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Research Paper

The digital divide in Canadian schools: factors affecting student access to and use of information technology

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Abstract

This paper provides a descriptive analysis of issues related to the access and use of Information and Communication Technology (ICT) among Canadian youth. In particular, this research examines the extent to which inequities in the use and access of ICT exist among Canadian high school students, based on gender, socio-economic status and rural-urban location. Three data sets have been used to study this issue: the Canadian portion of the Second International Technology in Education Study (SITES), an international survey which measures schools' use of technological resources; the Youth in Transition Survey (YITS), which was conducted in conjunction with the Programme for International Student Assessment (PISA); and the General Social Survey (GSS)–Cycle 14, which focuses specifically on issues related to ICT access and use.

The results of this analysis suggests that there is a "digital divide" for Canadian youth, in terms of access to and experience with ICT. Rural youths are less likely to have access to computers in the home; however, frequency of use and perceived competency levels are not compromised. Female youths and those from families with low levels of parental education are also less likely to have access to computers in their homes; they tend to spend less time on the computer and they tend to report lower levels of computer skills competency.

Keywords: computers, information technology, schools, youth

Introduction

Increasing access to Information and Communication Technology (ICT) is a priority in Canada as in most industrialized nations. This is evident in both government publications and in initiatives at the federal and provincial levels. The Speech from the Throne (Canada, 2000a) and the Prime Minister's response to it (Canada 2001b) both confirm the importance placed in developments in ICT and in skills relating to ICT. (See also Canada, 1996; 1997; Industry Canada, 1996; Information Highway Advisory Council, 1995, 1997) The Council of Ministers of Education, Canada and provincial Departments of Education (e.g. N.S. Department of Education and Culture, 1999) are working to increase the availability of ICT (Rideout, 2000), ICT education and training, and support for ICT in educational institutions from the elementary to post-secondary level.

At the same time, it is an ongoing priority for both levels of government to protect and promote equity for all Canadians. In the words of the Prime Minister "we need a literate, skilled, educated, healthy people to be a world-leading economy. But this in turn requires a truly inclusive society" (Canada, 2001b). There is recognition that the so-called "digital divide" compromises this goal of equity in access to ICT and ICT related skills.

Concern about the digital divide is not unique to Canada. The Organization for Economic Co-operation and Development (OECD) echoes this concern. They define the digital divide as "the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access information and communication technology (ICTs) and to their use of the Internet for a wide variety of activities." (OECD, 2001a: 8). They document divisions based on "income, education levels, gender, age and disability."(OECD, 2001a: 51). In another publication the OECD recognizes the ways in which this divide affects members of minority ethnic or language groups, and those in more rural and remote regions (OECD 2001b). Similarly, the World Economic Forum Task Force (Drake, 2000) emphasizes the need for ICT policies to address inequities based on gender, rurality, ethnicity and disability.

Reddick et al. (2000) identify what they call the "dual digital divide" in Canada in which there is not only a divide between those who do and those who do not use computers and/or the Internet, but also a divide within non-users reflecting the extent to which certain sub-groups of Canadians see value in getting on the "Information highway". They document that gender, social class background (as measured by education and/or levels of income), rural-urban location and age affect levels of use of ICT (Reddick et al., 2000: 37).

Attewell (2001) and Natriello (2001) discuss a different dimension of the digital divide–again proposing the existence of two divides. They see the first digital divide being one of access to computers and ICT. Their second digital divide relates to the "ways in which computers are *used* at school and at home." (Attewell, 2001: 253, emphasis added). The analyses presented later in the current paper will address both these types of divides.

Like Reddick et al. (2000), Rideout (2000) documents the nature and location of the digital divide in Canada. Again we see differences based on income, education, geography, gender, age, disability, and aboriginal status. What is disconcerting about Rideout's analysis is the suggestion that these gaps in Canadian society are widening (see also Dickinson and Ellison, 1999). What is more, many of these divisions overlap, so that some groups are doubly or triply disadvantaged.

One area of research that warrants separate mention is the literature on the gender divide in use of ICT. There is considerably more documentation of this gender divide than of other forms of inequities in Canadian society. This wealth of information may reflect the level of interest in gender issues among Canadian researchers, particularly feminist researchers (Balka and Smith, 2000; Cherny and Weise, 1996; Green, Owen and Pain, 1993; Grint and Gill, 1995; Harcourt, 1999; Millar, 1998; Spender, 1995) but it may also be a matter of gender being a readily accessible measure that governments and schools routinely record.

