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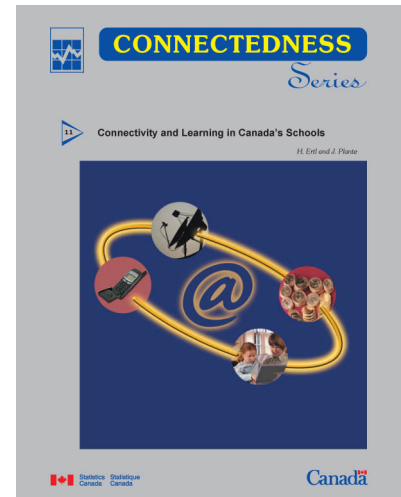
# Connectivity and Learning in Canada's Schools

by H. Ertl and J. Plante

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*by H. Ertl and J. Plante*

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# Abstract

Using data from the Information and Communications Technologies in Schools Survey (ICTSS), this paper provides key indicators of connectedness for Canada's elementary and secondary schools. National and provincial measures of ICT infrastructure and reach are examined across a number of school variables, including instructional level, size, location and type of school administration. Teacher skills and practices, as well as challenges to using ICTs in the learning environment are also addressed.

Canadian schools are equipped with the necessary infrastructure to integrate ICTs into the learning environment. In 2003/04, virtually all elementary and secondary schools had computers and nearly all were connected to the Internet, with rates ranging from 91% in Manitoba to 100% in the territories. Access to the Internet within schools is also pervasive, with more than nine out of ten school computers connected to the Internet and available to students.

Typically, there were about five students to a school computer, while there were slightly more students (5.5) per Internet-connected computer. The Yukon had the least number of students both per computer and Internet-connected computer (2.9). Quebec had the most students per Internet-connected computer (6.5), followed by Ontario (5.8), and British Columbia and Prince Edward Island (5.6).

An overwhelming majority (86%) of schools used broadband technologies to access the Internet, while only 9% used a regular dial-up telephone line. The Yukon, New Brunswick, Nova Scotia and Saskatchewan were leaders in broadband connectivity, while the Northwest Territories, Nunavut and Prince Edward Island had the lowest proportions of schools connected by broadband.

Despite the widespread availability of ICT infrastructure and high rates of connectedness in schools, maintaining current systems and equipment can be challenging. Indeed, one of the biggest concerns among school principals was the cost of technology. Slightly more than two-thirds of principals reported that getting sufficient funding for technology was an extensive challenge to using ICT in their school. The extent to which ICT is being integrated into teaching practices also needs to be further explored. Training opportunities for teachers were cited as an extensive challenge by 40% of schools, while teachers were perceived to be more skilled at using ICT for administrative purposes rather than for engaging students in learning.

# Connectivity and Learning in Canada's Schools

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## 1. INTRODUCTION

In this age of the information society, information and communications technologies (ICTs) have become everyday tools for living, working and learning. Nearly every facet of our economy and society has been touched by ICTs. ICTs in education have become a priority for governments, educators and businesses in order to equip students with the skills necessary to succeed in today's technology-savvy workplace, and in an effort to close the digital divide.

Substantial investments have been made over the past several years to acquire hardware and software for schools, to connect elementary and secondary schools and their classrooms to the Internet, as well as to help educators improve their own ICT-related skills (Statistics Canada 2004a). However, reliable and timely measures of ICT infrastructure, access and use are still lacking in the education sector, as are measures of the outcomes and impacts of these investments.

The Information and Communications Technologies in Schools Survey (ICTSS) was designed to build a comprehensive database on the state of ICT infrastructure and access in elementary and secondary schools across Canada. From these timely and reliable baseline data, policy makers, education practitioners and researchers can begin to measure, monitor and assess the achievements towards program objectives for ICT in education. Developed by the Government of Canada's *SchoolNet* Program, in cooperation with the *SchoolNet* National Advisory Board and Statistics Canada, the focus of the 2003/04 ICTSS was the measurement of ICT **infrastructure** and ICT **reach**.

Using data from the ICTSS, this study provides comprehensive national and provincial measures of ICT infrastructure and reach from nearly 6,700 elementary and secondary schools, which were weighted to represent the approximately 15,500 elementary and secondary schools in Canada. Key indicators of school connectedness are examined across a number of school variables, including instructional level, school size, location (urban or rural), and school administration (public or private).

Section two briefly profiles the elementary and secondary schools covered by the survey. Section three presents estimates of ICT infrastructure, including the number of computers in schools, the availability of computers for students, and computer operating systems, processing speeds and technical support time. In the fourth section, school connectivity is explored through the availability of Internet-connected computers, types of Internet connections, and school use of websites, intranets and videoconferencing technology. Access is examined in section five, including student access to software and online courses. Teacher training and professional development in the use of ICTs is addressed in section six, while section seven looks at the challenges to using ICTs in schools. Section eight summarizes and offers concluding remarks.

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This article has been adapted from the report entitled "Connectivity and ICT integration in Canadian elementary and secondary schools: First results from the Information and Communications Technologies in Schools Survey, 2003-2004" (Statistics Canada 2004a), which first released the national survey results. Provincial estimates are included here to provide a more comprehensive picture of ICTs in Canadian schools.

ICT **infrastructure** includes the different components of ICT that make up the underlying foundation of a connected school, such as the number of computers and their characteristics.

ICT **reach** refers to the degree to which the ICT infrastructure can be accessed by teachers and students.

## NOTE TO READERS

This study is based on 2003/04 data from the *Information and Communications Technologies in Schools Survey* (ICTSS). The ICTSS was designed as a census of kindergarten to grade 12 (K-12) schools in Canada, to provide a comprehensive measure of connectivity and ICT infrastructure, and to identify ICT access patterns. Sponsored by Industry Canada's *SchoolNet* program, which works with Canadian learning partners – provincial and territorial governments, education associations, school boards, schools, teachers and students – and conducted by Statistics Canada, the survey aims to measure access to and integration of ICT into the learning environment. Support to the survey initiative has also been provided by Library and Archives Canada.

The survey targeted all Canadian schools at the elementary and secondary levels (15,500 schools), including public, private and federal institutions, as well as schools for the visual and hearing impaired. In 2003/04, there were approximately 10,100 elementary schools, 3,400 secondary schools, and 2,000 mixed schools (i.e. schools offering a combination of elementary and secondary grade levels) in Canada. Continuing education/adult day schools, trade/vocational schools, language and cultural education schools, home schools, community education centres and social service centres were excluded, as were new schools that opened in 2003.

The analysis presented here is based on data collected from nearly 6,700 schools. For more information about the survey methodology, including weighting and non-response adjustments, readers should consult Statistics Canada Catalogue No. 81-595-MIE, no. 17, pages 31-33 (Statistics Canada 2004a). The survey was conducted from October 2003 to January 2004 and refers to the 2003/04 school year. The survey respondent was the school principal. For the purpose of this study, data for First Nations schools and distance learning schools were excluded.

### School characteristics

The *school instructional level* is classified as **elementary** if the school offers grade 6 and under or a majority of elementary grades and **secondary** if the school offers grade 7 and over or a majority of secondary grades. For the purpose of this analysis, schools offering a combination of elementary and secondary grades are referred to as **mixed**.

The *size of the school* is based on the number of students enrolled, by instructional level, as shown in the distribution below.

<b>School size</b>	<b>Elementary school</b>	<b>Secondary school</b>	<b>Mixed school</b>
Small .....	less than 200 students .....	less than 300 students .....	less than 60 students
Medium .....	$200 \leq \text{students} \leq 350$ .....	$300 \leq \text{students} \leq 700$ .....	$60 \leq \text{students} \leq 200$
Large .....	more than 350 students .....	more than 700 students .....	more than 200 students

The *location of the school* is defined as either rural or urban. **Rural** schools are located in rural areas and small towns (RST) or within the rural fringes of a larger centre (census metropolitan areas (CMAs) or census agglomerations (CAs)). **Urban** schools are located in a CMA or CA, but not in the rural fringe (Statistics Canada 2003).

A school is classified as either **public** or **private**, according to whether a public agency or a private entity has the ultimate decision-making power regarding school affairs. For example, a private school is controlled and managed by a non-governmental organisation (e.g., a church, a trade union or a business enterprise) or is governed by a board consisting mostly of members not selected by a public agency.

It is important to note that many of the school characteristics used for independent analysis may also be related to each other. For example, enrolment size may be related to school location (urban schools are typically larger than rural schools), and school administration (public schools are typically larger than private schools). These relationships should be considered in the interpretation of the data.

## Box 1: SchoolNet Programs

The **SchoolNet** Programs are an integral part of the Government of Canada's *Connecting Canadians* strategy to keep Canada among the leaders in connecting its citizens to the Internet. In partnership with the provincial and territorial governments, the education community and the private sector, *SchoolNet* promotes the effective use of ICTs in learning and aims to ready learners for the knowledge-based society. In 1999, with the collaboration and support of the provincial and territorial education sectors, Canada became the first nation to connect all willing public schools and libraries to the Internet (Industry Canada 2004a).

**SchoolNet** and the *SchoolNet* Advisory Board (SNAB) have expressed a desire for timely and reliable information to monitor connectivity in K-12 schools, to measure the integration and use of ICTs in education, and to evaluate the performance of existing programs. The ICTSS represents the first step in responding to this request.

## 2. A PROFILE OF K-12 SCHOOLS IN CANADA

In 2003/04, there were approximately 15,500 kindergarten to grade 12 (K-12) schools in Canada. Of these, the majority (65%) were classified as elementary schools, followed by secondary (22%) and mixed (13%) schools. Urban schools accounted for nearly three-quarters of all schools.

Overall, urban schools were more likely to be large in size, while a higher proportion of small schools were

located in rural areas. Eighty-eight percent of all schools were publicly administered, while roughly 11% were classified as private. Only about 1% of schools had a combination of public and private administrations. Table 1 presents the percentage of K-12 schools by various characteristics, as well as the distribution by instructional level and size, within each characteristic.

