Research Paper

Literacy and Digital Technologies: Linkages and Outcomes

by B. Veenhof, Y. Clermont and G. Sciadas

Science, Innovation and Electronic Information Division (SIEID)
7-A, R.H. Coats Building, Ottawa, K1A 0T6

Telephone: 1 613 951-2581   Fax: 1 613 951-9920

Statistics Canada   Statistique Canada

Canada

Connectedness Series

The Series publishes analytical studies and research reports in the broad area of Connectedness. This includes cross-economy activities, such as the penetration and use of the Internet and electronic commerce, as well as industries in the Information and Communications Technologies sector, such as telecommunications, broadcasting and Internet services. It offers a statistical perspective in these emerging phenomena that are transforming the economic and societal landscape.

All papers are subject to peer and institutional review, as well as review by subject matter experts, as necessary. They are distributed to Statistics Canada Regional Offices, Provincial and Territorial Focal Points and are also available on the Internet.

Aussi disponible en français

Literacy and Digital Technologies: Linkages and Outcomes

by B. Veenhof, Y. Clermont and G. Sciadas

Abstract

This paper investigates relationships between adult literacy skills and use of information and communications technologies (ICTs). Using the *Adult Literacy and Life Skills Survey (ALL)*, it becomes possible to compare respondents' ICT use, based on self-assessed ICT use patterns and attitudes toward computers, with literacy skills and a number of socio-demographic characteristics, including age, gender and educational attainment. The paper offers data for Canada, its provinces and territories, as well as five other countries (Bermuda, the United States, Italy, Norway and Switzerland), allowing international and inter-provincial comparisons. An important objective of the paper is to examine outcomes associated with literacy skills in combination with patterns of ICT use, and this is achieved by profiling these characteristics and studying their relationships with respondent income. In addition, it offers a portrait of adults' computer and Internet use, including purposes of use, attitudes toward computers, and use of other ICTs, and analyzes such use, with a detailed focus on Canada.

Patterns of Internet and computer access confirm the existence of "digital divides" both within and between nations. Apart from Italy, differences between the countries included in this study are not large. However, as found elsewhere, large divides exist within countries when examining respondents grouped by their level of income. In Canada, the Western provinces, the territories, and Ontario emerge as leaders in ICT use, although regional patterns are complex and vary depending on the specific technology examined.

Many other factors are also strongly associated with respondents' ICT use. Age, gender, educational attainment, and level of literacy proficiency help predict whether a respondent is a "high-intensity" computer user. A significant decline in ICT use is found to occur after age 45 in all countries. The findings for ICT use by gender, however, were mixed. In the European countries included in this study (Italy, Norway and Switzerland), clear gender differences emerge but no such gap exists in North America. Respondents with less than upper-secondary education are significantly less likely to use computers for a range of purposes, and this pattern is most pronounced in Italy and Bermuda. In addition, scales that measure individuals' use of computers and the Internet, and attitudes toward computers, tend to increase with the literacy proficiency of respondents.

Finally, literacy and computer use profiles are strongly related to the likelihood that respondents have high earnings. In most countries included in this study, adults who have average or higher literacy skills and who are intensive computer users have about three to six times the odds of being in the top quartile of personal income, compared to respondents with below average literacy skills and less intensive computer use.

Literacy and Digital Technologies: Linkages and Outcomes

By B. Veenhof, Y. Clermont and G. Sciadas

Ben Veenhof and George Sciadas are with the Science, Innovation and Electronic Information Division, and Yvan Clermont is with the Centre for Education Statistics at Statistics Canada.

1. ICT use in a time of change

The widespread diffusion of information and communications technologies (ICTs) has been a source of change on many fronts. Spurred by the rapid pace of this evolution, people have learned to develop new - and changing - skill sets to use ICTs effectively. ICTs are now linked with the experiences in many aspects of peoples' lives (Fanning 2001). Whether using a search engine on the Internet at home, manipulating data on a computer at work, or using a word processor at school, people engage in a process of learning – and sometimes adapting – skills related to these technologies. Some skills may be very specific, while others are generic and transferable (Committee on Information Technology Literacy 1999). Some argue that it is not necessarily application-specific knowledge, but rather generic skills applicable to several applications that equip individuals for the rapid change in the world of ICTs (Anderson and Bikson 1998).

Having basic literacy skills enables individuals to enter various forms of engagement in everyday life. Means of social participation, and the conception of literacy that goes along with it, have changed substantially over time (Meyer and Rose 2000, Leu Jr. 2000). At some point, literacy for the majority of the population consisted of little more than being able to sign a legal document. In time, the ability to read became critical to an individual's awareness and understanding of society, and this ability became intertwined with today's concept of literacy (International ICT Literacy Panel 2002).

Possessing the skills to use ICTs effectively allows individuals to function in the digital world, much like basic literacy enables various forms of engagement in other parts of everyday life. This link underpins the notion that ICT skills are an integral part of an emerging concept of literacy (Irish Information Society 2000), or form distinct sets of skills (BECTA 2002, Asha and Ramachandran 2001) or "workplace competencies" (OECD 2001a, OECD 2002). These skills are sometimes referred to as "foundation" skills because they are often not specific to any one job or task but are needed across many activities and provide the base upon which other skills are built (HRDC 2002, Conference Board of Canada 2000). However, there is currently no commonly-adopted definition of ICT skills (OECD 2004). While progress has been made in properly situating ICT skills within the overall skills continuum (International ICT Literacy Panel 2002), ICT skills have eluded measurement - with a few exceptions (see, for instance, DfES 2003).

While the study of literacy and general life skills dates back some time, and ICT penetration and use have attracted much research in recent years, it has seldom been possible to combine the two.[1] The *Adult Literacy and Life Skills Survey (ALL)*, however, collected information on individuals' use of and familiarity with ICTs in relation to general literacy skills. Using this new information source, largely based on survey respondents' self-assessment of ICT use, perceptions of experience, and degree of comfort with ICTs, this study explores the relationship between ICT use and literacy skills. It begins by profiling individuals' access to computers, the Internet and other ICTs. It then proceeds to investigate the relationship between ICT use and literacy skills, as well as to profile ICT use by individual characteristics, including age, gender, and educational attainment. Finally, outcomes associated with both the use of ICTs and literacy skills are explored. In many parts of the paper, results for Canada are compared with those of five other countries included in the *ALL* survey: the United States, Bermuda, Italy, Norway and Switzerland. In some sections, patterns are also examined at the provincial/territorial level to provide additional perspective for Canada.[2]

2. Connectivity and key determinants

2.1 Evolution of ICT connectivity in Canada

Following the commercial introduction of web browsers in 1993, Internet penetration in Canada was rapid. Although in 1996 only a very small number of households used the Internet from home (7.4%), by 2001 the penetration rate approached half of all households (48.7%) and by 2003 it reached 55%, while Internet use from any location reached 64% in 2003 (Statistics Canada 2004a). Growth was fast in the beginning[3],

particularly among high income households. In recent years, growth has slowed as the technology becomes more widely used and the potential pool of new users becomes smaller. As we shall see later in this section, Internet use among the highest income groups is very high, which means that much of the new growth in Internet penetration depends on households currently with low incomes.

Compared with Internet penetration, the growth of personal computer use has occurred over a longer time period and has been relatively stable, considering the computer's appeal to specialized users in its early years. By the time the Internet had gained popularity, computers were no longer in their initial growth period (Sciadas 2002). Computer growth rose steadily from 16.3% of households in 1990 to two-thirds (66.8%) of households by 2003. The penetration rate for individuals reported in ALL is slightly higher (75.6%) than the household rate, in part because families with several members are more likely to have a computer than one-person households.

In terms of other ICTs, penetration of telephones and colour televisions is nearly universal in Canada, while penetration of VCRs has stabilized at high levels for some time. CD players were taken up at a slightly faster rate than the personal computer, while growth in the proportion of cable television subscribers has stagnated in Canada, in part due to competition from other service providers, including satellite (Chart 1).

1. Some recent studies have addressed relationships between ICT use and academic performance among students. The findings are mixed, with studies showing positive, negative, and neutral relationships between specific types of ICT use and student performance (Bussière and Gluszynski 2004, Fuchs and Woessmann 2004). A review of research suggests that it is not merely the availability of ICTs, but rather the quality and type of ICT use that is a key factor in performance (Bussière and Gluszynski 2004). While some studies emphasize the role of ICT skills in today's society, others challenge their importance or relevance, in terms of labour market returns, for example (Borghans and ter Weel 2004). This study does not attempt to measure ICT skills directly, but rather compares individuals' attitudes and intensity of use of ICTs with literacy skills.

2. For an international comparative report on ICT use and literacy skills from the same survey source, see Veenhof, Clermont and Sciadas (2005). For a national report with detailed results for Canada, see Statistics Canada and Human Resources and Skills Development Canada (2005).

3. This rapid rate of growth of a new technology was not a new phenomenon. In fact, Internet penetration occurred more slowly than the penetration of television in the 1950s (Sciadas 2002).
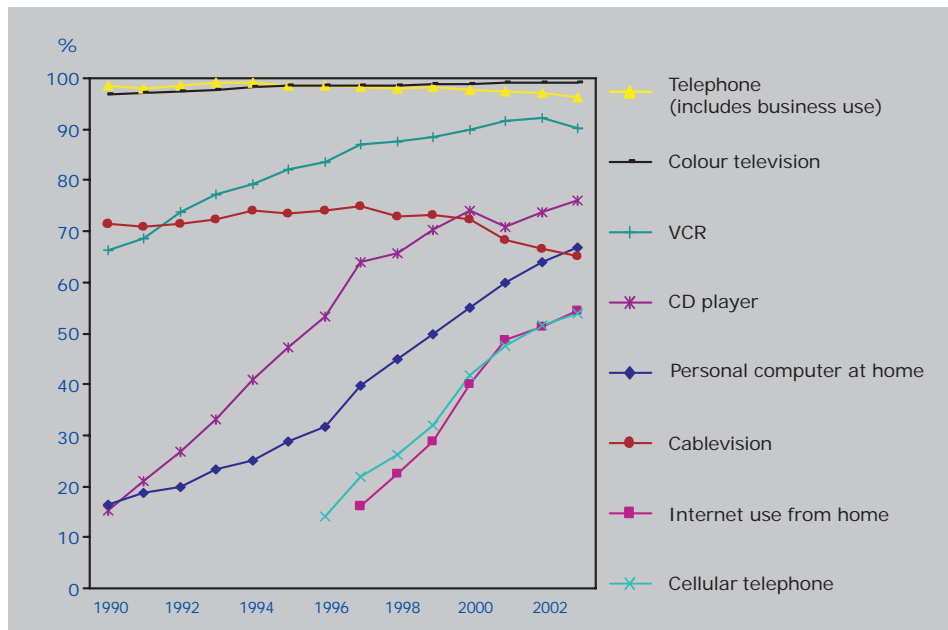
Chart 1.

Household penetration of various ICTs, Canada, 1990 to 2003

Sources:
Internet use data (1997-2003): Statistics Canada, Household Internet Use Survey, CANSIM Table 358-0003; all other ICT data (1990-1996): Statistics Canada, Household Facilities and Equipment, Cat. No. 64-202-XPB (discontinued); all other ICT data (1997-2003): Statistics Canada, Survey of Household Spending, CANSIM Table 203-0020.

Notes:
Data for computer access in 1997 and 1998 have been adjusted to conform to the revised estimation method implemented by the Survey of Household Spending beginning with 1999 data. For this reason, the 1997 and 1998 data do not match Statistics Canada's originally-released data. Furthermore, 1997 and 1998 data for computer communications include banking by telephone, business use of the Internet and wide area network, whereas 1999 data refer strictly to the use of the Internet. Personal computer data for 1990-1996 exclude video game systems or computers used solely for business use. In 1998, 1999, and every second year thereafter starting with 2001, personal computer statistics include the territories. For the other years, Canada-level statistics include the 10 provinces only. 1996 cellular telephone data exclude cellular phones provided by employers. The 2003 computer and Internet access rates reported elsewhere in this report are taken from the Adult Literacy and Life Skills Survey (ALL), and differ from the estimates provided here by the Survey of Household Spending (SHS) and the Household Internet Use Survey (HIUS). The SHS and HIUS figures measure household penetration, while the ALL figures measure individual use and include laptop computers brought home from work (for ICT penetration and growth over a longer time period, see Sciadas (2002)).

