. Upper secondary includes the final grade of secondary school. *EQR*

In upcoming issues

The following articles are scheduled to appear in upcoming issues of *Education Quarterly Review:*

Learning computer skills

The representation of women in university computer science programs in Canada decreased from one in four students in 1982 to about one in five in 1999. Are women and men learning their computing skills in different ways? This study examines why men and women often end up segregated into somewhat distinct fields of study and subsequent paid work.

Labour market performance of liberal arts and sciences university graduates

The labour market experiences of liberal arts and sciences university graduates are examined using data from the Survey of Labour and Income Dynamics. The paper examines dynamic issues, including occupational mobility and wage growth. Evidence is offered to suggest that the skills of the liberal arts and sciences group are more portable across industrial and occupational sectors.

Family income and participation in postsecondary education

This analysis looks at family income and its impact on participation in postsecondary education. It suggests that parents' education has a stronger effect than income on the likelihood of children going on to postsecondary education. In addition to the involvement of parents in their children's education, other important factors include aspirations, values and motivations that facilitate educational attainment.

Income prospects of British Columbia university graduates

Using tax and administrative records of British Columbia bachelor's graduates, income of graduates is examined with a focus on changes in income over time, as well as differences across major fields of study.

Female engineering graduates in Ontario: Success in the labour market

Using data from Statistics Canada's University Student Information System and the T-1 Family File, this article examines a series of questions of interest to students preparing to enter postsecondary studies, as well as to teachers, counselors and companies in the technology sector: What is the potential for earnings and growth in engineering? How has the proportion of female graduates in engineering changed over time? How do engineering incomes compare to incomes in other fields of study?

EQR

Cumulative index

This index lists, by major subject area, the analytical articles published in *Education Quarterly Review*. Included are descriptions of education and education-related surveys conducted by Statistics Canada, provincial governments and institutions.

Enrolment

Graduates

Teachers

Finance

Flows and transition

Accessibility

Achievement and literacy

Labour market