**Table 1.**  
Percentage of K-12 schools in Canada by characteristic, 2003/04

		All schools	Urban	Rural	Public	Private
	<b>All schools</b>	<b>100.0</b>	<b>73.7</b>	<b>26.3</b>	<b>88.4</b>	<b>10.5</b>
<b>Elementary</b>	<i>Small</i>	20.9	14.6	38.5	19.3	33.7
	<i>Medium</i>	22.0	24.7	14.5	23.5	10.8
	<i>Large</i>	22.2	27.9	6.3	24.7	4.0
<b>Secondary</b>	<i>Small</i>	6.8	7.0	6.4	6.2	12.6
	<i>Medium</i>	7.5	8.6	4.2	7.6	5.9
	<i>Large</i>	7.6	9.5	2.4	8.4	1.7
<b>Mixed</b>	<i>Small</i>	4.2	2.1	9.9	3.0	13.2
	<i>Medium</i>	4.4	1.9	11.5	3.7	9.4
	<i>Large</i>	4.4	3.7	6.4	3.7	8.8

Note: Estimates may not sum to 100% due to rounding.

Not surprisingly, the three largest provinces accounted for the highest proportions of K-12 schools in Canada (Table 2). In 2003/04, 42% of Canadian elementary schools were found in Ontario, followed by 22% in Quebec and 13% in British Columbia. Ontario also had the highest proportion of K-12 schools located in urban areas (40%), followed by Quebec (19%), British Columbia (14%) and Alberta (13%). One-quarter of rural schools were found in

Ontario, while 21% were located in Quebec. More than one-third of publicly administered schools were located in Ontario (35%), followed by Quebec (20%), and Alberta and British Columbia (12%). Ontario accounted for half of the proportion of privately administered schools in Canada.

**Table 2.**

*Percentage of K-12 schools in Canada by province, territory and selected characteristics, 2003/04*

	All schools	Elementary	Secondary	Mixed	Urban	Rural	Public	Private
<b>Canada</b>	<b>100.0</b>	<b>65.1</b>	<b>21.9</b>	<b>12.9</b>	<b>73.7</b>	<b>26.3</b>	<b>88.4</b>	<b>10.5</b>
Newfoundland and Labrador	2.1	1.3	2.6	5.5	1.3	4.6	2.4	x
Prince Edward Island	0.5	0.4	0.6	x	0.3	0.9	0.5	x
Nova Scotia	3.1	2.9	3.8	2.7	2.1	5.6	3.3	1.1
New Brunswick	2.4	2.4	2.7	1.4	1.9	3.5	2.6	0.8
Quebec	19.4	22.2	18.1	7.3	18.8	21.1	19.8	15.0
Ontario	36.3	41.7	34.2	12.1	40.4	24.5	35.1	50.0
Manitoba	5.3	3.9	4.7	13.2	4.1	8.5	5.2	5.3
Saskatchewan	5.2	3.7	4.0	14.8	4.0	8.5	5.7	1.1
Alberta	12.1	7.8	13.8	30.8	12.5	10.9	12.4	10.2
British Columbia	13.0	13.1	14.9	9.0	14.1	10.0	12.2	16.0
Yukon	0.2	0.1	x	0.7	0.1	0.4	0.2	x
Northwest Territories	0.3	0.2	x	1.2	0.1	0.9	0.4	0.1
Nunavut	0.3	0.2	x	x	0.1*	0.7	0.3	x

Note: Estimates may not sum to 100% due to rounding.

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

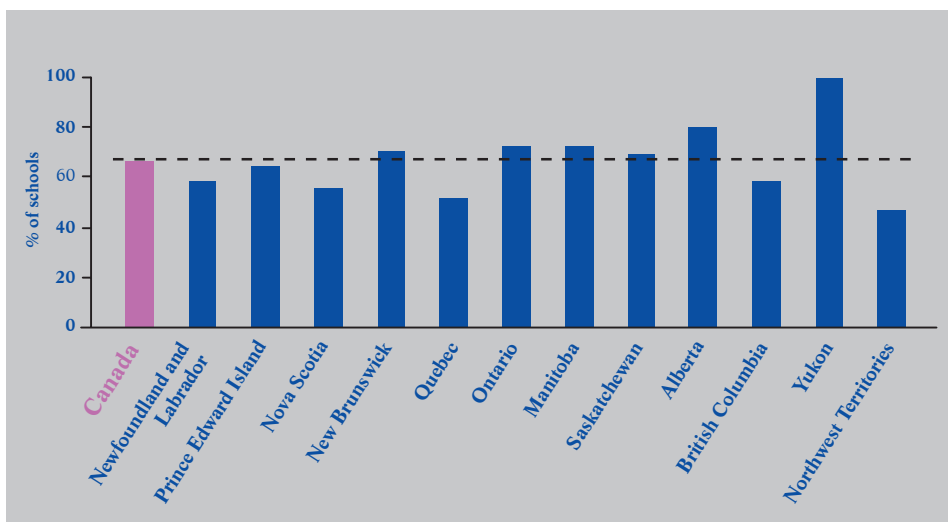
### 3. ICT INFRASTRUCTURE IN CANADIAN SCHOOLS

If schools and teachers are to be effective in integrating ICT into the learning environment, then having the necessary infrastructure or plan to acquire and maintain the infrastructure is the crucial first step. About two-thirds of school principals reported having a technology plan for ICT acquisition, upgrading and replacement (Chart 1). Public schools (72%) were more likely to have a technology plan than private schools (26%), while large schools (73%) were more likely to have such a plan than small schools (57%).

A closer examination of provincial and territorial data revealed that all schools in the Yukon reported having a technology plan for ICT acquisition, upgrading and replacement. In addition, the majority of schools in Alberta (81%), Ontario (73%), Manitoba (72%), New Brunswick (71%) and Saskatchewan (70%) also had a technology plan. The proportion of schools with such a plan in the remaining provinces and territories fell below the national average of 67%.

The ICTSS asked school principals whether or not the school or school board/district/jurisdiction/province or territory has a written technology plan that provides details about hardware and software acquisition, upgrading and replacement.





**Chart 1.**  
Percentage of schools with a technology plan for ICT acquisition, upgrading and replacement by province and territory, 2003/04

Note: Estimate for the territory of Nunavut suppressed to meet confidentiality requirements of the Statistics Act.

### 3.1 Availability of computers for students

Computerization is widespread in Canadian schools with both desktops and laptops being used in the learning environment. According to school principals, the majority of school computers being used for educational purposes during the 2003/04 year were desktops (94%). Laptops and notebooks were used to a lesser extent (6%) in the learning environment, however they represented a relatively high proportion of computers in private schools (20%) and in schools with both elementary and secondary instructional levels (12%).

The proportion of desktop computers used for educational purposes varied only slightly by province and territory, from about 94% in Quebec, Ontario and Alberta to 99% in the Yukon and Prince Edward Island. In turn, school laptops and notebooks were most prevalent in Alberta, Quebec and Ontario (6%) (Table 3).

**Table 3.**  
Percentage of school computers by type, province and territory, 2003/04

	Desktops	Laptops
	% of computers	
<b>Canada</b>	<b>94.4</b>	<b>5.6</b>
Newfoundland and Labrador	95.7	4.3*
Prince Edward Island	98.5	1.5
Nova Scotia	95.4	4.6
New Brunswick	96.2	3.8
Quebec	94.0	6.0
Ontario	94.0	6.0
Manitoba	94.8	5.2
Saskatchewan	96.6	3.4
Alberta	93.7	6.3
British Columbia	94.9	5.1
Yukon	99.3	0.7
Northwest Territories	95.5	4.5
Nunavut	95.9	4.1*

\* Lower reliability estimates due to sample size.

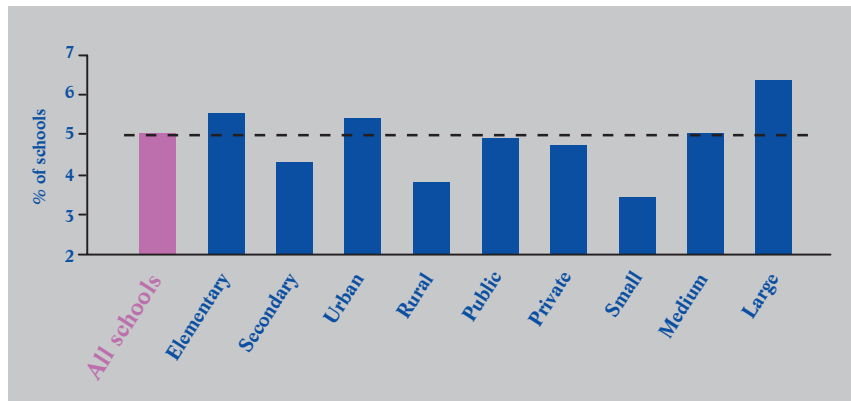
On average, there were about 72 computers per school used for educational purposes in 2003/04. However, the number of computers depends largely on the instructional level and size of the school. In general, the number of computers increases with these school characteristics (Table 4). For example, secondary schools have more computers on average than elementary schools, and the same is true for larger schools compared to smaller schools. This relationship is consistent with the average number of students, which increases with instructional level and school size, and since secondary schools are typically larger in size, the two characteristics are clearly correlated. But what does this mean for the availability of computers in schools?

Computers were more readily available to students in rural schools, higher grades (secondary) and in smaller schools. This is reflected in the student-to-computer ratio, which indicates the number of students per computer in the school (Table 4, Chart 2). In 2003/04, the median ratio was estimated at about five students for every computer in K-12 schools. For small schools, the median ratio was only three students per computer, compared to six students for large schools. Since large schools have more students per computer than do small schools, this suggests that the increase in the number of students in large schools exceeds the increase in the number of computers in those schools. In 2000, the Programme for International Student Assessment (PISA) found that a typical 15-year-old Canadian student attended a school at which there was one computer for every six students; the OECD average stood at one computer for every thirteen students (Statistics Canada 2002).

Unlike the average student-to-computer ratio, which may be influenced by extreme values, the median student-to-computer ratio indicates the typical number of students per computer, where half of the schools have a higher ratio (more students per computer) and half have a lower ratio.