Several studies of high school students indicate that males are more likely to use computers (Pritchard, 1998), the Internet (Bimber, 2000; Hanson, 1994), and to enter fields of study relating to ICT (Bolan, 2000). Bolan (2000) also documents that even if they go into this area, women exit from jobs in ICT, science and engineering at twice the rate of men, with respondents citing differential treatment as the primary reason for leaving. Withers (2000: 103) confirms that the percentage of women in ICT is *dropping* rather than increasing. Collis, Kass and Kieran (1989) did a comprehensive study of grade eleven students in urban schools across Canada and found that there were "significant gender differences … in the frequency of usage of computers within every subject area, as well as in computer courses." (1989:84). (See also Carmichael et al., 1985; Gaskell and MacLaren, 1987). Acker and Oatley (1993) provide an overview of some of the research on gender and computers done in Canada in the 1980's. They found that males tended to dominate computers and computer related fields, and that there tended to be an assumption of male association with science and technology that carried over to computers. According to their overview, teachers were reluctant to intervene to modify or counteract this gender bias. A study by Chan et al. (2000) shows that not only are women less likely to express an interest in computer science and related fields, they see themselves as having lower levels of ability. In these ways computer technology becomes a gendered "filter that can influence future plans and opportunities" (Crombie and Armstrong, 1999: 317). Both homes (Media Awareness Network, 2000) and schools (Oberg and Gibson, 1999) are implicated in reinforcing this gender divide.

There have been a number of initiatives to try to overcome this gender divide, with varying success. Pritchard (1998: 73) discusses how he created a "micro cybercommunity of resistance" among the girls in his high schools. Klawe et al. (2000: 94) describe a post-baccalaureate program in computer science geared to women that "encountered a variety of challenges but has been successful in most respects". Crombie and Armstrong (1999) present results that suggest that having all female computer science classes may enhance the learning experience of young women. But note Attewell's (2001: 256) caution about such focused projects: "Demonstration projects typically use highly motivated teachers, who have been properly trained ... And who draw upon extensive technical support…. The children receive a lot of enthusiasm and attention, beyond just the computing. Consequently, these studies represent a best case scenario, the upper bound to what one may reasonably expect of educational technology in a resource-rich school environment with well-trained teachers."

The current paper examines the issue of equity in access to ICT among Canadian youth, specifically youth in high school. As we will see, there are few "non-users" in this group of Canadians. Hence, the issue is less a matter of predicting who uses ICT than a question of understanding the types and extent of use. We see barriers to ICT as going beyond external barriers that affect direct access to the technology to include constraints affecting the development of skills in the use of technology as well as internal, attitudinal barriers. That is, we agree that there is more than one "digital divide". There is a divide between users and non-users. There are also divides–or differences–*among users* with some being "heavy users" and others light (Reddick et al., 2000:18); some users see themselves as confident and competent in the use of ICT, while others are more tentative.

Although our emphasis is somewhat different than that in the analysis by Reddick et al. (2000), we agree with them that, given the recent changes in ICT, its widespread use, and the emphasis given to skill development in ICT by various levels of government, “technological access and proficiency will be necessary for individuals to maintain a competent level of participation in society and derive the benefits thereof” (Reddick et al., 2000: 46). However, they (like Attewell, 2001) note that access to ICT “will not on its own overcome the social and economic inequalities and cleavages in society or communities. In fact, it may aggravate them” (Reddick et al., 2000: 46).

The question the current paper addresses is the extent to which there continue to be inequities in access to and use of ICT among Canadian youth, based on gender, social class and rural–urban location. Data from some pan-Canadian data sets will be examined in order to provide preliminary answers to this question.

Evidence from pan-Canadian data sets

The data sets

This research provides an overview of some key patterns on use of ICT by Canadian youth, based on three pan-Canadian surveys[1]: (1) the Youth in Transition Survey (YITS) which was done in conjunction with the Programme for International Student Assessment (PISA) (2) the General Social Survey (GSS)–Cycle 14, which focuses specifically on issues relating to ICT, and (3) the Second International Technology in Education Study (SITES), a school-based survey. The authors of this paper were given access to the micro data files for YITS/PISA and SITES through the Atlantic Regional Data Centre based at Dalhousie University. The data from the GSS–Cycle 14 come from the Public Use Data File. These surveys allow us to examine some recent information on the extent to which there are inequities in the use of ICT among youth in Canadian schools.

These data are drawn from large scale surveys that give a representative picture of patterns within the Canadian population. However, there are limitations to these surveys that must be kept in mind. Those living in the Northern territories are excluded from YITS/PISA and GSS. The territories were

[1] The original proposal for this paper included plans to analyse the Aboriginal Peoples Survey (APS). However, the recent APS (which has some questions on use of ICT) was not available at the time that this analysis was conducted; the earlier version did not have the detailed questions on ICT that would be useful in this analysis.

included in the SITES data gathering, but given the small number of cases sampled they were excluded from the data set made available for analysis. Aboriginal groups in other parts of the country and those in other racial or ethnic minorities are included, but make up such a small percentage of the population that only a few are included in samples, such as those for the data sets being examined here. This means that any detailed analysis for those sub-groups are unreliable because they are based on a very small number of cases and therefore do not produce reliable estimates. As a result of these data limitations we are unable to present analyses of the effects of race or aboriginal status. This is unfortunate since there is evidence of a large digital divide based on aboriginal status.[2]