Note to readers

The primary data source for this paper is the 2003 *Adult Literacy and Life Skills Survey (ALL)*, an international project coordinated by Statistics Canada and the Educational Testing Service (ETS) in collaboration with the National Center for Education Statistics (NCES) of the United States Department of Education, the Organization for Economic Co-operation and Development (OECD), and the UNESCO Institute for Statistics (UIS). The participating countries included Canada, Bermuda, Italy, Norway, Switzerland and the United States. The target population was individuals aged 16 to 65 years. *ALL* was built on the literacy assessment model developed for the *International Adult Literacy Survey (IALS)*, first conducted in 1994.[4] The primary objective of the 2003 *ALL* survey was to measure literacy across several domains (prose and document literacy, numeracy and problem-solving), but it also included for the first time an ICT module in recognition of the important role of ICTs in the knowledge society (Kirsch and Lennon 2005). The ICT module captured basic information about the respondents' ICT connectivity, but also asked respondents about their purposes of ICT use, and perceptions and attitudes toward ICTs. In addition to profiling respondents' use of ICTs, this study examines the relationship between ICT use and literacy skills, both of which are measured in this unique survey source.

Internationally, the survey source is named the *Adult Literacy and Life Skills Survey (ALL)*, while the Canadian component is termed the *International Adult Literacy and Skills Survey (IALSS).* For the sake of clarity, and because of the use of international data, this paper will only use the international name (*ALL)* when referring to the source.

Other sources used in this study include the following Statistics Canada surveys: *General Social Survey, Cycle 14: Access to and use of Information Communication Technology, Household Internet Use Survey,* the *Survey of Household Spending,* and its predecessor, the *Household Facilities and Equipment Survey*. This study also includes information taken from an international comparative report on ICT and literacy skills based on the *ALL* survey (see Veenhof, Clermont and Sciadas 2005), as well as a report focusing on Canadian results (see Statistics Canada and Human Resources and Skills Development Canada 2005).

4 . For more information on the 1994 International Adult Literacy Survey, see Jones, Kirsch, Murray and Tuijnman (1995).

2.2   Personal computer and Internet access

Differences in the penetration and use of various ICTs, both within and across countries, have been well documented in recent years. Studies of the **digital divide** (see, for instance, US Dept. of Commerce 1995, 1998, 1999, 2000, 2002, 2004, OECD 2001b, Sciadas 2002, 2003) have also identified and analyzed many factors that influence connectivity and use of ICTs, whether at the household or individual level. While income has always been a key determinant, many other factors have been found to exert an independent influence. These include education, age, gender, residential location (urban vs. rural) and even family type.

Results from the *ALL* survey confirm such findings. The data reveal that in 2003 computer access ranged from a high of over 80% in Switzerland to a low of less than 40% in Italy. Closely tied to this pattern is Internet access, where nearly three-quarters of individuals in Switzerland compared to less than one-third of individuals in Italy lived in a home with Internet access (Chart 2). In Canada, three-quarters (75.6%) of individuals aged 16 to 65 years had computer access, while Internet access from home followed closely (68.1%).
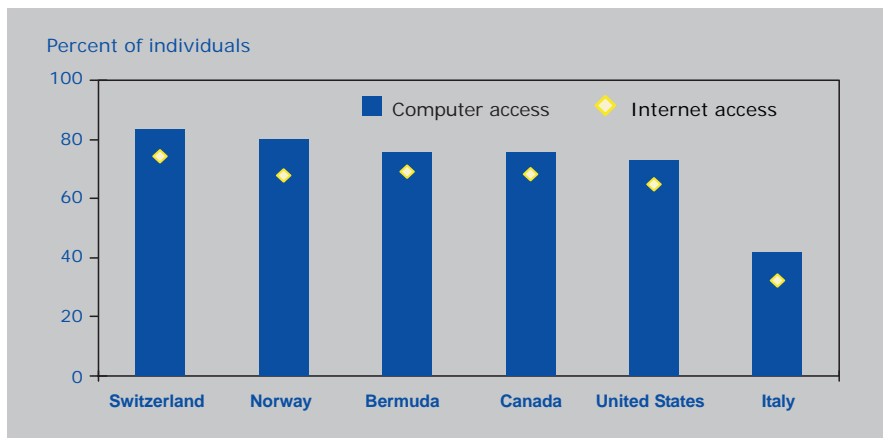
Chart 2.

Home computer and Internet access by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

As there are divides between nations, there are also divides between regions or provinces. In Canada, Ontario, Alberta, British Columbia and the Yukon Territory led in terms of home computer and Internet access (Chart 3). The western provinces have been leading in this area for some time and have traditionally been leaders in the

penetration of high-speed Internet by cable (Veenhof, Neogi and van Tol 2003, April 2000). The only provinces with Internet penetration rates below 60% were the Atlantic provinces of Newfoundland and Labrador, Prince Edward Island and New Brunswick, along with the Northwest Territories and Nunavut.
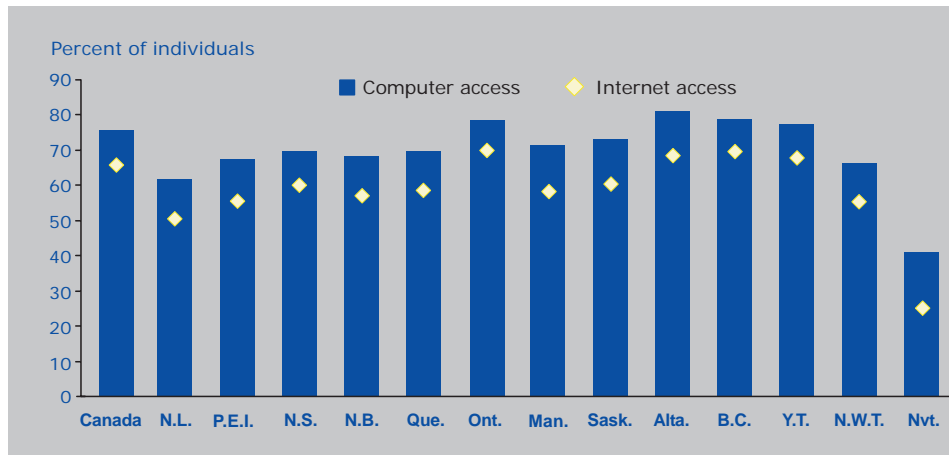
Chart 3.

Computer and Internet access, Canada, provinces and territories, 2003

Source:
Statistics Canada, Adult Literacy and Life Skills Survey, 2003

Looking only among computer users, British Columbia (92.3%) and Ontario (92.1%) led in terms of the proportion of computer users with Internet access at home. Nunavut trailed with about two-thirds (67.4%) of its computer users having access to a connection at home. The overall national figures mask the disparities occurring between regions.

Although Ontario, Alberta and British Columbia all had Internet access rates above 70%, penetration rates grew more quickly from 2000 to 2003 in most of the other provinces (Table 1). This is in part because the penetration rates in the leading provinces were already considerably higher, and therefore had less room to grow. Penetration rates for Alberta, British Columbia and Ontario grew by less than 40% from 2000 to 2003, while penetration rates for Manitoba, Saskatchewan, New Brunswick and Quebec grew by nearly 60%.

Table 1.

Individuals with computer and Internet access at home, Canada, provinces and territories, 2000 and 2003

	Computer access		Penetration growth rate	Internet access		Penetration growth rate
	2000	2003		2000	2003	
			%			
Canada	**58.3**	**68.0**	**16.6**	**42.2**	**60.9**	**44.4**
Newfoundland and Labrador	48.7	55.9	14.8	30.7	47.9	56.2
Prince Edward Island	51.9	60.5	16.5	34.4	51.7	50.2
Nova Scotia	53.7	62.2	15.8	40.7	55.4	36.0
New Brunswick	46.9	59.9	27.7	32.7	51.7	58.1
Quebec	50.1	61.6	23.1	33.8	54.1	60.1
Ontario	62.2	70.9	13.9	46.7	64.9	38.9
Manitoba	51.7	63.4	22.6	32.4	53.6	65.3
Saskatchewan	52.9	64.1	21.1	34.3	54.8	59.8
Alberta	63.4	74.4	17.4	47.7	65.2	36.6
British Columbia	66.2	72.8	10.1	49.6	66.8	34.7
Yukon Territory	..	75.0	..	..	67.7	..
Northwest Territories	..	63.6	..	..	55.9	..
Nunavut	..	39.8	..	..	26.9	..

Notes: For the sake of comparability between survey years, figures for Canada exclude the territories. 2000 data are for the population aged 15 and over, 2003 data are for the population aged 16 and over. 2003 figures for computer and Internet access reported in this table differ from figures reported elsewhere in this paper because they include the total population aged 16 and over. This was also done for the sake of comparability with the 2000 data source. Elsewhere in this report, unless otherwise noted, figures are for the population aged 16-65 only. 2003 data include laptop computers brought home from work.

.. not available for a specific reference period.

Source: Statistics Canada, General Social Survey, Cycle 14, Access to and use of Information Communication Technology, 2000. Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

2.3 Purposes of computer and Internet use

Although it is important to monitor access to key ICTs, such as personal computers and the Internet, it is equally important to examine their use if we are to understand their impacts. In Canada, the most common use of computers in 2003 was to access the Internet (91.2% of computer users). About three-quarters (75.4%) of Canadian computer users also used word processors to write or edit text on at least a monthly basis. The next most popular activity was reading information from a CD-ROM or DVD (58.9%). The computer is a source of entertainment for many Canadians, as over one-half of Canadian computer users played computer games in a typical month. Close to one-half also used their computers for managing accounts, using spreadsheets or carrying out statistical analysis (49.0%), and creating graphics, designs, pictures or presentations (42.8%). A small proportion of Canadian computer users engaged in programming (12.3%).

Compared with other countries included in this study, Canadians had the highest proportion of computer users who used the Internet, although the differences between most countries were not large. Computer users in Canada and the U.S. were also more likely to use their computers for playing games. In terms of most other computer activities, however, computer users in Bermuda and Switzerland were generally most active. Computer users in Italy were less likely to use computers for most types of activities (Table 2).

Table 2.

Purposes of computer use from any location in a typical month, by country, 2003

	Bermuda	Canada	Italy	Norway	Switzerland	United States
		% of computer users				
Use of the Internet	89.7	**91.2**	72.0	87.9	89.7	89.0
Writing or editing text	80.0	**75.4**	72.0	82.2	90.5	75.6
Reading information on a CD-ROM or DVD	62.1	**58.9**	57.6	56.6	63.0	60.4
Playing games	48.2	**51.1**	39.2	44.3	33.1	55.2
Accounts, spreadsheets or statistical analysis	56.8	**49.0**	46.1	49.8	56.3	48.9
Creating graphics, designs, pictures or presentations	49.4	**42.8**	39.3	42.3	52.2	44.5
Keeping a schedule or calendar	55.1	**38.7**	28.5	40.3	45.2	44.6
Programming or writing computer code	11.3	**12.3**	17.1	13.5	12.2	11.6

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Regional and provincial analyses of computer activities within Canada also reveal some interesting trends (Table 3). Residents of Alberta, British Columbia, Yukon Territory and the Northwest Territories were most active at writing or editing text on computers. In Ontario the proportion of computer users engaging in this activity was also quite high. Computer users in Alberta and the Northwest Territories were also above the national average in the use of computers to keep a schedule or calendar and to read information from a CD-ROM or DVD format. The Yukon Territory had the highest proportion of computer users who accessed the Internet from any location. In the Atlantic provinces use rates for many activities were lower, however the use of computers for playing games was quite popular in Newfoundland and Labrador, New Brunswick and Nova Scotia. Computer programming was not a particularly popular activity in

Table 3.