**Table 4.**  
Access to computers by school characteristic, 2003/04

	All schools	Elementary	Secondary	Urban	Rural	Public	Private
<b>All schools</b>							
Average number of computers	72	53	134	80	49	74	50
Average number of students	351	294	608	406	197	370	198
Median student-to-computer ratio	5.0	5.5	4.3	5.4	3.8	4.9	4.7
<b>Small size</b>							
Average number of computers	32	31	46	34	30	35	23
Average number of students	106	112	137	118	92	114	77
Median student-to-computer ratio	3.4	3.7	3.1	3.7	3.1	3.4	3.9
<b>Medium size</b>							
Average number of computers	65	53	117	68	56	66	59
Average number of students	301	273	490	322	235	306	258
Median student-to-computer ratio	5.0	5.5	4.6	5.3	4.3	5.0	5.6
<b>Large size</b>							
Average number of computers	112	74	227	114	102	111	132
Average number of students	629	487	1,145	645	502	630	588
Median student-to-computer ratio	6.3	6.9	5.1	6.4	5.3	6.3	5.8



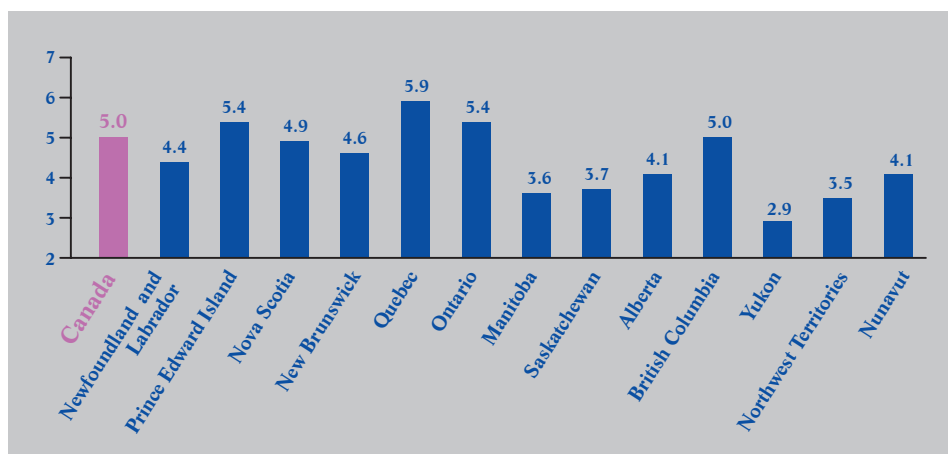
**Chart 2.**  
Student-to-computer ratio (median) by school characteristic, Canada, 2003/04

The ratios of students to computers also vary by instructional level and urban/rural location. There was one computer for about every four students at the secondary level, compared with one for every six elementary students. In urban schools, about five students shared a computer, while there were only four students per computer in rural schools. There was no significant difference in the student-to-computer ratios between public and private schools, even though private schools are typically smaller in size (Table 4, Chart 2). Certainly the student-to-computer ratio by itself does not convey much information about the actual functionality and use of the equipment, but serves as an indicator of the existing ICT infrastructure and its availability in a given school (Statistics Canada 2001).

As was previously noted, the student-to-computer ratio is strongly related to school size, as it is to some of the other school characteristics. For example, a lower student-to-computer

ratio in rural schools may reflect the smaller size of such schools and thus, for a given number of computers, fewer students sharing a computer.

Across the provinces and territories, the Yukon had the fewest students to a computer, while the larger provinces of Quebec and Ontario, along with Prince Edward Island had the highest number of students per computer (Chart 3). In general, the same story can be told for the provinces and territories as for the whole of Canada – computers are more readily available in secondary, smaller and rural schools (i.e. these schools typically have a lower student-to-computer ratio). However there were some exceptions. In Quebec, there were nearly seven secondary students to a computer, compared with six at the elementary level. Nova Scotia was the only province in which large schools reported slightly fewer students per computer (4.6) than did medium size schools (5.5), and there was no difference between the urban and rural student-to-computer ratios in Nunavut schools.



**Chart 3.**  
Student-to-computer ratio (median) by province and territory, 2003/04

### 3.2 Computer operating systems, processing speeds and technical support

The quality of the ICT infrastructure currently available in schools is one way to assess the capability and usefulness of computers and their applications for the learning environment.

Principals were asked to indicate the proportion of their school computers that were running on new or recent operating systems, as opposed to older operating systems. Just under one-quarter of the K-12 schools in Canada had at least half of their computers running on the most recent operating systems (Statistics Canada 2004a). Depending on the instructional level, however, many of the computer applications available in schools may not necessarily require the latest operating system in order to be useful learning tools.

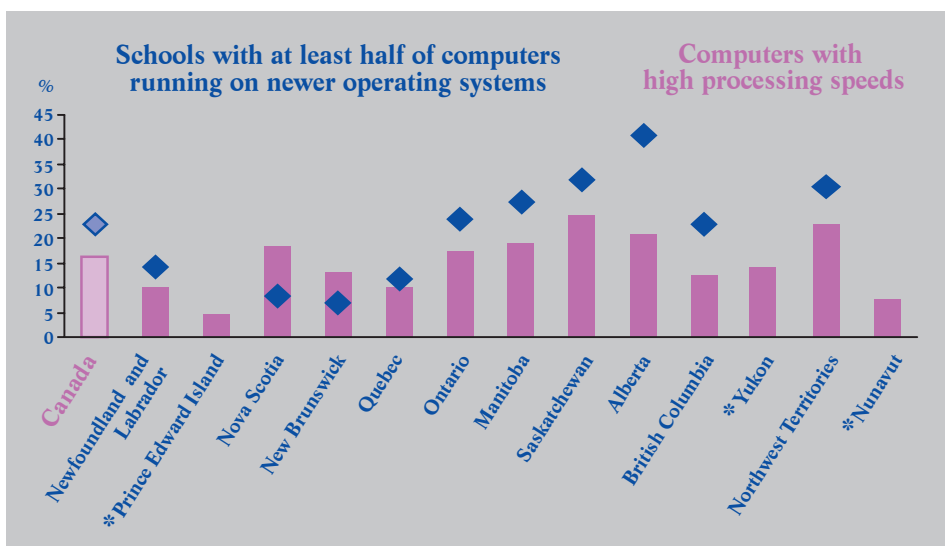
Secondary schools were more likely to have at least half of their computers equipped with the most recent operating systems than elementary schools (31% compared to 18%). This may reflect a more advanced level of instruction in secondary schools, which may in turn be complemented by more advanced learning tools. Private schools were also more likely (34%) to have at least half of their computers running on newer operating systems than public schools (21%).

Among the provinces and territories, Quebec and the Atlantic provinces had the lowest proportions of schools with at least half of their computers running on the most recent operating system. By contrast, schools in Alberta, Saskatchewan and the Northwest Territories were most likely to have computers running on up-to-date operating systems (Chart 4).

Most Canadian elementary and secondary school computers (54%) were equipped with medium processor speeds, while only 16% were considered high speed computers. It was private schools that had the largest proportion of computers with high processing speeds (28%) – nearly twice the proportion of high speed computers in public schools. Small schools were most likely to have computers with low speeds, followed by elementary and rural schools. Since elementary and rural schools tend to also be smaller, these variables are likely interrelated.

School computers in Saskatchewan were the most likely to have high processing speeds (25%), while only 5% of school computers in Prince Edward Island, 8% in Nunavut and 10% in Quebec and Newfoundland and Labrador were reported to be as fast. As Chart 4 demonstrates, there is generally a positive relationship between speed of school computers and schools with computers running

Processor speeds were measured in MegaHertz (MHz), with each MHz representing one million cycles per second (the number of times the computer processor is able to perform a task). Processor speeds were categorized as either low (66 to 233 MHz), medium (233 MHz to 1.4 GHz (GigaHertz)), or high (1.4 GHz to 3.8 GHz).



**Chart 4.**  
School computer operating systems and processor speeds by province and territory, 2003/04

Note: Estimates for the % of schools with at least half of computers running on newer operating systems in Prince Edward Island, the Yukon and Nunavut are suppressed to meet confidentiality requirements of the Statistics Act.

\* Lower reliability estimates due to sample size.

on newer operating systems – as the proportion of schools with more recent operating systems for at least half of their computers increased, so did the proportion of computers running on high processing speeds in that province. There are, however, a few notable exceptions. In Nova Scotia and New Brunswick, the proportion of computers with high speed processors exceeded the proportion of schools with at least half of their computers running on newer operating systems. In Quebec, these proportions were nearly equal and in Alberta – the province where 41% of elementary and secondary schools have at least half of their computers running on newer operating systems – the proportion of computers running on high processor speed was surprisingly low.

Principals were also asked how much time was spent on maintenance and technical support for ICT infrastructure per month. Overall, just over 12 minutes per school computer were dedicated to support and maintenance each month. While schools with a majority of low processor speed computers reported only 11 minutes of support and

maintenance per month per computer, nearly 16 minutes of technical time per computer per month were dedicated to schools with high processor speed computers. The amount of time spent on technical support increased with the computer processor speed, something that may be explained by the fact that higher-end computers are capable of supporting a wider range of applications and uses, thereby requiring more time for upgrades and technical maintenance. It may also be that the presence of faster computers reflects the general ICT environment in these schools; schools with more money for higher-end computers may also have more money to support and maintain the infrastructure (Statistics Canada 2004a).

For the provinces and territories, time spent per school computer per month ranged from only 6 minutes in Prince Edward Island to 18 minutes in New Brunswick, Quebec, Saskatchewan and the Northwest Territories (Table 5). The same positive relationship emerged between time devoted to technical support and maintenance of computers, and processor speed.

**Table 5.**  
*ICT technical support time by province and territory, 2003/04*

	<b>Minutes per computer per month</b>
	<i>(median)</i>
<b>Canada</b>	<b>12</b>
Newfoundland and Labrador	12
Prince Edward Island	6
Nova Scotia	12
New Brunswick	18
Quebec	18
Ontario	12
Manitoba	12
Saskatchewan	18
Alberta	12
British Columbia	12*
Yukon	6*
Northwest Territories	18*
Nunavut	x

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

#### 4. HOW CONNECTED ARE CANADIAN SCHOOLS?

In general, the speed with which schools have been connected to the Internet has been impressive considering Canada's geographic reality. In 2003/04, computerization was widespread and Internet connectivity nearly complete: over 97% of schools were connected and nearly 93% of school computers were used to access the Internet for educational purposes. This is substantially higher than the nearly 55% of Canadian households that regularly used the Internet from home in 2003 and the 78% of private sector enterprises that reported being connected to the Internet that same year (Statistics Canada 2004b, 2004c).