Since the focus of this paper is on the digital divide in Canadian *schools*, it was important to restrict our analysis as best we could to youth in school. The 15-16 year-old respondents in the YITS/PISA were all in school, and the SITES data set is explicitly school based. The challenge came in identifying the relevant sub-sample in the GSS data set. In order to keep the focus on youth, the analysis was restricted to those under the age of 25. Further, in keeping with the focus on schools, GSS respondents were included only if (a) they had not obtained their high school completion certificate and (b) their main activity in the last twelve months was going to school.[3]

The Canadian GSS (Cycle 14) had as its main focus the use of technology and computers. The target population for this survey were Canadian residents aged 15 or older excluding a) residents of the Yukon, Northwest Territories and Nunavut and b) full-time residents of institutions. A stratified sampling design was employed, with provinces as the first strata, census metropolitan areas as the second strata and separate strata for Toronto and Montreal. Random digit dialing was employed with respondents randomly selected from among the eligible persons aged 15 years and older. Computer-assisted telephone interviews were successfully conducted with 25,090 respondents between January and December of 2000, representing a response rate of 80.8%. Sampling weights were calculated to represent the target population, with adjustments made to agree with the

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[2] The Survey of Approaches to Educational Planning (SAEP) shows that 49% of aboriginal households surveyed report they have a computer, compared to 73% of those in other households. The aboriginal households included in this survey are restricted to those living off formal reserves in the ten provinces, not those living in the territories.

[3] This subset of GSS respondents includes 1001 individuals; 87% of them are between the ages of 15 and 17. However, there is much more age variation in this sample than in the YITS/PISA, which is restricted to 15-16 year olds.

projected provincial-age-sex population distribution. All analyses use weighted data; for tests of significance, the weights are normalized to the unweighted N.

The YITS/PISA is a survey of 15-16 year-olds. The target population was youth born in 1984 attending a school. A two-stage sampling design was used, with the first stage being schools (a total of 1,200 were selected) and the second stage being students within schools. Only schools in the ten provinces were selected. Excluded also were schools located on Indian Reserves and various types of schools where administration of the survey would not be feasible, such as schools for children with severe learning disabilities, schools for the blind and deaf students and home schooling. Altogether, less than 2% of Canadians born in 1984 were excluded from the sample frame. Provincial Ministries and Departments of Education provided lists of schools serving this age group and these were used to create the school sampling frame. Within schools, a minimum of 35 students per school were selected to participate; all students of the target age were selected in those schools with fewer than 35 students in that age category. The provinces of Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba required separate PISA assessments by whether English or French was the language of instruction of the school. This meant that in some provinces where there was a small population of students of the appropriate age, or small populations of such students in a particular language group, samples of more than 35 students per school were necessary. Information from the students was collected from April to May, 2000.

The Canadian SITES survey is part of an international study of technological resources in schools, undertaken in more than twenty-five countries. All provinces and territories in Canada participated in SITES, and samples were drawn at the provincial level in order to allow for provincial estimates from the data. The overall study targeted three populations of schools: those with enrolments in grade 5, those with enrolments in grade 9, and those with enrolments in grade 12, or equivalent (the last year of secondary school). Lists of schools were obtained from the enrolment file on schools kept by Statistics Canada (in Quebec and Ontario lists were compiled by the provincial Ministry of Education).[4] A stratified random sample of schools was chosen within each province or territory to ensure representation from these three types of schools. In Ontario, the sample lists were stratified by language of the school. Schools were sent two separate surveys in January of 1999: one to be completed by the school principal, the other to be completed by the person in the school most

[4] See SITES Microdata User's Guide (05-2001) for details.

"informed about computer facilities and practices regarding the use of computers in the school". The current analysis focuses on data from the technical respondent in those schools which offer the senior year of high school. This provides information on 589 schools. As was done for the GSS analysis, those of the SITES survey use weighted data, with weights normalized to the unweighted N for any tests of statistical significance.

The analysis of these data sets will allow us to identify the extent to which and the ways in which different subgroups of Canadian high school students have access to ICT. Specifically we will look at the effects of gender, rural-urban location and social class background (as measured by parental education) on access to, use of and attitudes about ICT. Having examined these patterns we will briefly discuss the relevance of the findings for policy initiatives.

Gender

The first thing to note, in terms of the impact of gender on use of ICT, is that there appears to be little or no difference in the proportion of females versus males who use ICT, overall. According to the GSS data, 97% of both males and females used a computer in the last 12 months (and only 2% say they have never used a computer). Equivalent percentages of males and females (just over 90%) report accessing the Internet in the last year. (See Table 1). There is little evidence of gender inequity here.