Purposes of computer use in a typical month, Canada, provinces and territories, 2003

	Canada	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.
						% of computer users								
Use of the Internet	**91.2**	85.5	87.6	90.7	88.7	89.2	91.4	89.4	90.9	94.5	93.3	95.1	89.2	77.7
Writing or editing text	**75.4**	63.2	69.3	69.8	67.0	71.3	77.7	70.3	72.1	79.8	78.6	83.0	79.1	71.2
Reading information on a CD-ROM or DVD	**58.9**	55.5	53.7	60.7	53.6	57.9	59.1	56.7	56.2	64.3	57.9	55.5	63.5	43.0
Playing games	**51.1**	58.8	53.5	57.2	58.4	49.0	49.5	54.9	55.2	53.2	52.1	45.1	54.1	55.5
Accounts, spreadsheets or statistical analysis	**49.0**	31.3	42.2	43.5	38.4	48.8	50.5	42.9	45.7	53.2	49.1	49.3	48.7	38.0
Creating graphics, designs, pictures or presentations	**42.8**	33.8	40.6	42.6	39.1	40.7	44.3	39.9	37.4	43.7	45.1	44.7	46.9	31.1
Keeping a schedule or calendar	**38.7**	31.1	34.3	36.0	35.2	35.0	40.7	34.2	32.0	43.1	40.7	39.7	43.8	32.5
Programming or writing computer code	**12.3**	7.8	8.0[1]	8.8	10.1	13.6	14.1	9.1	7.4[1]	9.8	11.0	12.1	9.5	12.2

[1] Lower reliability estimate due to sample size.

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

any province, although the rates were higher in Ontario and Quebec compared with most other provinces.

A closer look at the types of activities commonly carried out on the Internet demonstrates the medium's versatility as an information, communication, entertainment and business tool. In Canada, the vast majority of Internet surfers used e-mail (87.0%), browsed the web for general information (85.2%), and read news and current events (69.4%) in a typical month. Additionally, close to half of Canadian users used the Internet to search for information, including health (49.7%), weather (44.9%) and government information (44.0%). Placing the most frequently used public services online is part of Canada's *Government On-line (GOL)* initiative (see Government of Canada 2005, Statistics Canada 2003). The Internet also plays an important role in the job market, as close to one-third of Canadian users (31.7%) used the Internet to search for employment opportunities in a typical month.

There were some notable differences in the patterns of Internet use between Canadians and individuals in other countries. Individuals in the United States tended to use the Internet for the greatest range of purposes. In fact, Americans were among the leaders for most purposes of Internet use examined. The United States is often recognized as a leader in e-commerce and three-quarters (75.1%) of online Americans used the Internet to shop in a typical month in 2003. The majority of Internet users in Bermuda (71.6%) and Norway (61.0%) also used the Internet to shop or browse for products or services. Canadians were significantly less likely to do so (43.2%). Norway also emerged as a leader in online banking (64.1%).

While relatively few Internet users went online for formal education or training in a typical month, approximately one-quarter did so in Switzerland (26.5%), the United States (25.1%) and Bermuda (24.8%). Other less frequent activities on the Internet involved obtaining and saving music, and participating in chat groups or online discussions. Individuals in Canada and Italy were most likely to download music online (Table 4).

Table 4.

Purposes of Internet use in a typical month, by country, 2003

	Bermuda	Canada	Italy	Norway	Switzerland	United States
			% of Internet users			
Electronic mail (e-mail)	91.0	**87.0**	80.3	85.1	89.7	86.0
General browsing	88.8	**85.2**	38.0	60.5	77.4	84.6
Read about news and current events	75.1	**69.4**	65.1	81.5	55.8	75.9
Search for health-related information	55.5	**49.7**	28.4	32.2	30.2	53.5
Search for weather-related information	45.4	**44.9**	28.6	34.7	39.1	60.8
Search for government information	29.4	**44.0**	35.9	57.9	27.4	42.4
Shopping (including browsing for products or services but not necessarily buying)	71.6	**43.2**	19.8	61.0	45.4	75.1
Banking	40.2	**39.0**	17.3	64.1	32.1	31.6
Obtain or save music	26.3	**38.2**	36.5	31.1	22.0	31.2
Search for employment opportunities	15.4	**31.7**	19.3	20.0	13.9	32.2
Participate in chat groups or other online discussions	23.6	**24.5**	26.2	18.4	15.0	23.8
Formal education or training (part of a formal learning activity such as a course or a program of studies)	24.8	**17.4**	16.9	20.0	26.5	25.1
Playing games with others	16.3	**16.1**	10.8	10.6	6.6	20.8

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Within Canada, residents of the Northwest Territories and British Columbia were the most active Internet surfers in terms of the proportion of users performing specific tasks online. They were closely followed by individuals in Newfoundland and Labrador, Nova Scotia, and Ontario (Table 5).

E-mail use was above the national average in western and northern parts of Canada, including Alberta (87.5%), British Columbia (91.1%), Northwest Territories (89.9%) and the Yukon Territory (89.8%), as well as Ontario (88.8%). In addition, residents of the Northwest Territories, British Columbia, and Alberta were most active when it came to using the Internet for news and current events, and banking. In terms of searching for information online, surfers in British Columbia and the Northwest Territories were also very active, tracking down health-related and government information, and individuals in Newfoundland and Labrador and the Northwest Territories led the way in accessing weather forecasts.

The Internet can be an important medium for formal education, such as taking online courses, particularly for individuals living in remote locations who cannot attend a traditional school. Internet users in the Northwest Territories led the way (22.4%) in using the Internet for formal learning activities, such as taking a course or program of studies.

Residents in the Atlantic provinces of Newfoundland and Labrador, Nova Scotia and Prince Edward Island were busy when it came to looking for employment online. The Atlantic provinces were also among the leaders in downloading music and playing games over the Internet. Those in Newfoundland and Labrador, as well as residents of the Yukon Territory, were well above the national average in online shopping. Internet users in Nunavut and Quebec tended to be relatively less active online.

Table 5.
Purposes of Internet use in a typical month, Canada, provinces and territories, 2003

	Canada	N.L.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Y.T.	N.W.T.	Nvt.
						% of Internet users								
Electronic mail (e-mail)	87.0	79.1	83.2	83.5	81.7	83.8	88.8	83.9	83.9	87.5	91.1	89.8	89.9	81.0
General browsing	85.2	87.4	87.1	84.7	83.8	83.5	85.6	84.9	87.0	85.9	86.3	76.0	84.0	69.9
Read about news and current events	69.4	70.0	64.8	70.0	61.7	64.3	72.0	69.2	64.0	69.7	73.0	65.3	75.9	60.5
Search for health-related information	49.7	50.0	52.1	49.7	48.4	45.0	50.9	49.6	50.2	47.8	55.5	50.5	53.4	26.5
Search for weather-related information	44.9	55.4	45.5	49.6	47.3	39.8	45.2	49.2	45.6	48.7	45.5	48.6	64.0	47.9
Search for government information	44.0	41.3	45.1	43.7	37.2	45.1	44.4	37.0	32.7	41.6	48.2	44.6	53.2	39.5
Shopping (including browsing for products or services but not necessarily buying)	43.2	60.2	45.1	50.7	45.9	35.0	43.7	44.3	45.1	42.5	51.3	55.6	49.1	35.1
Banking	39.0	34.3	29.1	36.6	27.4	33.2	42.3	34.7	36.2	41.2	42.2	37.3	40.2	21.4
Obtain or save music	38.2	40.7	42.6	44.4	38.6	39.7	36.1	37.5	42.5	37.7	39.9	29.1	39.0	26.2
Search for employment opportunities	31.7	35.1	35.4	35.6	25.2	29.9	33.4	29.7	26.8	29.1	33.3	25.5	34.4	23.1
Participate in chat groups or other online discussions	24.5	24.6	23.2	27.2	23.3	25.3	25.3	20.2	21.2	19.0	27.0	19.7	27.2	20.6
Formal education or training (part of a formal learning activity such as a course or a program of studies)	17.4	16.6	17.9	17.7	17.0	14.2	19.2	16.0	16.3	15.6	19.6	17.3	22.4	13.0
Playing games with others	16.1	20.0	16.4	18.5	20.0	14.5	16.9	18.2	14.4[1]	14.1	16.5	14.7	19.1	13.0[1]

[1] Lower reliability estimate due to sample size.

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

2.4 Use of other ICTs

In 2003, Canadians were frequent users of automated teller machines (88.6% using in a typical month) and calculators (85.6%). In recent years, cellular phones have followed a similar pattern of growth to home Internet access, as they were used by about two-thirds (65.8%) of Canadians. The fact that nearly half of these cell phone users used them on a daily basis signals that cell phones are becoming a routine part of everyday life. Just over one-half (54.5%) of Canadians used fax machines for personal use and over one-third (37.6%) made touchtone telephone transactions in a typical month.

Internationally, these ICTs were also used with considerable frequency.

Generally, the majority of respondents used calculators, cellular phones, automated teller machines and fax machines at least once a month. In terms of incidence of use, calculators were used by the greatest number of respondents. In terms of frequency of use, cellular phones were used most often. One-half of all respondents used cellular phones daily, and this use was particularly high in the European countries. Automated teller machines were used regularly but not as often in Italy and the United States. The use of touchtone phones for financial transactions, to make purchases or pay bills was popular in the United States but less common elsewhere (Chart 4). In addition, electronic

Note: For a number of reasons, some ICTs are used more in some countries than others. For instance, while North America is ahead of Italy in Internet use, the use of cell phones in Italy is more prevalent. Such differences are becoming increasingly more important, as technological convergence expands the functionality of various ICTs, which can be used for multiple applications. For example, cell phones now support much more than voice communications, including access to the Internet. Such issues should be borne in mind where cross-country comparisons are concerned.
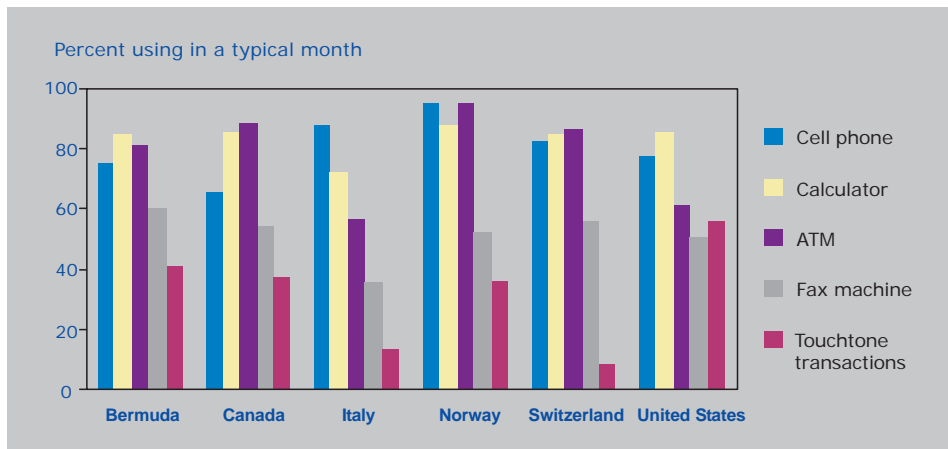
Percent using in a typical month

Chart 4.

Use of other ICTs, by country, 2003

Source:
Statistics Canada, Adult Literacy and
Life Skills Survey, 2003

personal organizers were used at work by nearly 22% of computer users who were employed - on average. This use was highest in Switzerland and Italy.

In addition to computer and Internet use, Western provinces were also heavier users of many other technologies in Canada (Table 6). Cellular phone use was particularly popular in Saskatchewan (74.1%) and Alberta (72.9%), while residents of the territories were significantly less likely to use cellular phones in 2003. Personal use of fax machines tended to increase from east to west, and

was well above the national average in the Northwest Territories (63.0%), the Yukon Territory (62.9%), British Columbia (62.4%) and Alberta (61.2%). Residents of the territories also took advantage of ICTs for making financial transactions, with the Yukon Territory (49.0%) and the Northwest Territories (43.8%) leading in the use of touchtone telephone transactions. In addition, use of automated teller machines was high in most provinces, especially Quebec (91.1%) and the Yukon Territory (90.7%).