Internet connectivity was most prevalent in secondary schools, where 95% of computers were connected. Size was also a factor, with small schools reporting only 88% of their computers connected to the Internet, compared to 94% in large schools. Public schools also had a higher proportion of Internet-connected computers (93%) than did private schools (85%), which may be partly explained by the fact that private schools are typically smaller than public schools (Table 6).

According to the ICTSS, less than 3% of Canadian schools were without an Internet connection. This may be due to religious beliefs or technical reasons (Statistics Canada 2004a).

**Table 6.**  
Access to Internet-connected computers by school characteristic, 2003/04

	All schools	Elementary	Secondary	Urban	Rural	Public	Private
<b>All schools</b>							
Average number of computers	72	53	134	80	49	74	50
Computers connected to the Internet (%)	92.7	91.0	95.3	92.9	91.8	93.4	85.0
Student-to-Internet-connected-computer ratio (median)	5.5	6.0	4.6	5.9	4.2	5.4	6.7
<b>Small size</b>							
Average number of computers	32	31	46	34	30	35	23
Computers connected to the Internet (%)	88.1	87.1	93.8	88.3	87.8	91.1	70.6
Student-to-Internet-connected-computer ratio (median)	3.9	4.2	3.5	4.3	3.6	3.8	6.0
<b>Medium size</b>							
Average number of computers	65	53	117	68	56	66	59
Computers connected to the Internet (%)	93.0	91.5	95.9	93.1	92.6	93.7	84.6
Student-to-Internet-connected-computer ratio (median)	5.4	5.9	4.7	5.7	4.6	5.3	6.7
<b>Large size</b>							
Average number of computers	112	74	227	114	102	111	132
Computers connected to the Internet (%)	93.8	92.2	95.2	93.6	95.0	93.8	94.6
Student-to-Internet-connected-computer ratio (median)	6.8	7.6	5.4	6.9	5.6	6.8	6.6

Across the provinces, the proportion of schools connected to the Internet in 2003/04 ranged from 91% in Manitoba to over 99% in Newfoundland and Labrador and New Brunswick. Moreover, all elementary and secondary schools in the three territories reported being connected. There is an important distinction, however, between the proportion of

schools with Internet-connected computers and the proportion of Internet-connected computers in a given school. In general, the proportion of schools connected to the Internet is higher than the proportion of school computers connected to the Internet for each province and territory (Table 7).

**Table 7.**  
*Internet-connected schools and computers by province and territory, 2003/04*

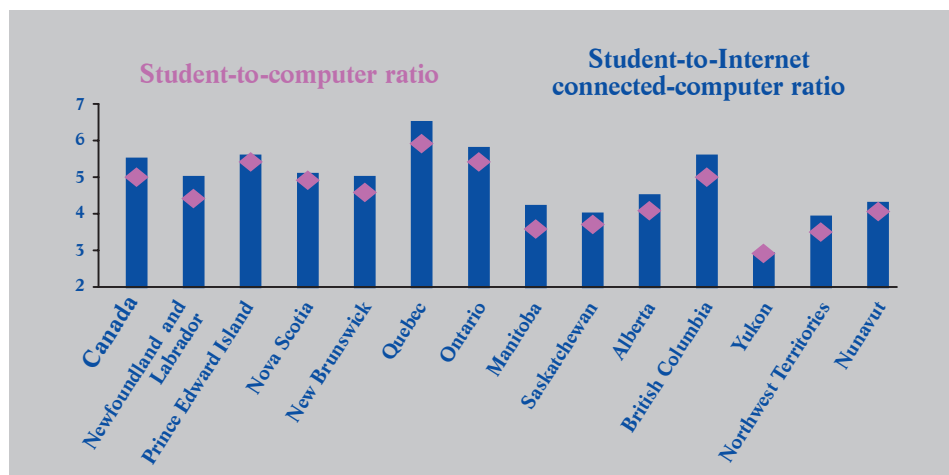
	% of schools connected to the Internet	% of computers connected to the Internet
<b>Canada</b>	<b>97.7</b>	<b>92.7</b>
Newfoundland and Labrador	99.5	93.1
Prince Edward Island	96.5	91.8
Nova Scotia	98.6	95.8
New Brunswick	99.5	96.3
Quebec	98.9	91.4
Ontario	97.1	93.8
Manitoba	91.1	88.6
Saskatchewan	97.3	94.3
Alberta	95.9	92.9
British Columbia	98.3	90.5
Yukon	100.0	95.9
Northwest Territories	100.0	96.2
Nunavut	100.0	87.9

Nunavut had the lowest proportion of Internet-connected computers (88%), although all schools in that territory were connected. New Brunswick, the Northwest Territories, the Yukon and Nova Scotia had the highest proportions of school computers connected to the Internet (96%).

By examining the proportion of Internet-connected computers in a school, relative to the proportion of students, a more direct assessment of connectivity is possible. As there were about five students for every computer, there were slightly more students (5.5) per Internet-connected computer, since not every computer used for educational purposes was connected to the Internet (Chart 5).

The smaller the difference between the two ratios, the more the proportion of connected computers is approaching the proportion of computers.

Quebec had the most students per Internet-connected computer (6.5), followed by Ontario (5.8), and British Columbia and Prince Edward Island (5.6). The Yukon had the least number of students per Internet-connected computer (2.9), which is the same number of students that was reported per computer. Thus, all of the computers being used for educational purposes in Yukon schools were also reported as being connected to the Internet.



**Chart 5.**  
*Student-to-computer and student-to-Internet-connected-computer ratios (median) by province and territory, 2003/04*

#### 4.1 Type of Internet connection

By increasing the speed at which information is transferred between networks and computers across the Internet, broadband technologies are able to support larger and faster applications than are possible using a dial-up Internet account. For schools, a broadband connection enables greater use of multi-media education applications by integrating images, text, data and sound (Industry Canada 2004b). The "always-on" feature of broadband is also significant. Unlike dial-up connections, the Internet is always immediately available and there is evidence that this alters patterns of Internet use (Veenhof, Neogi and van Tol 2003).

An overwhelming majority (86%) of schools used broadband technologies to access the Internet. This is quite remarkable, given that this was the case for only 65% of Canadian households that regularly used the Internet in 2003<sup>1</sup> and 66% among the private sector enterprises that use the Internet (Statistics Canada 2004b, 2004c). Among the most popular Internet access methods for Canadian elementary and secondary schools were high-speed (ISDN/DSL) (32%), optical fibre (23%) and cable modem connections (15%) (Table 8).

More than 90% of secondary and large size schools used broadband technologies to connect to the Internet, followed by schools in urban areas (89%). In contrast, only 9% of schools reported using dial-up access, largely represented by rural (21%) and small (19%) schools, where there may be significant challenges with respect to the deployment of broadband. This is likely due to the cost of providing broadband services in rural or remote areas, which is typically higher than in urban areas due to a smaller customer base spread over greater distances. Wireless broadband delivered by satellite or terrestrial systems may present an attractive option in rural or remote areas (Veenhof, Neogi and van Tol 2003). This is illustrated by the fact that just over 12% of rural schools used a satellite connection to access the Internet, while 11% used fixed wireless technologies.

All elementary and secondary schools in the Yukon were connected to the Internet through broadband technologies (Chart 6, Table 9). New Brunswick, Nova Scotia and Saskatchewan were also leaders, with more than 90% of schools connected by broadband. The territory of Nunavut had the lowest proportion of schools connected via broadband, at 50%.

For the purposes of this study, broadband includes connections by cable modem, high-speed line (e.g. ISDN, DSL), T1 line, optical fibre and fixed wireless devices. Satellite connections can also be considered as broadband technology, depending on their speed and bandwidth.

High-speed Integrated Services Digital Network (ISDN) lines operate over standard telephone wires and fiberoptic circuits, using a bandwidth that is typically slower than the most common broadband technologies (cable and DSL). A single ISDN line can handle up to eight devices, including a PC, telephone, fax and video, with any two devices operating simultaneously. ISDN penetration is extremely low in Canada. With Digital Subscriber Lines (DSL), the user is connected all the time and the telephone line is available for calls. The T-carrier system offers a direct link to the Internet, however T1 lines are more expensive and are generally for business use (Statistics Canada 2004a, Veenhof, Neogi and van Tol 2003).

1 -- Includes only those households with a high-speed link to the Internet through either cable or telephone connection (Statistics Canada 2004b).

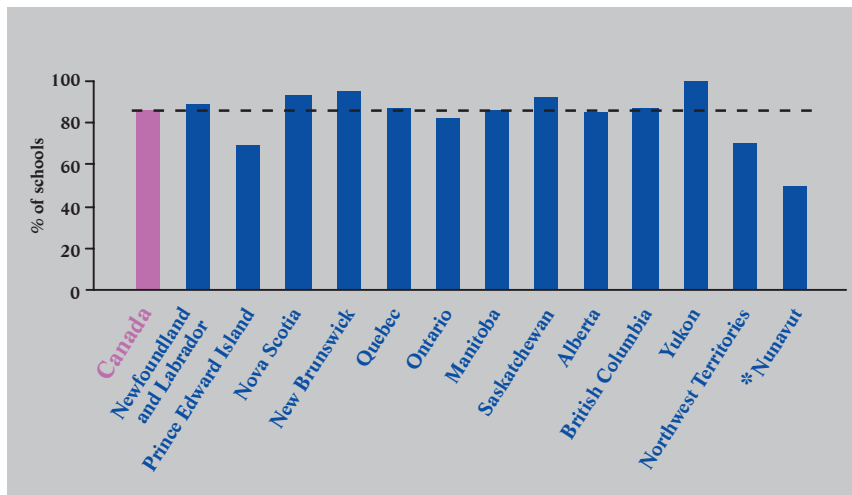
**Table 8.**

*Percentage of schools by type of Internet connection and school characteristic, 2003/04*

	All schools	Elementary	Secondary	Urban	Rural	Small	Medium	Large
	% of schools							
Dial-up access	8.6	8.0	3.9	4.5	20.7	19.0	6.0	2.7
Broadband technologies	85.8	84.2	93.2	89.3	75.6	77.1	87.9	90.8
High-speed line (ISDN/DSL)	31.6	30.5	32.1	33.1	27.2	31.6	33.1	30.1
Optical fibre	22.8	23.6	29.1	26.9	11.1	13.5	20.7	32.5
Cable modem	15.3	16.7	12.4	17.2	9.8	14.7	16.7	14.5
T1 line	11.6	9.4	19.9	12.3	9.7	9.8	11.5	13.2
Fixed wireless	7.6	7.2	8.1	6.5	11.1	8.0	8.2	6.8
Satellite connection	4.9	4.2	2.5	2.4	12.4	6.8	5.9	2.5
Unknown type	9.5	11.6	5.5	9.1	10.7	9.6	9.8	9.1

Note: Estimates may not sum to 100% since schools may have more than one type of Internet connection.