However, there are some interesting patterns when we look at where and why males and females use ICT. For example, the YITS/PISA data show that females are slightly more likely than males (13% versus 11%) to say they have no computer in the home. In the same data, males reported slightly higher rates of use of computers in the home (for example, 58% of males and 45% of females reported using the computer every day at home). However, many of the gender differences are fairly small (e.g. 15% of females and 12% of males say they never use a computer in their home). There seems to be little basis for concern that either males or females are disadvantaged in terms of physical access to ICT. After all, by and large they live in the same households and attend the same schools.

Table 1: Use of, and attitudes to, ICT by Gender

	Males	Females	Data Source[a]
In Last 12 Months:			GSS
Used a computer	97%	97%	
Accessed the internet	92%	91%	
Sent e-mail	68%	71%	
Played computer games	89%	78%	
Data entry	51%	44%	
Data analysis	23%	17%	
Wrote computer programs	28%	19%	
Used graphics program	60%	53%	
Used spreadsheet	57%	51%	
Used CD-ROMs	74%	69%	
Reason for first computer use:			GSS
School/study	39%	60%	
Personal interest	61%	40%	
Number of computers in house of child			YITS/PISA
None	11%	13%	
Two or more	10%	8%	
Percent who report using the computer "almost every day"			YITS/PISA
At home	58%	45%	
At school	21%	15%	
In library	6%	3%	
Agree that:			YITS/PISA
It's very important to work with computers	70%	58%	
Computers are fun	90%	82%	
I use computers out of interest	76%	58%	
"Excellent" self rated computer skills	38%	17%	YITS/PISA

a. GSS = General Social Survey–Cycle 14 (N = 1001); YITS/PISA = Youth in Transition Survey/Programme for International Student Assessment (N = 29,687).

More striking are the gender differences in *types* of ICT use. (See Table 1). Both the YITS/PISA and the GSS document that males are more likely than females to undertake computer programming. According to the GSS, 28% of males, compared to 19% of females report that they have written computer programs in the last 12 months. The YITS/PISA data show that males report more time on programming than females. Males were also more likely to report using graphics programs (60% compared to 53% of females in the GSS did this in the last 12 months). Similarly males were somewhat more likely to report using spreadsheets or desktop publishing. In other words while males and females report relatively similar levels of use, males tend to use computers and ICT in more diverse ways. Further, for any given type of task, males are more likely than females to say they use ICT for this task everyday. These diverse skills are ones that would serve the young men well when applying for high skilled jobs using ICT.

According to the GSS data (the pattern is less clear in the YITS/PISA) young women were less likely to report that they had done data entry, and/or record keeping using the computer in the last twelve months. Less job relevant, but more striking is the gender difference in the use of computers for gaming. More males than females reported playing games in the last year (89% versus 78%); according to the YITS/PISA, these young males spent more time than their female counterparts playing games on the computer.

This use of computers for games may be relevant to the next issue–that is how these youth first learned to use a computer. The GSS data show that females were much more likely to have developed their computer skills for school or study needs (60% of them report this, compared to 39% of the males). The other side of this picture is that the males are more likely to say they learned because of personal interest (61% versus 40%).

Related to the fact that males are more likely to have learned to use the computer for their own personal interest, they are also more likely than females to report in the YITS/PISA survey that it is "really fun" to work with computers (90% versus 82% of females) and that they use a computer because they are "very interested in this" (76% of males but only 58% of females gave this response). The young men in the YITS/PISA survey were also more likely than the young women (70% versus 58%) to say they agree "it is very important to me to work with a computer." In other words, the attitudes of young women and men towards computers seem to differ.

A key question, asked in slightly different format in the two surveys, is one that deals with how the youth rate their computer competence. In both surveys males are more likely than females to say they have "excellent" computer skills (38% versus 17% in YITS/PISA; 15% versus 8% in the GSS).[5] These are large and significant differences, with about twice as many males as females choosing this option. So, while males and females may have equal access to ICT and may report similar patterns of use, they have different conceptions of how they relate to ICT.[6]

So, what can we say about the gender differences we have observed? The differences are there, but in many instances they are not large. What is more, the differences tend to be attitudinal–males are more comfortable with computers, they are more likely to use computers out of interest and for pleasure. They feel more confident and competent using computers than do the young women. Working with computers is important to them. It remains to be seen how these predispositions will affect the use and skill development beyond high school. It does seem clear that there are some small but important gender differences in terms of experiences with and attitudes to computers among high school aged Canadian youth.

Rural versus urban location

One of the key issues in rural-urban comparisons is whether or not there is equitable access to ICT resources. Rural schools and rural communities often have a weaker economic base. What is more, for communities that are a large distance from an urban center, it can be very expensive to provide Internet access and/or technical support. Given these considerations rural schools and rural communities may not be able to afford to provide similar levels of ICT facilities to youth as their urban counterparts. Data from the GSS, YITS/PISA and the SITES data bases allow us to examine the extent to which this is the case.