Table 6.

Use of other ICTs, Canada, provinces and territories, 2003

	Cell phone	Calculator	Fax	Touchtone transactions	Automated teller machine
		% of individuals using in a typical month			
Canada	**65.8**	**85.6**	**54.5**	**37.6**	**88.6**
Newfoundland and Labrador	63.5	76.7	38.2	40.1	81.3
Prince Edward Island	56.9	80.4	42.2	36.8	84.3
Nova Scotia	68.0	84.4	46.8	39.1	84.5
New Brunswick	56.4	81.3	41.6	32.7	85.2
Quebec	57.8	85.0	51.7	28.5	91.1
Ontario	68.1	84.2	54.2	40.6	88.5
Manitoba	68.2	86.1	51.0	40.5	87.2
Saskatchewan	74.1	91.0	56.9	41.3	87.9
Alberta	72.9	88.6	61.2	37.8	89.6
British Columbia	68.4	89.9	62.4	43.6	86.9
Yukon Territory	33.5	88.1	62.9	49.0	90.7
Northwest Territories	43.2	84.7	63.0	43.8	84.1
Nunavut	16.5	75.7	46.4	36.5	57.5

Note: Data refer to personal use of technology, whether at home, at work or somewhere else, in a typical month.

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

2.5 The relationship between ICT access and income

As in previous research, a strong correlation was found between ICT connectivity and income, both across countries and within. Income has been established as one of the key factors shaping the digital divide, as it determines whether individuals live in households which can afford computers, the Internet and other ICTs. Individuals living in low-income households are generally disadvantaged due to lack of access to a home computer and home Internet access, and therefore have fewer opportunities for computer-related learning (Felstead et al. 2002). Examining access to key ICTs by income within individual countries can provide a sense of the magnitude of internal digital divides. Indicatively, Chart 5 shows access to computers by income quartile and country. (The situation is very similar for Internet access). With the exception of Italy, for both computer and Internet access, there exists relatively little difference between the top two income quartiles - it is between the second, third and lowest quartiles that differences become most evident. In Canada, for example, computer access in the highest quartile (91.8%) slightly exceeds that of the second-

highest income group (82.5%). These rates are significantly higher than computer access for the lowest income quartile (54.6%). Italy lags behind the other countries in terms of computer and Internet access for each quartile. In fact, computer and Internet access for users in the top income quartile living in Italy (62.5%) is only marginally higher than the access rates of the lower quartiles of other countries.

2.6 ICT non-users

While there is ample evidence that connectivity has been increasing to varying degrees in all countries, it is instructive for policy purposes to gauge perceptions among non-users. Data from the survey reveal that, in most countries, only a minority of individuals who do not use computers expressed an interest in starting to use one (Chart 6). In Canada, only 29.2% of non-users indicated an interest in starting to use a computer, and still fewer (22.7%) expected to use one in the following year. As shall be explained in the next section, this has significant consequences, as it has the potential to further marginalize that segment of the population with lower skills. This brings us to a more detailed investigation of the relation between ICTs and skills.
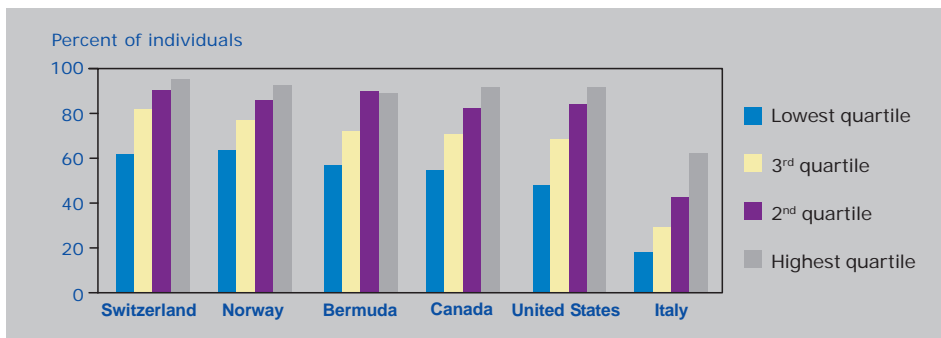

Percent of individuals

Chart 5.

Home computer access by household income quartile, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.
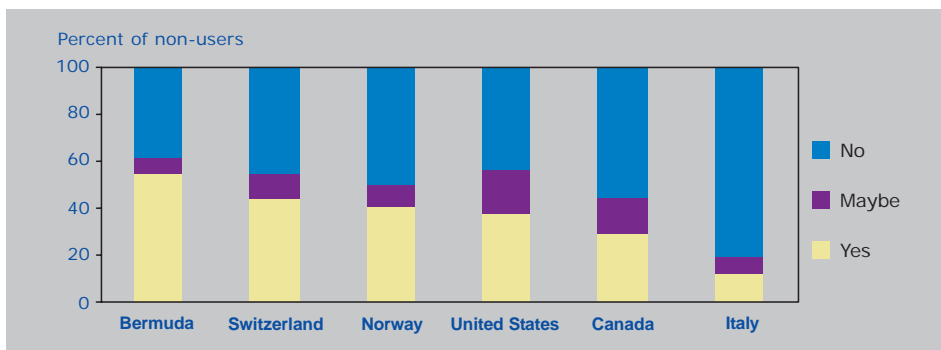

Percent of non-users

Chart 6.

Interest in starting to use a computer among non-users, by country, 2003

Source:
Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

3. ICTs and literacy skills

An early insight into the relationship between the use of ICTs and skills can be obtained by comparing the literacy skills of ICT users versus non-users (see Box 1 for definitions). From the discussion of computer usage above, those who did express an interest in using a computer over the next year did not differ substantially in their literacy skills from those who indicated no such interest. However, a gap in literacy skills was found between non-users and users in all countries (Chart 7). Not only do non-users face a digital divide, but this is built on top of the gap in literacy skills compared to the rest of the population. Consistent with the literature on the digital divide, the new gaps created from ICTs use accentuate already existing gaps. As has been argued in several studies, the group with the lowest skills continues to lose out, even though it is the group that stands to benefit proportionately more from the opportunities afforded by the new technologies. This is particularly the case with the Internet, where benefits include easier access to government services, lower prices and the like.
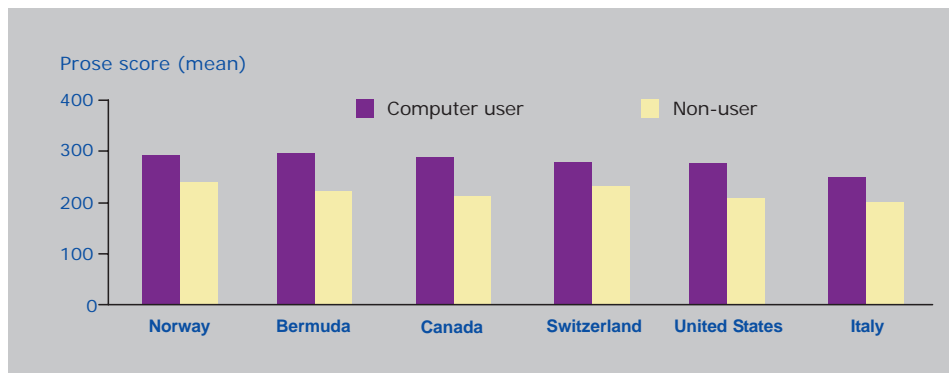
Prose score (mean)

Chart 7.

Prose literacy levels of those who have used computers vs. non-users, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

Box 1: *Literacy skill domains measured in the ALL*

The *ALL* survey measures literacy in four skill assessment domains. Respondents are tested and scored on a 500-point scale, and assigned "Levels" from 1 to 5 for each domain. Levels 4 and 5 are collapsed since it is difficult to produce reliable statistical estimates for the Level 5 population given its small size. The domains are defined as follows:

Prose literacy — "*the knowledge and skills needed to understand and use information from texts including editorials, news stories, brochures and instruction manuals*";

Document literacy — "*the knowledge and skills required to locate and use information contained in various formats, including job applications, payroll forms, transportation schedules, maps, tables and charts*";

Numeracy — "*the knowledge and skills required to effectively manage the mathematical demands of diverse situations*"; and

Problem Solving — "*Problem solving involves goal-directed thinking and action in situations for which no routine solution procedure is available. The problem solver has a more or less well defined goal, but does not immediately know how to reach it. The incongruence of goals and admissible operators constitutes a problem. The understanding of the problem situation and its step-by-step transformation, based on planning and reasoning, constitute the process of problem solving.*"

Prose literacy is the domain used for the statistical analysis throughout this study; in most cases the relationships between ICT use and prose literacy are similar to those of the other literacy domains. For a more detailed description of the measurement of literacy skills used in this paper, see Statistics Canada and OECD (2005), *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*, Ottawa.

Next we investigate in more detail respondent use of ICTs and literacy skills. To do this, three broad measures were obtained to effectively summarize ICT use in three domains:

- perceived usefulness and attitude towards computers;
- diversity and intensity of Internet use, and;
- use of computers for specific task-oriented purposes.

These measures were constructed as index scores, using several variables from the ALL survey (see Box 2). These indices will be used throughout the rest of this paper.

Box 2: *Indices of ICT use and familiarity*

Three indices of ICT use and familiarity were derived from several observed variables that were collected in the *ALL* survey. ICT related variables were examined using Exploratory Factor Analysis with principal components specified as the method. Confirmatory Factor Analysis was then used to validate three models that were hypothesized on the basis of the exploratory results and an interpretation of the observed variables. Index scores were derived according to the specified models using a Rasch scaling approach. Scores for each index are expressed as standardized scores on a 10-point scale, with a mean of 5 and a standard deviation of 1.5.

The underlying variables used to construct the three measures are outlined below:

1. **Index of perceived usefulness and attitude toward computers**
   - *Please tell me whether you strongly agree, agree, disagree, or strongly disagree with each of the following statements:*
     - Computers have made it possible for me to get more done in less time
     - Computers have made it easier for me to get useful information
     - Computers have helped me to learn new skills other than computer skills
     - Computers have helped me to communicate with people
     - Computers have helped me reach my occupational (career) goals

2. **Index of diversity and intensity of Internet use**
   - *In a typical month, how often did you use the Internet for the following purposes? (Daily, a few times a week, a few times a month, never)*
     - Electronic mail (e-mail)
     - Participate in chat groups or other on-line discussions
     - Shopping (including browsing for products or services but not necessarily buying)
     - Banking
     - Formal education or training (part of a formal learning activity such as a course or a program of studies)
     - Obtain or save music
     - Read about news and current events
     - Search for employment opportunities
     - Search for health-related information
     - Search for weather-related information
     - Search for government information
     - Playing games with others
     - General browsing
     - Other purposes; specify
   - *In a typical month, how many hours did you use a computer at home?*

3. **Index of using computers for task-oriented purposes**
   - *In a typical month, how often did you use a computer for the following purposes? (Daily, a few times a week, a few times a month, never).*
     - Writing or editing text
     - Accounts, spreadsheets or statistical analysis
     - Creating graphics, designs, pictures or presentations
     - Programming or writing computer code
     - Keeping a schedule or calendar
     - Reading information on a CD-ROM or DVD
   - *In a typical month, how many hours did you use a computer at home?*

Within the scope of this study, scores for perceived usefulness and attitude toward computers, diversity and intensity of Internet use, and use of computers for task-oriented purposes were relatively comparable within countries - with a few exceptions (Chart 8). As with ICT penetration generally, one would expect measures of ICT use and familiarity to vary by country, though. Bermuda emerged as a leader in all three measures, but it was closely followed by the United States, Canada, Norway and Switzerland. Scores were substantially lower in Italy, particularly for diversity and intensity of Internet use, and use of computers for task-oriented purposes. In Switzerland, scores for the perceived usefulness of computers, and diversity and intensity of Internet use were lower than most other countries, but together with Bermuda it was one of the leading countries for use of computers for task-oriented purposes.