**Chart 6.**  
Percentage of schools using broadband to access the Internet by province and territory, 2003/04

\* Lower reliability estimates due to sample size.

High-speed ISDN/DSL lines and cable modems were among the most popular types of broadband access for schools across the provinces and territories, while optical fibre was prevalent in New Brunswick, Quebec and, to a lesser extent, Ontario (Table 9). T1 lines were the method used most often for connecting schools in Prince Edward Island. Nearly one-third of schools in Nova Scotia also used T1 lines, albeit high-speed ISDN/DSL

lines were used by more than half of the schools in that province. Schools in the Northwest Territories (18%) and Newfoundland and Labrador (16%) were most likely to have used satellite connections to connect, followed by Manitoba (15%). A relatively high proportion of schools in Manitoba (17%) and Newfoundland and Labrador (16%) also used dial-up methods to access the Internet.

**Table 9.**  
Percentage of schools by type of Internet connection, province and territory, 2003/04

	Dial-up access	High-speed line (ISDN/DSL)	Optical fibre	Cable modem	T1 line	Fixed wireless	Satellite connection	Total broadband technologies
	% of schools							
<b>Canada</b>	<b>8.6</b>	<b>31.6</b>	<b>22.8</b>	<b>15.3</b>	<b>11.6</b>	<b>7.6</b>	<b>4.9</b>	<b>85.8</b>
Newfoundland and Labrador	15.7	37.4	19.2	19.9	x	x	16.0	89.1
Prince Edward Island	x	16.1*	18.1*	14.9*	27.1	x	x	69.0
Nova Scotia	x	50.5	1.9*	13.1	31.6	2.2*	x	92.9
New Brunswick	3.6	26.5	66.7	x	4.1	x	x	95.4
Quebec	12.0	21.6	47.0	12.0	5.6	3.8	3.9	87.1
Ontario	6.3	28.0	23.4	15.3	15.0	6.9	3.9	82.5
Manitoba	17.3	35.6	5.2*	7.5	7.0	25.7	14.6	86.4
Saskatchewan	7.1	58.5	9.3	5.3	8.1	5.7	12.2	92.2
Alberta	11.1	33.0	11.7	23.7	6.2	13.8	4.7	85.3
British Columbia	6.4	38.4	6.2	22.5	17.2	7.4	2.4*	87.4
Yukon	x	65.2	x	26.1	x	x	x	100.0
Northwest Territories	x	29.4	x	x	x	x	17.6*	70.6
Nunavut	x	x	x	x	x	x	x	50.0*

Note: Estimates may not sum to 100% since schools may have more than one type of Internet connection. Estimates for 'unknown connection type' not shown.

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

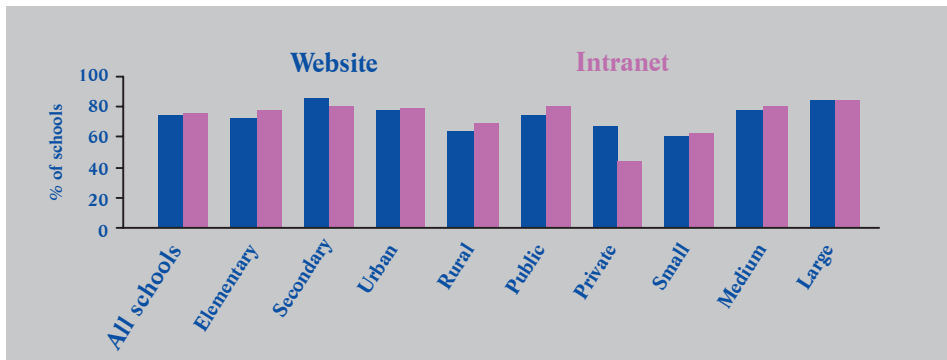
### 4.2 Website and intranet use in schools

Nearly three-quarters (74%) of K-12 schools in Canada had a website in 2003/04. Half of the schools reported having a formal corporate or administrative site, while just over 44% reported having a non-administrative educational site for teachers and students to share information. Large schools (84%) and secondary schools (86%) were most likely to have a website during the 2003/04 school year, while rural (63%) and small (60%) schools were least likely (Chart 7). In 2003, only 34% of private sector enterprises in Canada had a website – less than half the proportion of elementary and secondary schools (Statistics Canada 2004c).

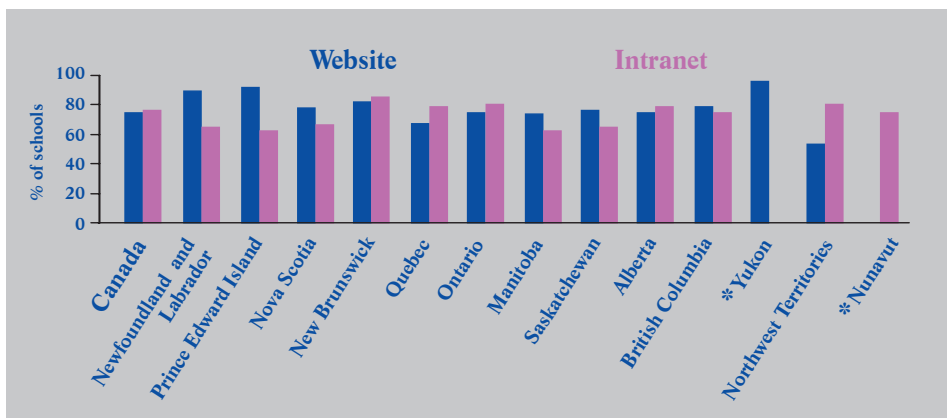
Intranets were also used by the majority of schools (76%). This was substantially higher than the 16% of private sector enterprises that used an intranet in 2003 (Statistics Canada 2004c). For about half of these schools, the intranet was accessible to students and teachers within the same school board, while about one-third of schools had intranets that were only accessible within an individual school.

Secure intranets are now one of the fastest growing segments of the Internet because they are much less expensive to build and manage than private networks based on proprietary protocols (Veenhof, Neogi and van Tol 2003). Large schools had the highest proportion (85%) of intranet use, while only 44% of private schools reported using intranets. Private schools may not require such networks in order to share information, since they are typically smaller in size and have fewer Internet-connected computers. Moreover, there may be less of a need to communicate or share information with other schools, given that private schools do not belong to a school board and have more flexibility in their administration.

Schools in the Yukon (96%), Prince Edward Island (92%) and Newfoundland and Labrador (90%) had the highest proportion of websites (Chart 8). New Brunswick was not far behind, and that province also boasted the highest proportion of schools with intranets (82% and 86%, respectively).



**Chart 7.**  
Percentage of schools with website, intranet by school characteristic, 2003/04



**Chart 8.**  
Percentage of schools with website, intranet by province and territory, 2003/04

\* Estimate for intranet suppressed for the Yukon and estimate for website suppressed for Nunavut to meet confidentiality requirements of the Statistics Act.

### 4.3 Videoconferencing technology

Videoconferencing technology allows two or more people at different locations to see and hear each other in real time and share computer applications such as Internet pages, library catalogues, documentation and software aids, including presentations. Overall, only 7% of principals reported having videoconferencing technology in their schools.

Videoconferencing technology also helps to reduce the barriers of distance and isolation experienced by schools in rural and remote areas, enabling access to educational applications that may not have otherwise been possible. Rural secondary schools were most likely to have videoconferencing capability (21%).

A video conference system requires audio-visual equipment – monitor, camera, microphone and speaker – as well as a means of transmitting information between sites. Broadband and satellite connections are ideal, but also carry expenses – 91% of the schools with videoconferencing technology accessed the Internet through broadband.

Among the most popular methods to access the Internet for schools with videoconferencing technology were high speed line (ISDN/DSL) (33%), T1 line (25%), and optical fibre (21%). Only 6% of the schools with such technology used a dial-up telephone line to access the Internet, however this may have limited the capabilities of the videoconferencing system.

Small schools with videoconferencing technology were more likely to use dial-up connections (14%) than medium (5%) and large schools (2%). The same was true for private (15%) and rural schools (12%) compared with public (6%) and urban schools (4%).

While about one-third of principals reported that videoconferencing technology was used in their schools for professional development and training for staff, collaboration between students in different locations and staff meetings, nearly 40% of

principals reported that such technology was either used as a primary mode of delivery for courses or as a supplement to other modes of delivery (e.g. face-to-face and asynchronous online<sup>2</sup>). Rural, secondary and public schools were more likely to use videoconferencing technology for such activities, compared to urban, elementary and private schools.

Schools in the Eastern provinces of Newfoundland and Labrador (20%), Nova Scotia (17%) and New Brunswick (11%) were most likely to have videoconferencing technology. About 30% of secondary schools in Newfoundland and Labrador had such technology – the highest proportion of schools across the country.

## 5. ACCESS TO COMPUTERS AND THE INTERNET

The belief that the educational use of computers and the Internet may provide an enriched learning environment for students, as well as a useful pedagogical resource for teachers is generally widespread. Whether it is the location of computers or the availability of educational software and the Internet, access to ICTs is critical.

Overall, about 45% of the computers in elementary and secondary schools in Canada were located in computer labs, followed closely by classrooms (41%). Libraries and other locations accounted for the remaining 14%. These proportions were generally the same for Internet-connected computers, with 47% located in computer labs, 39% in classrooms and 14% in libraries and other areas. More than half (55%) of secondary school computers were located in computer labs, while 51% of elementary school computers were located in classrooms. This is not surprising since in elementary schools, students are generally taught in the same classroom, while secondary students tend to move from one classroom to another for different courses.