[5] The actual percentages are not comparable because of differences in question coding. The GSS offered respondents five skill categories along with "never used a computer"; the YITS/PISA had only four categories, so each category has more respondents. Also important to keep in mind is the fact that the two samples are different– with the GSS having a larger age spread than the YITS/PISA. Additional analyses (not shown) reveal that there is a negative relationship between age and computer use, with young youth using computers more extensively. Hence 15-year-olds are more likely to rate their computer skills higher than older youth.

[6] The SITES data set indicates that 81% of those in charge of information technology at senior high schools in Canada are males–providing role models for the young men but not the young women.

At first glance, there does not seem to be a problem. The GSS data documents that equal proportions of rural and urban youth in Canada[7] use computers. (See Table 2). Almost all (96% of urban and 98% of rural youth) reported using a computer in the last twelve months. Similar percentages of the two engaged in different types of ICT related activities during that time frame, with only minor differences, such as: slightly more urban youth had accessed the Internet (93% versus 89%) and had sent e-mail (71% versus 66%). The YITS/PISA data parallel this result showing those in cities reporting slightly more time per month on the Internet and in electronic communication, but few differences by community size in the amount of time spent on other activities.

The YITS/PISA data do show that rural households were somewhat less likely than urban ones to have a computer: 18% of those in "villages" (with a population of less than 3000) compared to 16% of those in small towns, 13% of those in towns, but only 8% of those in cities (of 100,000 or more) said they had no computer in their home. At the other end of the spectrum, 12% of those in cities compared to 6% of those in villages or small towns had two or more computers in their home.

Related to this, the same data set shows that those in the smaller rural villages reported fewer days per month, on average, spent on computers at home (44% of those in villages, compared to 57% in urban centres said they used a computer almost every day). However, rural youth in villages report somewhat more time per month spent on computers at school. They also report slightly more computer use in libraries. This pattern suggests that rural schools and communities have been able to provide computer access to youth who may not have direct access in their own homes. According to the GSS more rural (60%) than urban youth (45%) first learned to use a computer because of school or study needs. Urban youth were more likely to say they first learned out of personal interest.

[7] The GSS analysis omits those in PEI (who were not differentiated into rural versus urban in the GSS Public Use Data File), as well as those in the Northern territories who are excluded from the survey. The GSS uses census designations of postal code areas as rural or urban. YITS/PISA and SITES ask respondents to classify their area into type of community, based on size.

Table 2: Use of, and attitudes to, ICT by Rural-Urban Location

	Urban		Rural		Data Source[a]
In Last 12 Months:					GSS
Used a computer	96 %		98 %		
Accessed the internet	93 %		89 %		
Sent e-mail	71 %		66 %		
Played computer games	83 %		86 %		
Data entry	47 %		47 %		
Data analysis	20 %		21 %		
Wrote computer programs	24 %		23 %		
Used graphics program	57 %		55 %		
Used spreadsheet	55 %		51 %		
Used CD-ROMs	73 %		67 %		
Reason for first computer use:					GSS
School/study	45 %		60 %		
Personal interest	55 %		40 %		
Number of computers in house of child	**City**	**Town**	**Small Town**	**Village***	
None	8 %	13%	16 %	18%	YITS/PISA
Two or more	12 %	8 %	6 %	6 %	
Percent who report using the computer "almost every day"					YITS/PISA
At home	57%	49%	48%	44%	
At school	19%	13%	18%	29%	
In library	4%	4%	4%	8%	
Agree that:					YITS/PISA
It's very important to work with computers	69 %	61 %	60 %	61 %	
Computers are fun	86 %	85 %	85 %	85 %	
I use computers out of interest	68 %	66 %	67 %	64 %	
"Excellent" self rated computer skills	28 %	28 %	26 %	26 %	YITS/PISA

a. GSS = General Social Survey–Cycle 14 (N = 1001); YITS/PISA = Youth in Transition Survey/Programme for International Student Assessment (N = 29,687).
* City (> 100,000), Town (15,000 to 100,000), Small town (3,000 to 15,000), Village (< 3,000)

The SITES data set allows us to examine the issue of computer resources in rural and urban schools in more detail. It shows that rural schools are less likely than urban ones to have someone formally serving as a technology coordinator. Only 43% of rural schools have someone formally designated as the technology coordinator compared to 63% of schools in the urban core (see Table 3). The other side of this picture is that those who serve in this capacity in rural schools are more likely to also have duties teaching in the classroom (89% versus 83% or fewer of those in charge of technology in other schools). As a result, rural technology coordinators and their assistants spend less time than their counterparts in urban schools on various types of technology coordination.[8]

Table 3: Rural–urban differences–SITES data set[a]