Within Canada, attitudes and intensity of ICT use varied by province and territory (Chart 9). The Yukon Territory, the Northwest Territories, Alberta and British Columbia were all above the national mean in all three indices. These provinces and territories had the most intensive ICT users in the country. In fact, in the Yukon Territory and the Northwest Territories, scores were above the international mean (obtained from all 6 countries in this study) in all three ICT measures. Residents of Ontario were also intensive computer and Internet users. Individuals in the Yukon Territory and Quebec had the highest perceived usefulness of computers, however those in Quebec scored lower in terms of their actual ICT use. Similarly, in Nunavut perceived usefulness and attitude toward computers scored the highest of the three measures, but actual use of ICTs scored lower. Overall, Nunavut and Newfoundland and Labrador were the areas with the least intensive ICT users. In most of the other provinces, scores mirrored those at the national level.
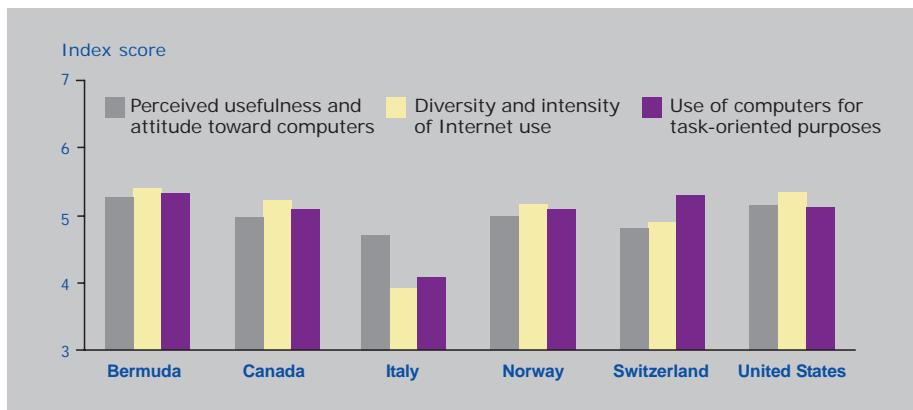

Chart 8.

Mean ICT scores by country, 2003
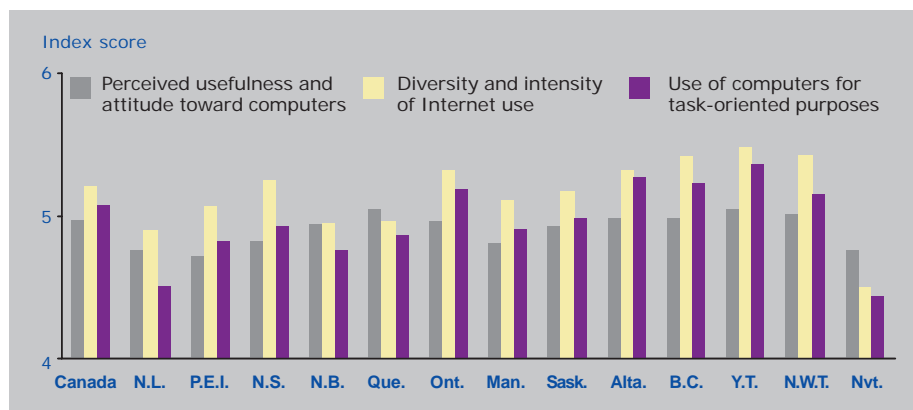
Source:
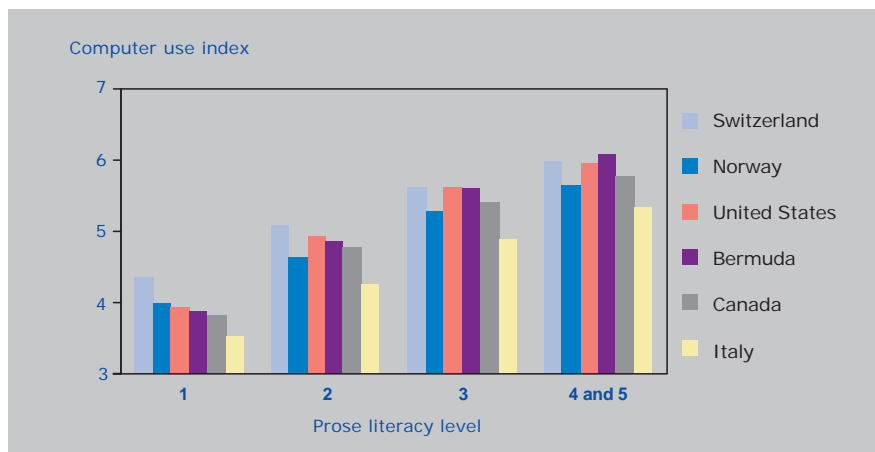Veenhof, Clermont and Sciadas, 2005.

Chart 9.

Mean ICT scores, Canada, provinces and territories, 2003

Source:
Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

A key question emerging from the earlier *International Adult Literacy Survey (IALS 1994)* was the relationship between basic literacy skills and other skills thought to be important to workplace productivity and labour market success (OECD and Statistics Canada 2000, McAuley and Lowe 1999). In practice, ICT use is linked to literacy skills in a number of ways. Being skilled with most ICTs requires, to some degree, having literacy skills. By their very nature, ICTs both depend on and enhance communication abilities. Literacy skills are therefore essential to the development of digital literacy (Massé et al. 1998). One of the reasons is that ICT literacy includes not only technological proficiency, but also requires cognitive skills, such as those underlying reading and problem solving, which are critical to using ICTs effectively (International ICT Literacy Panel 2002). Much of the content of ICTs, notably of the Internet, remains text-based (Stewart 2000), and the format and content of web pages sometimes demands skills similar to those of document literacy. Further, it is likely that basic reading and writing literacy become more important as more information is transmitted and shared through ICTs than ever before (Leu Jr. 2000).

In general, the prose, document, numeracy and problem-solving skills of respondents increased as their perceived usefulness and attitude toward computers, diversity and intensity of Internet use, and use of computers for task-oriented purposes increased (see Chart 10 for an example of the association between prose literacy skills and computer use for task-oriented purposes). As literacy skills increased, the increases in diversity and intensity of Internet use and use of computers for task-oriented purposes were substantial; increases in perceived usefulness and attitude toward computers were moderate. These patterns generally held for all countries, with no exceptions. They also held true for other available measures of literacy (document literacy, numeracy and problem-solving) and, overall, concurred with those of another study where the more literate and numerate the respondent, the more likely they were to perform at high levels in an assessment of ICT skills (DfES 2003). Although aimed at a different age group, another study has found a positive relationship between access to home computers and reading skills among 15-year-old students (Bussière and Gluszynski 2004).

Chart 10.

Use of computers for task-oriented purposes by prose literacy level, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

Note: Countries are ranked by the index of computer use among respondents with prose literacy level 1.

# 4. Analysis of ICT use by socio-demographic characteristics

Having made the connection between ICTs and income clear, and having explored relationships between ICTs and skills, this section examines the three measures of ICT use and familiarity in relation to other pertinent respondent characteristics; age, gender, and educational attainment are examined.

4.1 Age

There is some concern that older workers have fewer ICT skills and that this may result in a deterioration of their position in the labour force (OECD 2004). A 'generation gap' with respect to exposure to computers and other ICTs may explain a reduced opportunity to learn ICT skills. Young workers aged 25 and under were significantly more likely to grow up with a computer in the home than those aged 25 and over (DfES 2003). As a result, there are fears of a growing mismatch between the skills of older workers and those skills that are in demand, and concern that a lack of skills may cause a slowdown in the introduction of ICTs in jobs filled by older workers, hurting a company's productivity growth and competitiveness (OECD 2004). However, to date there has been no firm evidence of such a competitive disadvantage, at least in terms of returns to ICT skills of older workers in the labour market (OECD 2004).

Overall, and consistent with previous research, age exhibited a strong relationship with patterns of ICT use and familiarity. These patterns were generally similar across countries, showing a steady decline with age, particularly for diversity and intensity of Internet use, and use of computers for task-oriented purposes (the latter is shown in Chart 11). Many of these task-oriented purposes are associated with computer use at work, such as writing or editing text, managing accounts or spreadsheets, programming, creating presentations or keeping a schedule or calendar. The drop in these activities was most substantial between the age categories of 46 to 55 and 56 to 65, suggesting that older workers and retired persons may not be performing these tasks regularly.

Young computer users are an interesting focal point because in many ways they represent a group of people with a different outlook on technology. While at different points in time, much of the older population adopted ICTs such as the computer and the Internet and learned to adapt their lives to the use of these technologies, the younger generation has grown up at a time when these technologies were already pervasive. The types of computer and Internet activities performed by the younger generation are particularly distinct from the uses of middle-aged and
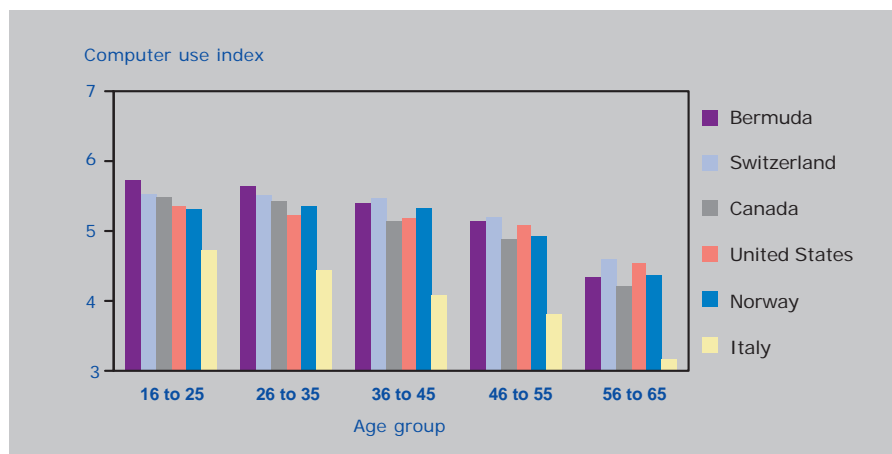
Note: Countries are ranked by the index of computer use among the 16 to 25 age group.

Chart 11.

Use of computers for task-oriented purposes by age group, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

older individuals. As they will represent computer users long into the future, it is important to understand the ways in which young people use ICTs. At the same time, it is important to recognize that these uses are not static and are likely to change over time.

Of the three ICT index scores included in this study, young Canadian computer users were most different from the rest of the population in terms of their elevated diversity and intensity of Internet use (Chart 12).

As noted earlier, these young users also had higher indices for use of computers for task-oriented purposes and perceived usefulness and attitude toward computers, but these differences were not as pronounced as the gap between young and older users in Internet use.

The second youngest group - those aged 26 to 35 years - were not far behind the youngest users in Internet use. These are individuals who would have been in their late teens or twenties in the mid-90s, beginning their careers at a time when Internet use began to emerge as a growing phenomenon.
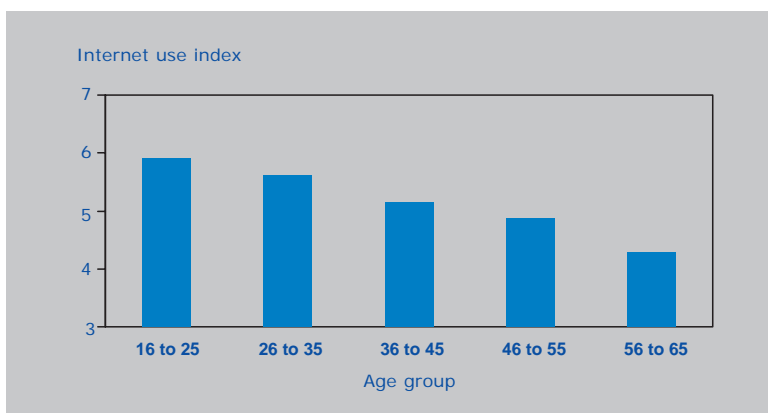

Chart 12.

Diversity and intensity of Internet use by age group, Canada, 2003

Source:
Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

It comes as no surprise, given the broad differences in attitudes and use, that young Canadians have devoted a significant part of their time to using computers (Table 7). A large proportion of Canadian computer users aged 16 to 25 years (43.3%)

used computers at home an average of one hour or more per day, while 18.1% used them for 2 hours or more. Given time spent on computers at work, school, and other locations (not measured here), the total time spent in a typical day is even higher.