2 -- Asynchronous online learning refers to a learning event in which people are not online at the same time and cannot communicate without time delay. Examples are self-paced courses taken via the Internet or CD-Rom, Web presentations, videotaped classes, streamed audio/video presentations, Q&A mentoring, discussions groups, and e-mail.

In Nova Scotia, New Brunswick, Quebec, the Northwest Territories and Nunavut, a higher proportion of school computers were located in classrooms than in computer labs (Table 10). Schools in Quebec had the lowest

proportion of computers in libraries. In fact, schools in Newfoundland and Labrador, New Brunswick, Quebec and the Northwest Territories had a slightly higher proportion of computers in other locations (hallways and other open spaces), than in libraries.

**Table 10.**

*Location of school computers by province and territory, 2003/04*

	Computer labs	Classrooms and portables	Libraries	Other locations
	% of computers			
<b>Canada</b>	<b>44.9</b>	<b>41.0</b>	<b>7.5</b>	<b>6.6</b>
Newfoundland and Labrador	49.8	31.9	8.3	9.9
Prince Edward Island	54.7	28.5	9.3	7.6
Nova Scotia	32.1	56.5	5.6	5.9
New Brunswick	39.9	47.9	5.2	7.0
Quebec	43.8	46.0	3.8	6.3
Ontario	42.8	41.9	8.8	6.6
Manitoba	49.1	38.6	6.7	5.6
Saskatchewan	47.0	37.5	9.0	6.6
Alberta	48.4	35.9	8.4	7.3
British Columbia	51.1	34.4	8.1	6.3
Yukon	47.7	45.7	5.9	x
Northwest Territories	35.7	49.2	5.3	9.9
Nunavut	38.9	42.6	9.5*	9.0

\* Lower reliability estimates due to sample size.

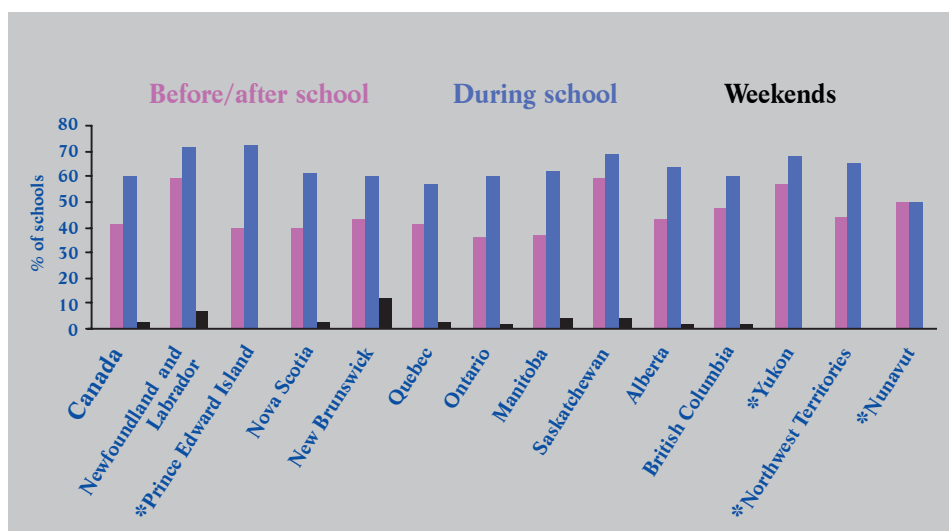
x Suppressed to meet confidentiality requirements of the Statistics Act.

### 5.1 Student access to the Internet

In general, students have access to the Internet at school. However, unless the Internet is also accessible at home or in some other public location, completing homework activities that require the use of the Internet or specialized educational software can be problematic. Making the Internet accessible outside of regular school hours allows students who may not otherwise have access to this technology to use this resource for school-related activities. In 2003/04, nearly 61% of school principals reported giving their students frequent access to Internet-connected computers *during school but outside of instructional hours* (i.e. lunch hours or breaks). This practice was most common among secondary schools, where students are generally expected to complete some work on their own outside of class time.

Schools in Prince Edward Island (72%), Newfoundland and Labrador (71%), Saskatchewan (69%) and the Yukon (68%) were most likely to have Internet-connected computers available for students during school but outside of instructional hours (Chart 9).

About 42% of schools provided frequent access to Internet-connected computers *before and/or after school*, while only 3% of schools allowed student access to the Internet on *weekends*. Schools in Saskatchewan and Newfoundland and Labrador (60%), as well as the Yukon (57%) were most likely to provide Internet access before/after school. Weekend access was more prevalent in small schools (5%), as well as schools in New Brunswick (12%).



**5.2 Student access to software**

Most elementary and secondary school students had access to a number of software applications, including word processing, Internet browsers, educational drill and practice programs, spreadsheet and database programs, and presentation software. In addition, the majority of secondary schools provided students with access to desktop publishing software (88%) and graphic programs (84%). It comes as no surprise that secondary and large schools generally provided students with access to a wider range of software applications, compared to elementary and small schools.

Across the provinces and territories, student access to software varied only slightly. Schools in some provinces and territories were less likely to use presentation software, in particular Prince Edward Island the Northwest Territories, Nunavut and British Columbia, while spreadsheet and database, desktop publishing and graphic programs were less common in Quebec and Nunavut schools (Table 11). The proportion of schools offering desktop publishing software was highest in the Yukon and Prince Edward Island, while other graphic programs were most accessible to students in the Yukon and Ontario.

**Table 11.**

Percentage of schools by type of software accessible to students, 2003/04

	Word processing	Internet browsers	Educational drill & practice	Spreadsheet & database	Presentation software	Graphic programs	Desktop publishing
	% of schools						
<b>Canada</b>	<b>97.1</b>	<b>95.9</b>	<b>93.1</b>	<b>88.0</b>	<b>84.5</b>	<b>81.1</b>	<b>68.8</b>
Newfoundland and Labrador	100.0	98.8	89.0	84.8	87.3	78.7	77.4
Prince Edward Island	96.5	93.9	85.4	87.9	71.2	79.8	90.2
Nova Scotia	99.4	98.9	93.8	91.5	96.2	88.2	83.8
New Brunswick	97.3	98.1	90.7	83.8	84.6	65.3	72.8
Quebec	97.4	98.0	92.3	79.1	80.7	59.5	51.7
Ontario	97.6	96.4	95.2	91.3	84.8	93.7	77.6
Manitoba	96.3	86.0	93.2	93.0	87.7	72.4	69.2
Saskatchewan	94.0	94.5	92.4	87.5	88.2	74.9	77.9
Alberta	96.2	93.6	89.1	93.3	91.7	80.3	68.6
British Columbia	96.4	96.9	93.9	85.4	77.0	86.1	59.0
Yukon	100.0	100.0	100.0	100.0	100.0	95.8	100.0
Northwest Territories	100.0	100.0	94.3	88.6	72.7	65.7	70.6
Nunavut	93.8	87.5	80.0	75.0	75.0	56.3*	56.3*

\* Lower reliability estimates due to sample size.

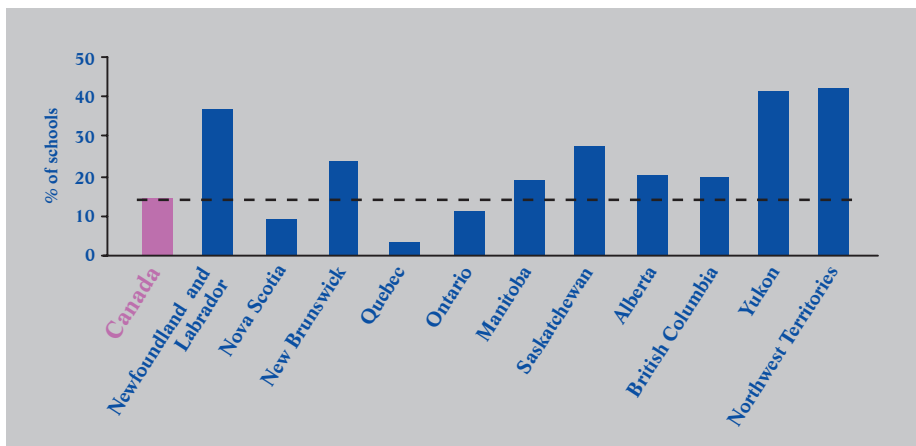
Although e-mail is one of the most common uses of the Internet today, and 63% of principals reported that their students had access to e-mail software, the majority of students were not provided with an e-mail account by the school. Just over three-quarters of schools reported providing e-mail accounts to fewer than 25% of their students. Regardless of whether or not the school provided e-mail accounts, students may still have had access to Internet e-mail software – such as Hotmail – to access personal e-mail accounts. Secondary schools were most likely to provide more than three-quarters of students with e-mail accounts, as were schools in Prince Edward Island and Nova Scotia.

By contrast, 84% of principals reported that more than three-quarters of their teachers were provided with e-mail accounts by either the school or the school board. This was most common in public schools (88%), while it was the case for only 49% of private schools. The share of schools that provided e-mail accounts to more than 75% of teachers also varied across the country – from 68% in Quebec to nearly all schools in Prince Edward Island, New Brunswick and the Yukon. Teacher use of e-mail is important for corresponding with other teachers and school administrators, while school boards may use e-mail as a form of communicating messages, notices, newsletters or announcements with staff or parent associations.

### 5.3 Student access to online courses

Online courses can be an effective alternative to traditional teaching methods if certain courses are not available to students during class time. Some online courses, for example, may be offered to prepare students for a particular school program, such as second language immersion, university or college. Overall, 14% of schools reported having students participating in online courses. This option would be most useful where certain prerequisite courses for university or college programs are not available at the school: 36% of secondary schools had students participating in online courses, compared with only 3% of elementary schools. Similarly, schools in rural or remote areas may use online courses more frequently, particularly for very specific subject areas that may not be readily available to students in class. Nearly 40% of rural secondary schools offered online courses, compared to 35% of their urban counterparts.

Online courses were used most frequently in the Yukon and Northwest Territories, where about 42% of schools had participating students (Chart 10). Schools in Newfoundland and Labrador also had a high proportion of students studying online (37%). This is largely due to the relatively higher number of rural or remote areas in these regions of the country.