A. Role of technology Coordinator:	**Urban core**	**Outer urban**	**Small town**	**Rural**
Formal	63%	59%	50%	43%
Informal	30%	29%	44%	44%
Neither	8%	12%	6%	14%
B. Technical coordinator teaches in Classroom	83%	77%	81%	89%

C. Relationship with rurality:	**Correlation***	**Significance**
Average number of hours as technology coordinator	0.18	0.001
Availability of educational software in different subjects	0.16	0.001
Much use of ICT in various subjects	0.09	0.05
Types of technical transfer among teachers	0.13	0.001
Availability of external training opportunities for teachers	0.09	0.05
Adequacy of preparation of technology coordinator	0.20	0.001
Priority of ICT and ICT support	0.10	0.05

a. Analyses based on responses from the person most "informed about computer facilities and practices" in each school, in those schools with the senior year of high school. (N = 589 schools).
* Where a positive correlation indicates more urban than rural schools have this attribute.

[8] These include training, user support, trouble shooting, installing software, staff development workshops, selecting and acquiring hardware and software.

Based on the responses on the SITES technology survey, Table 3 also shows that more urban schools report educational software available for and used in specific subjects (mathematics, earth science, language, creative arts, geography, multi-disciplinary projects). Urban schools report more opportunities and structures for knowledge transfer regarding ICT among teachers and more options, particularly options external to the school, for formal training. As a result urban coordinators are more likely to say they have an adequate training in a number of areas of ICT. Urban schools are more likely to say they see acquiring support for on-line services for curriculum as a high priority. Ironically, urban schools report more barriers to realizing the school's computer-related goals for their senior high school students (data not shown). They are more likely to report that the software is too complicated for students and teachers, that they do not have enough technical support and that there is a problem of cultural incompatibility with much of the instructional software. The only barrier that is more likely to be reported by rural schools is that their network connections are too slow.

Overall, based on the responses from those in charge of technology at the schools, rural schools seem to be disadvantaged in various ways. Rural schools are less likely to have a well trained specialist, or one freed from teaching responsibilities, to coordinate ICT in the school. Rural schools have less educational software; they use fewer types of specialized software in different subjects. Rural schools are also less likely to have different types of technical training for teachers. The results suggest that the priority given to ICT use and support in the school is lower in rural as compared to urban schools.[9] There is little evidence of advantages in this field accruing to the more rural schools. The only exception to this statement is that there appear to be more computers per student reported in the more rural schools (data not shown).[10] However, this result should be interpreted with caution since the data on number of students in the senior year comes from the principal while the data on the number of computers available to these students comes from the technical coordinator, increasing the response error.

Despite the limitations that many rural schools seem to face, as we have seen, their students use computers and other forms as ICT as much as urban students. What is more, rural students (in the

[9] Multi-variate analyses (not shown) indicate that most of these urban-rural differences can be attributed to differences in school size. Controlling on school size, rurality directly affects only the level of preparation of the technical coordinator and the opportunities for technology transfer among teachers.

GSS and YITS/PISA studies) report *more* use in schools. While the available software may not be most specialized, sufficient resources are apparently made available for rural students to gain experience in ICT.

Given that there are few overall differences by community size in access or in use patterns, it is perhaps not surprising that there are few rural-urban differences in attitudes to computers and ICT (see Table 2). Equal percentages of youth report using computers for interest or because it is fun, according to the YITS/PISA data. The only difference is between those in cities and all others where more in cities (69% compared to 61% in villages, 60% in small towns and 61% in larger towns) agree "it is very important to me to work with a computer."

The picture is less clear in terms of how size of community affects the youths' reports of their level of computer competence. The YITS/PISA data (see Table 2) show virtually no difference by community size; 26% of those in villages and small towns and 28% of those in larger towns and cities say they have excellent computer skills. The figures for the GSS suggest some advantage to urban youth–13% of them, compared to 9% of rural youth report they have excellent computer skills.[11]

In sum, the analyses of these three data sets suggest that there are some disadvantages facing high school students in the more rural areas of Canada. Rural youth are less likely to have access to computers in their homes; the computer support they have in their schools may be less specialized; their teachers may have less access to ICT support. Nevertheless, the differences tend to be small and seem to have little impact on student use of ICT. The one consistent pattern that bears noting is the difference in access to the Internet. Rural schools report more barriers related to this issue and rural students report somewhat less use of this medium. As more and more resources become available via the Internet this may become more of a policy imperative.

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[10] These results reflect the number of computers reported to be available to senior year students in the schools. If one examines the number of computers which can access the Internet or the World Wide Web at the same time, the pattern shifts–there are more of these connected computers per student the more urban the area.

[11] Recall that the scale used in the two surveys is different–one has five levels of competence, the other four. Also, the measures of rural-urban differ, so the percentages cannot be directly compared. The relevant information is the overall pattern of difference, or lack of difference by area.