Table 7.

Time spent on computers at home in a typical month, by age group, Canada, 2003

Age group	Less than 10 hours	10 to less than 30 hours	30 to less than 60 hours	60 hours or more
		% of computer users		
16 to 25	27.3	29.4	25.1	18.1
26 to 35	39.0	29.1	19.1	12.8
36 to 45	48.3	29.1	12.7	9.9
46 to 55	47.8	31.6	12.9	7.7
56 to 65	48.1	25.9	15.7	10.3

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Compared to the two youngest age groups of Internet users, those in their late thirties and beyond were more likely to be casual users, with nearly half of them spending less than 10 hours per month (or less than 20 minutes per day on average) on their computers at home. By comparison, just over one-quarter (27.3%) of young Canadian computer users aged 16 to 25 years were casual users. Interestingly, although the intensity and variety of activities performed with ICTs tends to decrease with age, the proportion of heavy computer users (30 hours or more per month) did not fall off for the oldest age group (26.0%), when compared to the 36 to 45 (22.6%) and 46 to 55 (20.6%) age groups. In some cases, those who are retired may have more free time than those in middle-aged groups who may be working, and for some this could represent an opportunity to spend greater lengths of time on their computers at home.

Data from the *ALL* survey show that heavy computer use was an emerging phenomenon in North America in particular. The proportion of computer users aged 16 to 65 years who were very heavy users at home (averaging 2 hours per day or more)

was about twice as high in Canada (11.9%) and the United States (11.1%) than in the other countries (where it ranged from 4.8% to 6.3%).

The Internet browsing experience for young, middle-aged and older Canadians is often quite different (Table 8). The group of young Canadian users aged 16 to 25 years stood out when compared with the older age groups, particularly for their preference for downloading music, participating in chat groups, and playing online games with others. In fact, the proportion of these young users who engaged in these activities was about double the proportion of the next youngest age group, aged 26 to 35 years, and over five times the rate of the oldest group, aged 56 to 65 years. Going online to obtain or save music was in fact the third most popular online activity measured for young Internet users in Canada. However, young Canadians' elevated use of the Internet was not restricted to entertainment, as they were also more likely to participate in formal education or training and to connect with potential employers online. Internet job sites and company websites have become an important

Table 8.
Purposes of Internet use in a typical month, by age group, Canada, 2003

| | Age group | | | | | Ratio youngest age group: oldest |
	16 to 25	26 to 35	36 to 45	46 to 55	56 to 65	
	% of Internet users					
General browsing	92.3	88.9	84.9	79.7	71.2	1.3
E-mail	89.1	88.6	84.8	86.6	85.0	1.0
Obtain or save music	73.5	38.8	28.9	19.3	13.0	5.7
Read about news and current events	66.8	75.8	69.6	67.3	64.8	1.0
Participate in chat groups or other online discussions	50.7	24.2	15.5	12.2	9.9	5.1
Search for employment opportunities	44.1	41.9	28.5	20.1	8.9	4.9
Search for weather-related information	41.6	51.5	45.3	41.9	41.9	1.0
Shopping	41.2	49.4	44.7	40.9	34.2	1.2
Search for health-related information	34.9	56.2	52.8	53.4	54.8	0.6
Playing games with others	34.4	16.5	9.4	7.0	6.5	5.3
Search for government information	29.4	49.1	50.3	47.2	44.8	0.7
Banking	28.5	51.2	41.9	36.3	33.5	0.9
Formal education or training	25.7	18.1	15.2	14.6	6.6	3.9

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

source for job information, and over 40% of Canadian Internet users in the two youngest age groups went online to search for employment opportunities in a typical month in 2003. Online employment and education resources are becoming valuable tools for employers and educators, meaning that Canadians who do not have Internet access may be missing out on significant personal opportunities.

Although young Canadians could be described as being Internet savvy, some important browsing activities were more common among older users. In particular, Canadians aged 16 to 25 were significantly less likely to go online to search for health-related or government information. Certainly, younger Canadians may have less need for this information, but that changes quickly beginning with the 26 to 35 age group and beyond. Approximately half of those older than 25 years of age performed these activities in a typical month in 2003.

Although few Canadians in their teens or early twenties had an interest or a need for online banking, more than half (51.2%) of those aged 26 to 35 did banking online in a typical month. Shopping or browsing for products on the Internet was also most popular among those in their late twenties and

early-to-mid-thirties (49.4%), although it caught the attention of most other age groups to a lesser degree.[5]

There was relatively little difference in the proportion of Canadian Internet users of different age groups engaging in some of the most popular Internet activities, such as general browsing, e-mail, and following news and current events. These activities appear to be essential to a majority of Internet surfers of all ages.

Young Canadian computer users aged 16 to 25 years were also the most active in terms of writing or editing text (84.8%), playing games (68.3%), reading information from a CD-ROM or DVD (65.2%), creating graphics, pictures, designs or presentations (52.2%) and programming (17.3%) (Table 9). Computer graphics and web design (not measured in the *ALL* survey) have also emerged as popular post-secondary programs of study for young individuals. Meanwhile, activities that tended to be work-related, such as maintaining accounts or spreadsheets and keeping a schedule or calendar, were more popular among middle-aged adults. Overall, differences for non-Internet related computer activities by age were not as large as differences observed in Internet usage.

5. An estimated 3.2 million Canadian households actively participated in e-commerce in 2003, spending just over $3.0 billion on Internet shopping. Although rising every year, this represented only a fraction of the $688 billion in total personal expenditure in Canada in 2003 (Statistics Canada 2004).

Table 9.

Purposes of computer use in a typical month, by age group, Canada, 2003

	Age group					Ratio youngest age group: oldest
	16 to 25	26 to 35	36 to 45	46 to 55	56 to 65	
	% of computers users					
Use of Internet	97.9	94.1	91.2	87.4	78.5	1.2
Writing or editing text	84.8	79.5	72.9	71.0	62.4	1.4
Playing games	68.3	52.7	45.7	41.0	44.5	1.5
Reading information on a CD-ROM or DVD	65.2	63.2	60.6	54.3	41.9	1.6
Creating graphics, designs, pictures or presentations	52.2	47.4	42.4	37.8	24.5	2.1
Accounts, spreadsheets or statistical analysis	40.6	56.1	53.0	50.5	39.2	1.0
Keeping a schedule or calendar	29.1	48.4	43.2	39.1	27.5	1.1
Programming or writing computer code	17.3	14.2	12.3	8.8	5.3	3.3

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

Regarding the attitudes of Canadians toward computers, the 16 to 25 age group had the highest proportion of users with positive attitudes in most areas (Table 10). The only exception was the perception of whether computers have helped the user reach their career goals, where individuals aged 26 to 35 years were more likely to feel this way (54.9%). This would be an expected result since some in the 16 to 25 year age group would not have yet started their careers.

Table 10.
Attitudes toward computers, by age group, Canada, 2003

| | Age group | | | | | Ratio youngest age group: oldest |
	16 to 25	26 to 35	36 to 45	46 to 55	56 to 65	
	% of computer users who agree with the statement					
Computers have made it easier for me to get useful information	93.6	91.5	88.2	86.8	78.5	1.2
My level of computer skills meets my present needs	91.2	83.9	76.4	72.5	73.0	1.2
Computers have helped me to communicate with people	82.2	79.0	72.5	71.5	62.7	1.3
Computers have made it possible for me to get more done in less time	80.4	74.8	66.9	64.5	57.3	1.4
Computers have helped me learn new skills other than computer skills	72.2	69.5	60.7	56.3	45.2	1.6
I feel comfortable installing or upgrading computer software	59.0	59.0	44.8	36.6	31.8	1.9
Computers have helped me reach my occupational (career) goals	45.3	54.9	46.5	43.0	33.2	1.4

Source: Statistics Canada, Adult Literacy and Life Skills Survey, 2003.

The higher perceived usefulness of computers among young users in general may not come as a surprise in light of the variety of activities young individuals perform on computers, the time they devote to these activities, and the fact that they have grown up during a time of widespread computer use. Of the measures obtained, the one that varied the most was the users' level of comfort installing or upgrading software. A majority (59.0%) of those in the two youngest age groups felt they were comfortable performing these tasks, while only a minority of those over age 35 felt this way. It should be noted that although the youngest age group had the highest proportion of users with a positive outlook on computer use, these attitudes were also quite common among all other age groups. Indeed, positive attitudes were commonplace, but users were divided on whether they felt comfortable installing software on their computers and whether in fact computers had helped them reach their occupational goals.

4.2 Gender

Many studies have found gender differences in patterns of computer use. For example, in Canada one study found that with the exception of word processing, men were more likely than women to use computers for a range of common tasks (Marshall 2001). In the United Kingdom, men have also been found to perform slightly better than women on a practical performance assessment of ICT skills, and also to have higher awareness of ICTs (DfES 2003). The fact that men were more likely to be frequent users of computers is suggested as a reason for much of the difference in performance (DfES 2003). Access to ICTs is found to be lowest among unemployed women (Commission of the European Communities 2002).

In this study, differences in ICT use and familiarity by gender were evident in Switzerland, Norway and Italy (Chart 13). In each of these countries men scored higher on each of the three measures - perceived usefulness and attitudes toward computers, diversity and intensity of Internet use and use of computers for task-oriented purposes. The patterns were unlike those in North America, where differences for Bermuda, Canada and the United States were much smaller. In Switzerland, Norway and Italy, men also had higher rates of computer and Internet access than women, but in the North American countries included in this study, such differences were virtually non-existent. When speaking of ICT use patterns by gender it therefore becomes very important to refer to national contexts, which can vary substantially. Elsewhere, research has identified that gender gaps in ICT use are particularly high in developing countries (Huyer, Hafkin, Ertl and Dryburgh 2005).

Although there appears to be a relationship between gender and ICT use, gender alone does not tell the entire story. There is enough evidence to suggest that gender differences in ICT usage are more pronounced during the early stages of the introduction of new ICTs but decline over time. Therefore, gender differences must be analyzed in conjunction with the actual penetration of ICTs. As well, age has been found to exert an independent influence. Furthermore, in this study, men ranked higher in ICT use and familiarity than women in Italy, but the scores of men in Italy were generally still lower than women for all other countries examined. In Switzerland, differences by gender were quite strong, with men in this country scoring the highest in use of computers for task-oriented purposes among all countries. Intensity and diversity of Internet use was highest for men in Norway while the group scoring highest in perceived usefulness and attitudes toward computers was women in Bermuda. Available evidence suggests that there are significant differences in the extent of the gender gap, where it exists, by country.
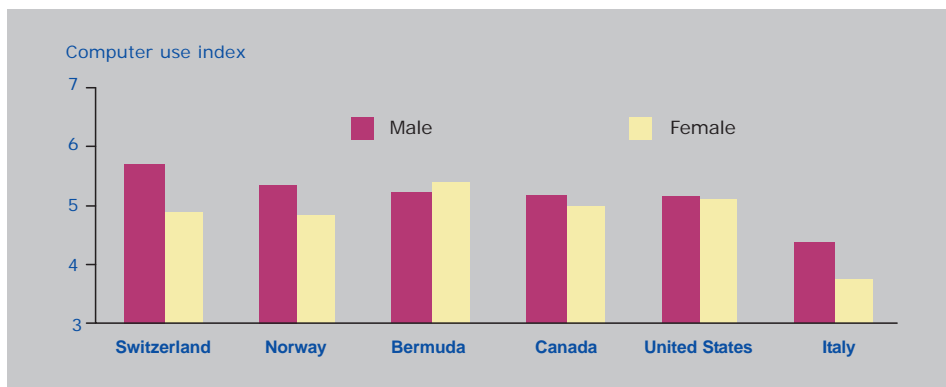

Chart 13.