**Chart 10.**  
*Percentage of schools whose students participated in online courses by province and territory, 2003/04*

Note: Estimates for Prince Edward Island and Nunavut are suppressed to meet confidentiality requirements of the Statistics Act.

The topic of *access* to the Internet is frequently tied to *use* of the Internet. Although use was not the focus of the 2003/04 ICTSS, the survey did ask principals about their school plans and policies for ICT use. Nearly 9 out of 10 schools (88%) reported having a policy in place for appropriate use of ICT by students. All principals in the Yukon reported that their schools had an ICT use-policy for students,

followed closely by Prince Edward Island, Nova Scotia and New Brunswick (95%), as well as Saskatchewan and Alberta (94%). Nunavut and Quebec had the lowest proportions of schools with such a policy (Table 12).

**Table 12.**

*Percentage of schools with policy for appropriate use of ICT, province and territory, 2003/04*

	ICT use policy for students	ICT use policy for teachers
	% of schools	
<b>Canada</b>	<b>87.5</b>	<b>70.4</b>
Newfoundland and Labrador	91.7	59.5
Prince Edward Island	95.8	47.8
Nova Scotia	95.3	78.8
New Brunswick	95.0	93.0
Quebec	73.6	62.1
Ontario	89.3	71.7
Manitoba	88.8	61.1
Saskatchewan	94.1	68.0
Alberta	93.7	85.0
British Columbia	90.0	66.8
Yukon	100.0	100.0
Northwest Territories	87.1	82.8
Nunavut	57.1*	x

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

## 6. TEACHERS AND TECHNOLOGY

Teachers are one of the most important factors affecting the extent to which ICTs are adopted and implemented at school. Education policymakers are increasingly aware of the need to make teachers feel comfortable using ICTs and to encourage them to integrate ICTs into their lesson plans. Establishing school policies for ICT use is a key step in creating an environment conducive to learning using ICT. About seven out of ten schools reported having a policy for the appropriate use of ICT by teachers during the 2003/04 school year (Table 12). All schools in the Yukon reported having such a policy for teachers, followed by New Brunswick (93%), Alberta (85%) and the Northwest Territories (83%). Although Prince Edward Island had

one of the highest proportions of schools with a use-policy for students, only 48% of schools had such a policy for teachers – the lowest in the country.

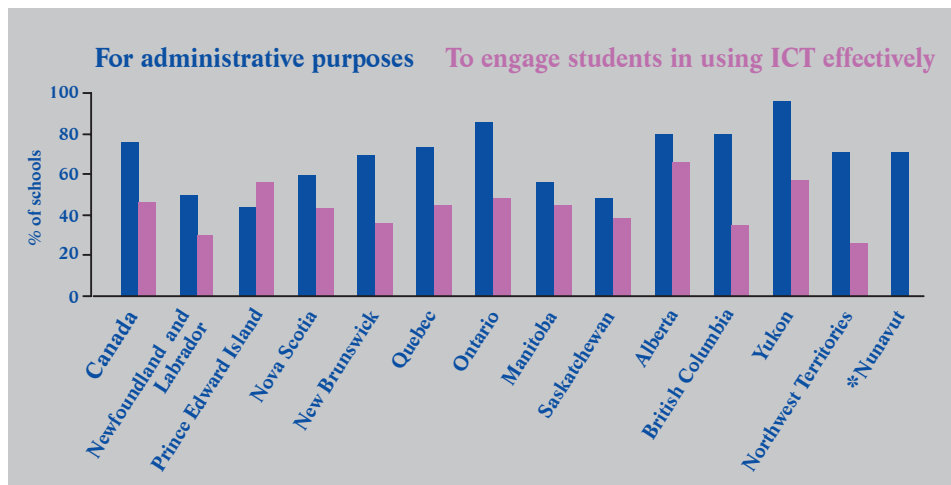
### 6.1 Teacher skills

There is some evidence that although teachers are using ICT in the classroom, they may not always feel that they are using it in the most effective and efficient way (O'Haire 2003). It is not surprising that most teachers possess the required technical skills to use ICTs for administrative purposes. In fact, 76% of schools reported that more than three-quarters of their teachers use ICTs for preparing report cards, taking attendance or recording grades. This proportion was lower for private (57%), small (64%) and rural (67%)

schools. However, when assessing teacher ICT skills to engage students to use ICTs effectively, only 46% of schools reported that more than three-quarters of their teachers possessed these skills. When examining these skills by school characteristic, private (32%) and secondary (39%) schools had the lowest proportion of more than three-quarters of teachers with ICT skills to enhance student learning. In the case of secondary schools, this could be related to the fact that teachers are often subject specialists, thus ICT skills may be more prevalent among teachers specializing in an ICT-related course, and less prevalent among teachers of other subjects. It is also possible that because secondary

students may have already attained some of the knowledge required to use ICTs for learning, it is not as crucial for the majority of secondary school teachers to possess the technical skills required to engage students in the effective use of ICTs.

The proportion of schools with more than three-quarters of teachers possessing ICT skills to engage students was highest in Alberta (66%), the Yukon (57%) and Prince Edward Island (56%). Moreover, Prince Edward Island was the only province to report a higher proportion of schools with teachers possessing ICT skills for engaging students than for administrative purposes (Chart 11).



**Chart 11.**  
Percentage of schools with more than 75% of teachers possessing ICT skills by province and territory, 2003/04

\* Estimate for schools with more than 75% of teachers possessing ICT skills to engage students in using ICT effectively is suppressed to meet confidentiality requirements of the Statistics Act.

**6.2 Teaching practices**

According to 78% of school principals, word processing software was frequently ('most of the time' or 'always') incorporated into teaching practices (Table 13). This was followed by use of Internet/intranet to disseminate information (34%), software for special needs students/remedial programs for individualized learning, and use of Internet for online learning (29%) and software for specific subject areas (28%).

New Brunswick had a relatively low proportion of schools incorporating various technology applications into their teaching practices; word processing applications were frequently used for teaching by only 61% of schools, while use of the

Internet for disseminating information and for online learning were used by only 17% and 15% of schools, respectively (Table 13). This likely has less to do with the accessibility of these applications and software, which is widespread, and more to do with specific teaching practices and school environments. Newfoundland and Labrador had the highest proportions of schools with teaching practices involving the use of the Internet for online learning (51%) and for the dissemination of information (46%). Ontario schools were leaders in incorporating word processing applications, software for special needs/remedial students, and software for specific subject areas into their teaching practices.



**Table 13.**

Percentage of schools with technology applications frequently incorporated into teaching practices by province and territory, 2003/04

	Use of word processing	Use of Internet/intranet to disseminate information	Use of software for special needs students and/or remedial programs	Use of Internet for online learning	Use of software for specific subject areas	Use of desktop publishing	Use of presentation software
	% of schools						
<b>Canada</b>	<b>78.2</b>	<b>34.4</b>	<b>29.1</b>	<b>28.8</b>	<b>28.3</b>	<b>24.1</b>	<b>21.4</b>
Newfoundland and Labrador	79.7	45.5	34.1	51.2	20.7	34.7	27.2
Prince Edward Island	76.9	31.0	19.6*	39.0	13.4*	31.7	x
Nova Scotia	72.9	33.5	29.7	30.6	19.8	22.3	25.3
New Brunswick	61.2	16.7	18.9	15.3	8.8	11.5	10.4
Quebec	79.7	32.6	10.1	22.4	19.2	9.1	17.3
Ontario	80.3	38.4	39.9	30.7	38.6	34.5	23.5
Manitoba	79.6	31.5	29.9	30.0	34.0	29.4	24.7
Saskatchewan	79.1	35.3	31.8	37.8	20.1	25.6	23.8
Alberta	75.0	34.5	25.3	30.0	28.7	20.4	29.2
British Columbia	76.8	29.2	31.2	25.3	21.8	18.0	13.3
Yukon	75.0	x	x	31.8	25.0	29.2	x
Northwest Territories	68.6	25.7*	20.0*	23.5*	20.0*	x	x
Nunavut	50.0*	x	x	x	x	x	x

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

Subject areas for which ICT learning was included in teacher training and development were also examined in the ICTSS. Overall, 40% of elementary and secondary schools in Canada incorporated ICT learning into their teacher development programs for Mathematics, followed by Computer Education and Informatics (35%) and English (31%). As seen in Table 14, schools in the Yukon were most likely to include ICT learning in

teacher development for a wide range of subject areas, including Mathematics (68%), Computer/Informatics (64%) and English (46%). For schools in Quebec, French was the subject for which ICT learning was most likely to be used in teacher development (41%). In Alberta and Manitoba, a large proportion of schools counted General Science among the leading subject areas for which ICT learning was included in teacher development.

**Table 14.**

Percentage of schools with ICT learning included in teacher development, selected subject areas by province and territory, 2003/04

	Mathematics	Computer/Informatics	English	French	General science	Arts
	% of schools					
<b>Canada</b>	<b>40.4</b>	<b>34.5</b>	<b>30.6</b>	<b>18.7</b>	<b>15.1</b>	<b>12.9</b>
Newfoundland and Labrador	23.9	26.8	19.6	10.4	10.5	11.6
Prince Edward Island	40.3	25.9	33.5	x	17.0*	x
Nova Scotia	45.9	32.0	36.7	13.8	17.4	11.1
New Brunswick	38.9	37.3	30.2	21.9	16.7	10.9
Quebec	35.1	37.0	22.2	41.1	9.6	14.4
Ontario	43.8	33.5	31.1	15.6	14.0	14.6
Manitoba	52.6	38.5	36.2	14.8	25.1	10.6
Saskatchewan	35.6	36.0	28.6	10.7	12.9	13.3
Alberta	52.9	37.2	50.0	12.4	28.6	14.1
British Columbia	26.1	30.8	22.7	6.6	10.7	7.1
Yukon	68.2	63.6	45.5	27.3	x	x
Northwest Territories	22.2*	22.2*	x	x	x	x
Nunavut	x	x	x	x	x	x

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

### 6.3 Strategies to help teachers use ICT

According to principals, mentoring activities among teachers was the most emphasized strategy to help teachers learn how to use ICTs. It was also the strategy perceived as the most highly effective. Other preferred strategies included information-sharing with other staff members, personal-learning activities, professional development and training sessions. Formal credit courses and online courses were among the least common strategies.