Parental education

Much of the discussion of the “digital divide” centers around differences in access to ICT that reflect socio-economic status (SES). Parental education is one of the key measures that has been shown to be related to youth educational experiences and youth access to ICT. This next section will examine the extent to which use of and attitudes towards computers and other forms of ICT are related to parental education in these pan Canadian data sets.

While we have seen that the patterns of use did not vary by gender or size of community, there is an effect based on parental education. While very few (3%) of the youth in the GSS sample say they have never used a computer in the last twelve months, these few tend to come from families in which one or both parents have low education (see Table 4). Thus, 8% of those whose fathers did not complete high school say this. Virtually all (99% or 100%) of other youth report using a computer during this time frame. The YITS/PISA data shows a similar pattern. About a third of the youth whose fathers or whose mothers have no formal education or who have only elementary school education compared to 13% of those whose parent has completed high school report they have no computer in their home. Only 6% of those with a parent who has post-secondary education say they have no computer in the home.

Reflecting these levels of access in the home, those from high education families (regardless of whether it is mother’s or father’s level of education that is used as the indicator) reported higher levels of *use* of computers at home. We saw, above, that differences in home access for rural as compared to urban students tends to be compensated, at least in part, by increased access at school or in their local library. This pattern of compensation seems less evident when we look at the effects of parental education. Those students whose parents have low levels of education report about the same level of use in school as those from higher education households. This result shows that those from lower education households are not disadvantaged in schools, but they also show that these students do not make up for the lower levels of use at home by using school (or community) computers more.

Table 4: Use of, and Attitudes to, ICT by Father's education

	< High School	High School	Some Post-Secondary	University Degree	Data Source[a]
In Last 12 Months:					GSS
Used a computer	93%	99%	99%	100%	
Accessed the internet	84%	95%	93%	99%	
Sent e-mail	60%	72%	75%	83%	
Played computer games	80%	88%	89%	86%	
Data entry	49%	49%	52%	56%	
Data analysis	20%	21%	24%	25%	
Wrote computer programs	21%	27%	25%	27%	
Used graphics program	51%	62%	63%	66%	
Used spreadsheet	44%	59%	53%	69%	
Used CD-ROMs	63%	78%	76%	83%	
Reason for first computer use:					GSS
School/study	56%	52%	49%	42%	
Personal interest	44%	48%	51%	58%	

Number of computers in house of child	**<Grade 6**	**Grades 6-9**	**Grades 9-12**	**High School**	**Post – Secondary**	YITS/ PISA
None	34%	34 %	21%	13%	6%	
Two or more	3%	2 %	3 %	6%	13%	
Percent who report using the computer "almost every day"						YITS/ PISA
At home	38%	35%	43%	49%	59%	
At school	13%	15%	16%	19%	19%	
In library	5%	4%	4%	4%	5%	
Agree that:						YITS/ PISA
It's very important to work with computers	56%	54%	58%	61%	69%	
Computers are fun	84%	87%	87%	85%	86%	
I use computers out of interest	68%	66%	65%	65%	68%	
"Excellent" self rated computer skills	19%	21%	22%	26%	31%	YITS/ PISA

a. GSS = General Social Survey–Cycle 14 (N = 1001); YITS/PISA = Youth in Transition Survey/Programme for International Student Assessment (N = 29,687)

Overall, students whose parents have little or no formal education were less likely to report several types of computer use, particularly using the Internet, e-mail, doing data entry, writing computer programs, using graphics programs, using spreadsheets, using CD-ROMs as well as playing games. The only computer activity that those from lower education families were *more* likely to report was record keeping.[12]

The YITS/PISA data suggest that one result of these differences is that those from more highly educated families are more likely to say they have excellent computer skills. The pattern is less clear in the GSS data, partly reflecting the smaller sample size and therefore the instability of the coefficients when one considers a multi-category variable such as parental education.

There is little or no evidence of difference in attitudes to computers, based on parental education. Similar percentages of students say they find computers fun, or that they use computer because they are interested. The only difference comes through in terms of attitudes to working with computers. Those from families with higher levels of education are more likely than others to agree that "it is very important to me to work with a computer." That is, better-educated parents seem more likely to instill in their sons and daughters the importance of having computer skills.

Overall, the results from our analyses suggest there still is a "digital divide" for Canadian youth, in terms of access to and experience with ICT. Those from families with low levels of parental education and those from rural areas are less likely to have a computer in their home. Those from lower SES homes tend to spend less time on the computer and they tend to report lower levels of computer competency. In our gender analysis we found similar patterns of use for males and females, but differences in attitudes to computers. For those with different levels of parental education we see similar attitudes and levels of interest, but differences in objective access to computers and ICT.