Use of computers for task-oriented purposes by gender, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

4.3 Education

While an individual may master certain skills - for example, the ability to produce tables and graphs using spreadsheet software - one characteristic of ICT skills is that they are often the product of a process of continuous learning (HRDC 2002, Bertelsmann Foundation & AOL Time Warner Foundation 2002, Committee on Information Technology Literacy 1999, Ginsburg and Elmore 1998). Because the learning process is continuous, learners often incorporate several methods to learn necessary computer skills, both formal and informal, and seldom rely on only one method of learning. Formal methods include courses sponsored by an employer, while less formal methods may include help from colleagues or

family, the use of manuals and books, observing others, or self-teaching through trial-and-error (Dryburgh 2002, Felstead et al. 2002). It is through the particularly rapid change taking place in underlying technology (for example, the introduction of new versions of software, supporting hardware or interface technologies) that skill requirements change. The ability to learn and keep up with application-specific knowledge, while also developing and maintaining a growing set of core 'generic' skills, therefore become essential to participating in the digital world.

At the same time, the role of formal education in building a workforce equipped with ICT skills is currently the subject of debate. While formal education such as training at colleges and universities may be an effective means to reach the future workforce, the rapid nature of technological change and developments in the world of ICTs emphasize the need for lifelong learning over one-time educational instruction. Nonetheless, education can be an important means to develop at least basic ICT skills and the relatively recent introduction of ICTs in schools may mean that as time goes by more people are likely to use ICTs in school (OECD 2004).

One study found that those with more education have higher ICT skills, but suggests that more educated people tend to work with computers, making it difficult to differentiate whether education or employment has the biggest impact on ICT skill levels (DfES 2003). While beyond the scope of this study, more effort is needed in the future to measure ICT skills directly and gain insight into their development and evolution.

Differences in ICT use and familiarity by education level in 2003 were strongest in Bermuda and Italy and slightly smaller in Canada, the United States, Norway and Switzerland (Chart 14). In Canada, the gap between individuals with upper secondary (high school) education and those who did not complete high school was greater than the gap between those with high school and those with post-secondary education. While differences in intensity and diversity of Internet use, and use of computers for task-oriented purposes were clear, differences by education level were smaller for perceived usefulness and attitudes towards computers.
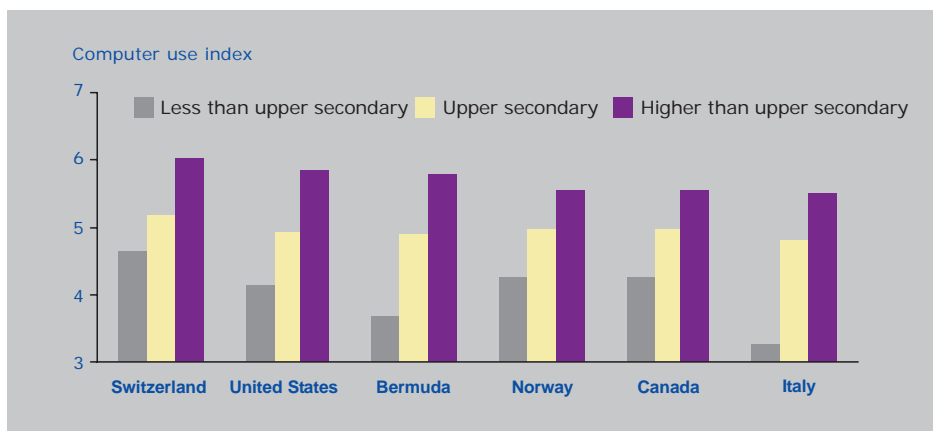

Chart 14.

Use of computers for task-oriented purposes by educational attainment, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005.

4.4 Synthesis

In order to gain a better understanding of some of the factors affecting ICT use, the index measuring the use of computers for task-oriented purposes was examined in more detail. The remaining part of this section uses a logistic regression to measure the degree to which different factors influence the odds of being a high-intensity user of computers for task-oriented purposes (see Box 3).

Box 3: *Measuring the likelihood of being an intense computer user*

Data for this section come from a logistic regression which is designed to measure the odds of being a "high-intensity" user of computers for task-oriented purposes. We identify "high-intensity" users as those respondents who are in the top quartile (highest 25%) of the scale measuring the use of computers for task-oriented purposes.

While the previous section measured variables in isolation, this section uses a logistic regression model that incorporates several variables in the analysis. The model was used to study the influence of age, gender, educational attainment, employment status, household income and literacy skills on the use of computers for task-oriented purposes. Using this technique, it is possible to isolate the influence of each variable by controlling for all other variables in the model. For example, the influence of education can be examined among those with the same age, gender, employment status and so on.

The results varied substantially by country. In some countries gender exerted a particularly strong influence on the use of computers for task-oriented purposes. While controlling for other factors, men in Italy, Norway and Switzerland were still more likely to be high-intensity computer users. In contrast, and consistent with findings reported earlier in this paper, gender differences with respect to ICTs were smaller in North America. In fact, in Bermuda there was no difference in the odds between males and females of being a high-intensity computer user.

The analysis also confirmed that education is strongly associated with computer use. In the United States and Italy, adults with upper secondary education had more than two times the odds of being high-intensity computer users compared to those with less education. In the remaining countries, the odds were approximately twice as high for adults with post-secondary education compared to those with less than upper secondary educational attainment - even while controlling for other variables.

The results also reaffirmed that those with high levels of household income were more likely to be intense computer users. In most countries, respondents whose income falls in the top income quartile had approximately two times the odds of being high-intensity users of computers for task-oriented purposes compared to those with lower income.

Literacy skills proved highly correlated with computer use. As literacy skill levels[6] increased, the odds of being a high-intensity computer user increased. For example, in the United States and Switzerland, a respondent with high prose literacy skills (levels 4 and 5) had nearly twice the odds of being a high-intensity user compared to respondents with low literacy (levels 1 and 2). The relationship between literacy skills and computer use was even stronger in Canada, Bermuda, and Norway, where respondents with high literacy skill levels had between two to more-than-three times the odds of being intense computer users compared to those with low literacy skills. Furthermore, in all countries except Norway, the gaps between low and average literacy groups were greater than the gaps in the odds ratios between those with average and high literacy. Table 11 depicts the odds ratios of being a high-intensity computer user by different literacy levels.

6. For a detailed description of literacy levels, see Statistics Canada and OECD (2005), *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*, Ottawa and Paris.

Table 11.

Adjusted odds ratios showing the likelihood of adults aged 16 to 65 of being high-intensity computer users, by prose literacy levels, by country, 2003

	Prose literacy level		
	Levels 1 and 2	**Level 3**	**Levels 4 and 5**
Bermuda	1.00	2.38 **	3.39 **
Canada	**1.00**	**1.83** **	**2.40** **
Italy	1.00	1.64 *	2.02 *
Norway	1.00	1.80 **	2.66 **
Switzerland	1.00	1.78 **	1.91 *
United States	1.00	1.59 **	1.94 **

Note: In order to produce reliable estimates, Levels 1 and 2 and 4 and 5 have been collapsed. Levels 1 and 2 are used as the reference group. Odds are adjusted for gender, age, educational attainment, labour force status and total household income.

*   statistically significant at the 5% level.
* *   statistically significant at the 1% level.

Source: Veenhof, Clermont and Sciadas, 2005.

5. Towards understanding outcomes

While ICT penetration and use have been analyzed extensively, more research is needed to understand outcomes associated with such use. Such an effort becomes more illustrative if ICT use is combined with literacy skills. This section represents an attempt to assess such outcomes, by exploring the association between personal income and a combined measure of literacy skills and ICT use.

As in the previous section, a logistic regression model is used to estimate the odds of being a high-income earner (dependent variable), while controlling for various socio-economic characteristics. In this case, groups with different profiles of literacy skills and computer use are included in the model (see Box 4 for details regarding the delineation of the groups).
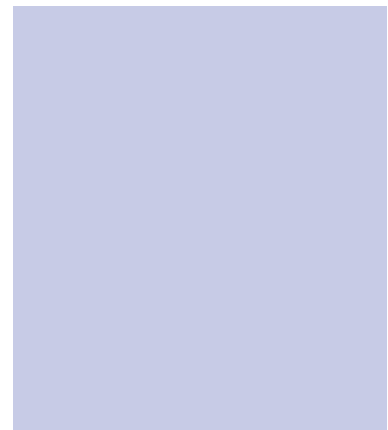
Box 4: *Combined literacy and computer use profiles*

The logistic regression in this section models the effects of various socio-economic characteristics, as well as literacy and computer use profiles on personal income. Respondents were divided into 4 groups on the basis of their literacy and computer use profiles as follows:

Group	**Prose literacy level**	**Level of use of computers for task-oriented purposes**
Group 1	below average (levels 1 and 2)	low-to-medium intensity (lowest 75% of computer users)
Group 2	average or higher (levels 3 to 5)	low-to-medium intensity (lowest 75% of computer users)
Group 3	below average (levels 1 and 2)	high-intensity (top 25% of computer users)
Group 4	average or higher (levels 3 to 5)	high-intensity (top 25% of computer users)

The regression estimates the odds of being in the top income quartile (highest 25%) of personal income, relative to the reference group (Group 1).

The distribution of the groups, delineated by their literacy and computer use profiles, varied by country (Chart 15). In Italy, Switzerland and the United States the largest group consisted of users with below average literacy skills and low-to-medium intensity computer use[7]. In Italy this group was particularly large, accounting for over 60% of all respondents. Conversely, in Bermuda, Canada and Norway, the largest group consisted of users with average or higher literacy skills and low-to-medium intensity computer use. For all countries except Italy, respondents with strong prose literacy skills and high intensity computer use represented the third largest group. The smallest group contained individuals with high computer use but below average literacy skills.

In order to study the effect of literacy skills and computer use on income it was important to control for gender, age and other variables. Results indicate that literacy skills and computer use were strongly associated with personal income. With the exception of Italy, respondents who were in the high group for either literacy skills or computer use (Group 2 or 3) had approximately twice the odds of being top quartile income earners compared to respondents who had below average literacy skills and low-to-medium intensity computer use (Group 1). Moreover, the odds of being a top income earner effectively doubled again for respondents with both average or higher literacy skills and high computer use (Group 4) compared with Groups 2 and 3 – again with the exception of Italy. In fact, in Canada, Bermuda and Switzerland, respondents with average or higher literacy skills and high computer use had from about five to more than six times the odds of being top income earners than respondents with below average literacy and low-to-medium intensity computer use (Table 12).

7. By definition, one would expect this group to be relatively large because we define low-to-medium intensity computer use as the lowest 75% of values obtained for the index score representing use of computers for task-oriented purposes.
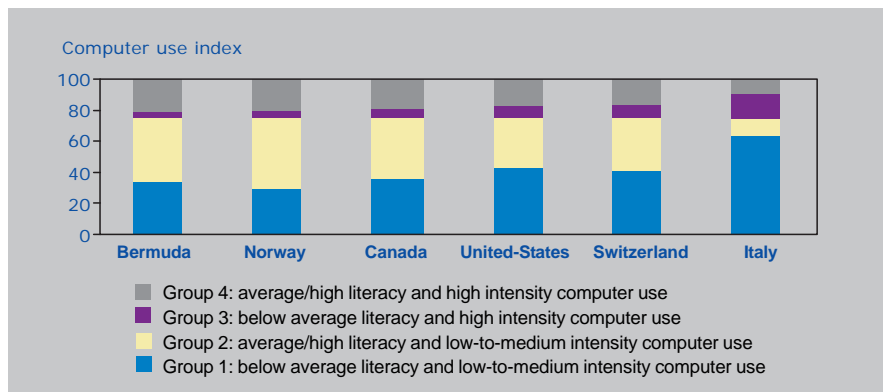

Computer use index

- Group 4: average/high literacy and high intensity computer use
- Group 3: below average literacy and high intensity computer use
- Group 2: average/high literacy and low-to-medium intensity computer use
- Group 1: below average literacy and low-to-medium intensity computer use

Chart 15.

Distribution of literacy and computer use profiles, by country, 2003

Source:
Veenhof, Clermont and Sciadas, 2005

Table 12.