Interestingly, 8% of principals reported placing a lot of emphasis on staff meetings, but only 4% perceived this strategy to be highly effective. Similarly, while formal credit courses were among the least likely to be heavily emphasized to train teachers to use ICTs, they were perceived to be highly effective by about 12% of principals. Thus although some strategies are considered to be effective for training teachers, they

are not necessarily emphasized by principals. A number of factors may be contributing to this phenomenon, such as cost, and lack of time and resources to implement the strategy. Private and small schools were more likely to place little or no emphasis on strategies for helping teachers use ICTs. This may be due to the more informal structure of these schools, where teachers learn to use ICTs on an 'as needed' basis or in a more informal setting.

The proportion of schools using mentoring activities to help teachers learn how to use ICT was highest for schools in the Yukon, Alberta and Quebec (Table 15). The Yukon also had the highest proportion of schools making use of information sharing strategies. Personal learning activities and training sessions were highly emphasized strategies by schools in Quebec, while Alberta had the highest proportion of schools using professional development to train teachers in ICT.

**Table 15.**

*Percentage of schools with strategies for teacher use of ICT by province and territory, 2003/04*

	Mentoring or coaching activities with teachers or ICT professionals	Information- sharing or discussion with staff	Personal learning activities	Professional development	Training sessions	Staff meetings	Organized after- school sessions
	% of schools						
<b>Canada</b>	<b>25.1</b>	<b>18.2</b>	<b>14.6</b>	<b>12.8</b>	<b>12.2</b>	<b>8.0</b>	<b>7.2</b>
Newfoundland and Labrador	17.3	12.7	6.6*	7.8	6.1*	4.4*	x
Prince Edward Island	27.4	17.4*	x	13.6*	x	x	x
Nova Scotia	21.0	16.1	16.4	11.9	10.2	5.5	5.5
New Brunswick	20.4	12.6	12.0	10.0	12.3	7.6	8.7
Quebec	30.9	16.8	20.6	11.7	19.3	10.2	9.8
Ontario	24.9	21.4	12.6	13.1	10.6	8.6	7.1
Manitoba	24.9	16.9	14.5	14.0	14.8	5.6	4.9
Saskatchewan	19.7	13.9	12.0	10.9	10.4	5.3	6.4
Alberta	31.3	21.8	17.3	20.2	13.0	9.0	8.8
British Columbia	17.8	12.8	11.2	8.5	7.0	5.7	4.0
Yukon	33.3	33.3	x	x	x	x	x
Northwest Territories	x	x	x	x	x	x	x
Nunavut	x	x	x	x	x	x	x

*Note: Estimates reflect the answer category 'a lot of emphasis placed by principal on strategies to help teachers learn how to use ICT'.*

*\* Lower reliability estimates due to sample size.*

*x Suppressed to meet confidentiality requirements of the Statistics Act.*

## 7. CHALLENGES TO USING ICTS IN SCHOOLS

The ICTSS asked principals to indicate to what extent certain ICT-related issues, such as funding for technology, obtaining a sufficient number of computers, and ensuring that computers and peripherals were up-to-date, were perceived as challenges or barriers to the use of ICT in their school. More than two-thirds of principals reported that sufficient funding for technology was an extensive challenge or area of concern. Large schools were most likely to cite funding as a challenge.

Having up-to-date equipment was cited as an extensive challenge by 52% of school principals, followed by sufficient number of copies and licenses for instructional software (43%), training opportunities for teachers (40%), sufficient number of computers (39%), and sufficient level of ICT in subjects for teachers to provide adequate instruction (38%).

Other significant challenges included finding enough time to integrate ICT into learning (37%), and obtaining adequate technical support for operating and maintaining computers (32%) (Table 16).

Schools in Newfoundland and Labrador were most likely to report sufficient funding for technology as an extensive challenge. Quebec, Prince Edward Island and New Brunswick followed close behind. Only one-third of schools in the Yukon cited funding as a challenge. In fact, the Yukon and Nunavut were the only regions where a higher proportion of schools cited a challenge other than funding – maintaining a sufficient level of ICT in all subject areas for the Yukon, and having enough training opportunities in Nunavut (Table 16).

Obtaining software in the language of instruction was more likely to be an extensive challenge for schools in Nunavut (46%), Quebec (19%) and New Brunswick (18%).

**Table 16.**

*Percentage of schools citing challenges to using ICT by province and territory, 2003/04*

	Having sufficient funding for technology	Ensuring computers and peripherals are up to date	Obtaining sufficient copies/licences of software for instructional purposes	Having enough training opportunities for teachers	Obtaining sufficient number of computers	Maintaining sufficient level of ICT in all subjects for teachers to provide adequate level of instruction
<i>% of schools</i>						
<b>Canada</b>	<b>66.8</b>	<b>51.8</b>	<b>43.4</b>	<b>40.1</b>	<b>39.3</b>	<b>38.3</b>
Newfoundland and Labrador	79.6	71.2	62.6	56.9	59.2	40.9
Prince Edward Island	74.8	55.7	36.4	52.7	52.9	31.0
Nova Scotia	59.6	51.8	51.7	43.7	37.4	37.2
New Brunswick	74.7	64.2	53.8	48.1	41.1	46.8
Quebec	78.8	57.4	55.0	37.5	51.7	46.7
Ontario	63.6	50.2	35.3	44.7	36.8	38.7
Manitoba	49.2	35.6	38.7	25.4	22.0	24.0
Saskatchewan	43.7	34.7	40.5	39.0	23.6	29.4
Alberta	69.5	53.0	41.2	29.0	37.5	27.4
British Columbia	70.5	54.8	46.6	40.7	39.3	41.2
Yukon	33.3	x	x	x	x	34.8
Northwest Territories	57.1	41.7	44.4	54.3	22.2*	40.0
Nunavut	61.9	57.1	50.0	72.7	27.3*	63.6

\* Lower reliability estimates due to sample size.

x Suppressed to meet confidentiality requirements of the Statistics Act.

## 8. SUMMARY AND CONCLUDING REMARKS

According to the ICTSS, schools have the necessary infrastructure to integrate ICTs into the learning environment. During the 2003/04 school year, virtually all schools in Canada had computers and nearly all were connected to the Internet, with rates ranging from 91% in Manitoba to over 99% in Newfoundland and Labrador and New Brunswick. Moreover, all elementary and secondary schools in the territories reported having Internet-connected computers.

Not only are schools connected to the Internet but access to the Internet within schools is also pervasive. Overall, nine out of ten computers were connected to the Internet and available to students, ranging from a low of 88% in Nunavut to a high of 96% in New Brunswick, Nova Scotia, the Northwest Territories and the Yukon.

An overwhelming majority (86%) of schools used broadband technologies to access the Internet, while only 9% used a regular dial-up telephone line. While there are many ways to connect to the Internet, not all types of connections are available in every geographical area. The type of connection may in fact be limited to what local providers can offer. The Northwest Territories and Nunavut, along with Prince Edward Island, had the lowest proportions of schools connected by broadband, while the Yukon, New Brunswick, Nova Scotia and Saskatchewan were leaders in broadband connectivity.

School computers were generally available to students and teachers, opening up a wide range of opportunities for making teaching and learning more effective. Typically, there were about five students sharing a computer in schools, while there were slightly more students (5.5) per Internet-connected computer. Quebec had the most students per Internet-connected computer (6.5), followed by Ontario (5.8), and British Columbia and Prince Edward Island (5.6). The Yukon had the least number of students per computer and Internet-connected computer (2.9).

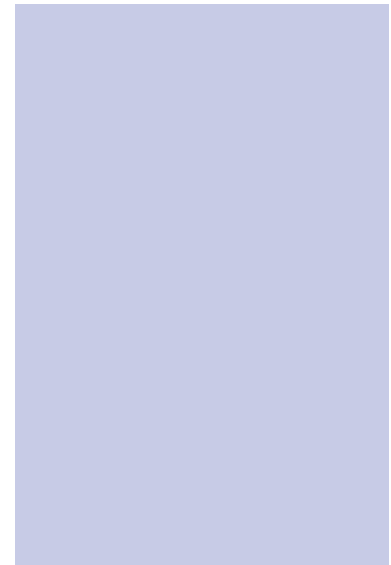
Many principals reported having computers with dated technology. Just under one-quarter of the elementary and secondary schools in Canada had at least half of their computers running on the most recent operating systems, ranging from a low of 7% in New Brunswick to a high of 41% in Alberta. However, the use of older operating systems may not always indicate a problem since many software applications available to students in schools may not require the most up-to-date system to operate efficiently.

Furthermore, more than half (54%) of the computers in elementary and secondary schools were equipped with medium processor speed, while only 16% were considered high speed computers. School computers in Saskatchewan were most likely to have high processing speeds (25%), while a smaller proportion of computers in Prince Edward Island (5%), Nunavut (8%), and in Quebec and Newfoundland and Labrador (10%) were reported to be as fast.

Results from the ICTSS suggest that the extent to which ICT is being integrated into teaching practices needs to be further explored. Training opportunities for teachers were also cited as an extensive challenge by 40% of schools, and teachers were perceived to be more skilled at using ICT for administrative purposes rather than for engaging students in learning.

Despite the widespread availability of ICT infrastructure and high rates of connectedness in schools, maintaining current systems and infrastructure can be challenging. Indeed, one of the biggest concerns among school principals was the cost of technology. Slightly more than two-thirds of principals reported that getting sufficient funding for technology was an extensive challenge to using ICT in their school. While at least three-quarters of principals in Newfoundland and Labrador, Quebec, Prince Edward Island and New Brunswick felt that ICT funding was a major area of concern for their school, less than half of principals in the Yukon, Saskatchewan and Manitoba reported that such funding was an extensive challenge.

Notwithstanding the perceived financial challenges, more than nine principals out of ten agreed that ICTs are worth the investment. Now, more than ever, these measures for infrastructure and reach need to be followed by data on the use and impact of ICT in education. Moreover, issues such as ICT training and development for teachers need to be further explored to ensure the effectiveness of such technology for student learning.



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