Multi-variate analyses (not shown) document that gender, rurality and parental education all have a direct effect on composite measures of ICT use and related variables, even when the other variables

[12] This pattern in the GSS data holds only when looking at mother's levels of education (data not shown).

are controlled.[13] The composite measures used are: computer usage and experience, attitudes towards computers and comfort/ability with computers.

Summary

Data from these pan-Canadian data sets document that there *are* differences in the ways in which Canadian youth access ICT. Gender, rural-urban location and parental education all seem to affect patterns of use and attitudes to ICT. While some of the differences are not large, they seem to be persistent and are likely to have an impact on the ways and the extent to which members of different sub-groups involve themselves in the "information society."

An interesting point to note is that it is not the difference between users and non-users that seems to be important for this age group. As Reddick et al. (2000: 15) note, youth generally are heavy users, especially of some technologies such as the Internet. Rather, it is variation *within* the group of users that warrants attention (those in Attewell's second divide). While males and females, rural and urban youth are equally likely to have used the computer and have used it in the last year, their patterns of use seem to differ. Youth from families in which the parents have relatively low levels of education tend to use the computer less, but even here, only about one in every ten report no computer use.

Those in rural areas and those from the lower socio-economic strata (SES), as measured by parental education, are less likely to have a computer in their own home. Rural schools seem to be able to compensate for this lack. There is little evidence of a corresponding compensation for students who come from lower socio-economic households. Rather, this lack of access in the home seems to keep these students from developing a positive orientation to ICT. Males and females also differ in their attitudes towards ICT and the types of use they experience most often. This experience appears to affect their perceptions of their levels of competence with computers and ICT.

[13] These results are based on multiple regression analyses with gender, rurality and parental education as independent variables, and three dependent variables: computer use and experience, attitudes towards computers, and comfort and ability with computers.

What do these results say in terms of possibilities for policy? There is support for the argument that the heavy investments made into providing computers in the schools has exposed most if not all Canadian youth to ICT. Most feel comfortable with and competent using computers and other forms of ICT. Rural youth use the computers in their schools more often than do urban youth. These patterns suggest an important role that can be played by schools in providing and encouraging further access to and use of ICT. Differences in attitudes can perhaps be tackled best by increasing both the opportunities for use and the relevance of computers for school-related tasks. However, in every instance, those with less interest in, competence with, or experience with ICT (i.e. females, rural youth, youth from lower SES households) are more likely to have first learned to use a computer in school.

It is also relevant to note the apparent discrepancies in access to quality Internet connections in rural areas. These discrepancies are particularly pronounced in some of the more remote rural areas. As more and more resources become available via the Internet, these discrepancies, if not countered, will have serious implications for the divisions among youth in terms of their access to the presumed benefits of the information society.

We are living in a society in which many tout the virtues of ICT: "Information technology in education is an incredible resource and will, without question, continue to be the single most important component of 21st century education." (Trattner et al., 2000: 34). However, it is important to recognize the limitations and/or obstacles facing those who wish to shift to more and more ICT use in schools. Teachers face a number of constraints that make the shift to a more technologically driven classroom difficult. These include time limitations, pressure to cover the curriculum, lack of funds to purchase or upgrade hardware and/or software, and limited numbers of Internet connections. (Oberg and Gibson, 1999). Attewell (2001: 256) also comments on the pressures created by the high costs of computer equipment , as well as the "limited time for training … on technology or for a developing a curriculum tailored to computers. Finally few schools can afford technicians to support educational computing." What is more, he notes that "much of the appeal of educational computing stems from the hope that children can learn at the computer with minimal intervention from adults. … Unfortunately, we discover that computers can easily provide unsupervised *entertainment*, but to educate effectively with computing requires as much if not more adult support and effort as do traditional teaching methods." (Attewell, 2001: 255). The concern about teaching resources is echoed in Couture's discussion (1998: 27) of the situation in Alberta schools. “As librarians, guidance counselors and speech pathologists continue to be cut back in schools, administrators report that they are increasingly unable to meet the budget strain to maintain adequate computer facilities. …. The question for teachers is not whether computers are good or bad, but rather what are the long term effects on school budgets as an increasing portion of limited resources goes to support technology purchases.” Healy (1998, 2000) is one of the most outspoken critics of the rush to introduce ICT into school classrooms, but even those who do not take her extreme stance recommend that we proceed with caution, and make note of the social and other costs of the shift to ICT. One of those costs may be an exacerbation of inequities given that “unequal outcomes may stem from differences between affluent and disadvantaged students in what they do with the technology, once they have access.” (Attewell, 2001: 256).

The data we have presented in this paper based on Canadian surveys indicates that there is room for optimism. Many of the sub-group differences in use of and attitudes toward ICT are fairly small, and there seem to be possibilities for further reducing them. However, the results suggest that there is still room for improvement if we are to meet the goal of “ensuring that Canadians, their communities and their schools can have an on-ramp to the information highway.” (Canada, 2001a: 5).

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