Adjusted odds ratio showing the likelihood of adults aged 16 to 65 of being a top quartile income earner, by combined literacy and computer use profiles, by country, 2003

	Group 1	Group 2	Group 3	Group 4
Bermuda	1.00	2.38**	2.06	5.68**
Canada	**1.00**	**2.63****	**2.52****	**5.18****
Italy	1.00	1.27	1.69**	1.80*
Norway	1.00	1.79**	1.95*	3.85**
Switzerland	1.00	2.25**	3.27**	6.30**
United States	1.00	1.86**	2.07**	3.75**

Note: Group 1 is used as the reference group. Odds are adjusted for gender, age, educational attainment, and labour force status. For definition of Groups 1-4, see Box 4.

*   statistically significant at the 5% level.
** statistically significant at the 1% level.

Source: Veenhof, Clermont and Sciadas, 2005.

Additional insights can be gained by looking at the unemployment rates among these four groups. Individuals with below average literacy skills and low-to-medium intensity computer use had a much higher unemployment rate (11.2%) than those with both average or higher literacy skills and high computer use (3.8%). Interestingly, and consistent with earlier findings on the income effect, the unemployment rate among individuals with average or higher literacy but low-to-medium intensity computer use (5.6%) exceeded that of individuals with low literacy but high computer use (4.4%).

6. Key findings and future work

Patterns of Internet and computer access confirm the existence of digital divides both across and within nations. Apart from Italy, differences in ICT use and access between countries included in this study were not large. In 2003, home computer access rates were about 80% and home Internet access rates approximately 70% for most countries surveyed.

Within countries, however, sizeable divides exist in access to and use of ICTs. Among other factors, income stands out as an important predictor for access to and use of ICTs. Many other factors were found to exert an influence on adults' use of and familiarity with computers and the Internet, as well as impact on their attitudes toward computers. Age, gender, level of education and level of literacy proficiency were associated with individuals' use of ICTs and could be used to predict whether a respondent would be a "high intensity" computer user. Age was found to have a particularly strong influence on computer use, showing a significant decline after age 55. Clear gender differences in Internet use existed in the European countries included in this study but not in North America. Additionally, respondents with less than upper secondary education used computers significantly less frequently than the rest of the population.

An overview of provincial and territorial ICT use in Canada revealed numerous patterns and reaffirmed the existence of divides within the nation. The Western provinces, the territories, and Ontario emerged as leaders in ICT use, although regional patterns of ICT use were complex and varied depending on the specific technology examined.

Results also confirmed an association between literacy skills and ICT use. While controlling for other factors, adults' perceived usefulness and attitude toward computers, use of the Internet, and use of computers for task-oriented purposes increased as literacy skill levels increased. This was true for all four literacy domains examined. In most countries, for example, respondents with medium to high prose literacy skills had between two to three times the odds of being a high-intensity computer user compared to those with below average literacy skills.

Those without access to ICTs also tended to have lower literacy levels than the rest of the population. In addition, only a minority of non-users of computers expressed an interest in starting to use a computer. This has implications for all nations if those individuals who perhaps stand to benefit most from ICTs (by obtaining health, employment and government information, for example) are not in a position to access and use them.

Finally, combined literacy and computer use profiles were strongly related to the likelihood that respondents would have higher incomes. In most countries, adults with average or higher literacy skills and high-intensity computer use had about three to six times the odds of being in the top personal income quartile compared to respondents with low literacy and low-to-medium intensity computer use.

Work is needed to further examine the economic and social outcomes associated with ICT use and related literacy skills. Part of this work should include the development of ICT skills measures in order to evaluate an individual's ability to use ICTs.

References

Anderson, Robert H. and Bikson, Tora K. (1998) *Focus on Generic Skills for Information Technology Literacy.* Paper presented at Information Technology Literacy Workshop, Irvine, California, January 14-15.

April, Daniel (2000) "Internet by cable", *Connectedness Series*, Statistics Canada, Cat. No. 56F0004MPE, No. 2, December.

Asha, R.P. and Ramachandran, R. (2001) *Emerging Statistical Concepts and Definitions in the Information Era*, IAOS Satellite Meeting for Statistics for the Information Society, Tokyo, August 30-31.

Bertelsmann Foundation and AOL Time Warner Foundation (2002) *21st Century Literacy in a Convergent Media World*, White paper, 21st Century Literacy Summit, Berlin, March 7-8.

Borghans, Lex and ter Weel, Bas (2004) "Are computer skills the new basic skills? The returns to computer, writing and math skills in Britain," *Labour Economics* Vol. 11, No. 1, pp. 85-98.

British Educational Communications and Technology Agency (BECTA) (2002) *The 6 ICT literacies - a draft outline for discussion*, qtd. in Bradbrook, Gail and Fisher, John et al. (2004) *Digital Equality: Reviewing Digital Inclusion Activity and Mapping the Way Forwards*, March 2004.

Bussière, Patrick and Gluszynski, Tomasz (2004) *The Impact of Computer Use on Reading Achievement of 15-year-olds*. Learning Policy Directorate, Strategic Policy and Planning Branch, Human Resources and Skills Development Canada, May 2004.

Commission of the European Communities (2002) *Information Society Jobs - Quality for Change*. Commission Staff Working Paper, Employment and Social Dimension of the Information Society (ESDIS) working group, Brussels.

Committee on Information Technology Literacy (1999) *Being Fluent with Information Technology*. Computer Science and Telecommunications Board, Commission on Physical Sciences, Mathematics, and Applications, National Research Council. Washington, D.C.: National Academy Press.

Conference Board of Canada (2000) *Employability Skills 2000+*, http://www.conferenceboard.ca/education/learning-tools/employability-skills.htm

Department for Education and Skills (DfES) (2003). *The Skills for Life Survey: A National Needs and Impact Survey of Literacy, Numeracy and ICT Skills*, DfES research report 490, United Kingdom.

Dryburgh, Heather (2002) "Learning computer skills," *Canadian Social Trends*, Cat. No. 11-008, Statistics Canada, Spring.

Fanning, James (2001) *Expanding the Definition of Technological Literacy in Schools*. http://www.mcrel.org/PDFConversion/Noteworthy/Learners_Learning_Schooling/jimf.asp

Felstead, Alan, Duncan, Gallie and Francis Green (2002) *Work Skills in Britain 1986-2001*. January.

Fuchs, Thomas and Woessmann, Ludger (2004) *Computers and Student Learning: Bivariate and Multivariate Evidence on the Availability and Use of Computers at Home and at School*, CESIFO Working Paper No. 1321, November. http://www.CESifo.de

Ginsburg, Lynda and Elmore, Jennifer (1998) *Technology in the Workplace: Issues of Workers' Skills*. National Center on Adult Literacy Technical Report TR98-04, University of Pennsylvania.

Government of Canada (2005) *Government On-Line 2005: From Vision to Reality ... and Beyond.* http://www.gol-ged.gc.ca/index_e.asp

Human Resources Development Canada (HRDC) (2002) *Knowledge Matters: Skills and Learning for Canadians*.

Huyer, Sophia, Hafkin, Nancy, Ertl, Heidi and Heather Dryburgh (2005) "Women in the Information Society", chapter 6 in Sciadas, George (ed.) *From the Digital Divide to Digital Opportunities: Measuring Infostates for Development,* Orbicom/ITU.

International ICT Literacy Panel (2002) *Digital Transformation: A Framework for ICT literacy*. Educational Testing Service, Princeton, NJ, May.

Irish Information Society, qtd. in Doczi, Marianne (2000) *Information and Communication Technologies and Social and Economic Inclusion*, Ministry of Economic Development, Information Technology Policy Group, Competition and Enterprise Branch, New Zealand.

Jones, Stan, Kirsch, Irwin, Murray, Scott and Albert Tuijnman (1995) *Literacy, Economy and Society: Results of the First International Adult Literacy Survey,* Statistics Canada Cat. No. 89-545-XPE, December.

Kirsch, Irwin and Lennon, Marilou (2005) "The ICT literacy framework", in Murray, T. Scott, Clermont, Yvan and Marilyn Binkley (eds.) *Measuring Adult Literacy and Life Skills: New Frameworks for Assessment,* Statistics Canada, Cat. No. 89-552-MIE, No. 13, Ottawa.

Leu Jr., Donald J. (2000) *Literacy and Technology: Deictic Consequences for Literacy Education in an Information Age*. Syracuse University.

Marshall, Katherine (2001) "Working with computers," *Perspectives on Labour and Income*, Cat. No. 75-001-XIE, Statistics Canada, May.

Massé, Philippe, Roy, Richard and Yves Gingras (1998) *The Changing Skill Structure of Employment in Canada*, Applied Research Branch, Strategic Policy, Human Resources Development Canada, November.

McAuley, Julie and Lowe, Graham (1999) *International Life Skills Survey Computer Literacy Assessment Framework*, Draft document, October 26.

Meyer, A. and Rose, D.H. (2000) *Learning to Read in the Computer Age*. qtd at North Central Regional Educational Laboratory: **http://www.ncrel.org/sdrs/areas/issues/content/cntareas/reading/li3lk51.htm**

OECD and Statistics Canada (2000) *Literacy in the Information Age: Final report of the International Adult Literacy Survey*, Paris.

OECD (2001a) "Competencies for the knowledge economy", *Education Policy Analysis*, Paris.

OECD (2001b) *Understanding the Digital Divide*, Paris.

OECD (2002) *ICT Skills and Employment*, STI Working Paper, Paris, July 17.

OECD (2004) "ICT skills and employment," *Information Technology Outlook 2004*, Working Party on the Information Economy, Paris, April 1-2.

Sciadas, George (2002) "Unveiling the digital divide", *Connectedness Series*, No. 7, Statistics Canada, Cat. No. 56F0004MIE.

Sciadas, George (ed.) (2003) "Monitoring the Digital Divide...and Beyond", National Research Council of Canada, Orbicom. **http://www.orbicom.uqam.ca**

Statistics Canada (2003) *Canada's Journey to an Information Society*, Cat. No. 56-508-XIE, December. **http://www.statcan.ca/cgi-bin/downpub/freepub.cgi?subject=2256#2256**

Statistics Canada (2004a) "Household Internet Use Survey", *The Daily*, July 8. **www.statcan.ca**

Statistics Canada (2004b) "E-Commerce: Household shopping on the Internet", *The Daily*, Sept. 23. **www.statcan.ca**

Statistics Canada (2005) "Electronic commerce and technology", *The Daily*, April 20. **www.statcan.ca**

Statistics Canada and Human Resources and Skills Development Canada (2005) *Building on Our Competencies: Canadian Results of the International Adult Literacy and Skills Survey,* Cat. No. 89-617-XIE.

Statistics Canada and OECD (2005) *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*, Cat. No. 89-603-XWE, Ottawa and Paris. **http://www.statcan.ca/bsolc/english/ bsolc?catno=89-603-XWE**

Stewart, James (2000) *The Digital Divide in the UK: A Review of Quantitative Indicators and Public Policies.* Research Centre for Social Sciences, University of Edinburgh, Scotland.

U.S. Department of Commerce (1995) "Falling through the Net: A Survey of the 'Have-Nots' in Urban and Rural America", July.

U.S. Department of Commerce (1998) "Falling through the Net II: New Data on the Digital Divide", July.

U.S. Department of Commerce (1999) Falling through the Net III: Defining the Digital Divide", July.

U.S. Department of Commerce (2000) "Falling through the Net IV: Toward Digital Inclusion", October.

U.S. Department of Commerce (2002) "A Nation Online: How Americans Are Expanding Their Use of the Internet", February.

U.S. Department of Commerce (2004) "A Nation Online: Entering the Broadband Age", September.

Veenhof, Ben, Neogi, Prabir and van Tol, Bryan (2003) "High-speed on the information highway: Broadband in Canada", *Connectedness Series*, Statistics Canada, Cat. No. 56F0004MIE, No. 10.

Veenhof, Ben, Clermont, Yvan and Sciadas, George (2005) "Skills and information and communications technologies", Chapter 8 in Statistics Canada and OECD, *Learning a Living: First Results of the Adult Literacy and Life Skills Survey*, Statistics Canada, Catalogue no. 89-603-XIWE, Ottawa and Paris.

Connectedness Series