

Tech and teens: Access and use

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Students' use of technology in education is expected to improve their academic performance, increase their technological skills, and decrease inequities between groups.^{1,2} Many educators believe that teaching that incorporates technology is necessary to prepare students for work in the information age. The new economy has intensified competition among nations, and rapid technological advances require a skilled workforce able to cope with constant changes in the workplace as well as in day-to-day living. As society becomes more complex, people require higher skill levels while literacy requirements increase dramatically. Elementary and secondary schools have a central role to play in laying a solid foundation on which subsequent knowledge and skills can be built.³

This study uses data from the 2000 Programme for International Student Assessment (PISA) to examine Canadian 15-year-old students' use of information and communication technologies (ICT) at home and at school. Canadian students' results are compared with those of students from other countries in the Organisation for Economic Co-operation and Development (OECD). In addition, the paper examines home and school factors affecting learning, including the availability of ICT at home and at school.

Nine out of 10 Canadian 15-year-old students have access to a home computer

According to the 2000 PISA, Canada ranked 11th among the 32 OECD countries in access to home computers. About 88% of 15-year-old Canadian students had access to a computer at home, compared with 91% in Australia, 83% in the United States, 82% in Finland and 67% in Japan.⁴ Internet access at home is less prevalent here in Canada and abroad. Only 69% of Canadian students had

home Internet access. Still, this is comparable with Australia (67%) and the United States (69%) and considerably

1. Pelgrum, W.J. and R.E. Anderson. 1999. *ICT and the Emerging Paradigm for Lifelong Learning: A Worldwide Educational Assessment of Infrastructure, Goals, and Practices*. Enschede, The Netherlands: International Association for the Evaluation of Education Achievement.
2. Industry Canada. 1997. *Preparing Canada for a Digital World*. www.strategis.ic.gc.ca/SSG/ih01650e.html (accessed February 25, 2002).
3. Human Resources Development Canada, Council of Ministers of Education, Canada and Statistics Canada 2001. *Measuring Up: The Performance of Canada's Youth in Reading, Mathematics and Science. OECD PISA Study — First Results for Canadians Aged 15* (Statistics Canada Catalogue no. 81-590-XPE). www.statcan.ca/english/freepub/81-590-XIE/81-590-XIE.pdf.
4. These countries were selected for the following reasons: Australia, because it is quite similar to Canada in its socio-economic status; Finland, because it ranked first in reading performance; Japan, because it ranked first in mathematics; and the United States, because of its geographic proximity to Canada.

This study uses data from the 2000 Programme of International Student Assessment (PISA). Conducted in 32 countries, PISA is a school-based survey that tests the knowledge and skills of 15-year-old students in reading, mathematics and science at or near the end of their compulsory education.¹

In most countries, about 5,000 students from 150 to 250 schools were surveyed. In Canada, nearly 30,000 students from more than 1,100 schools were interviewed during April and May 2000 to enable interprovincial comparisons and within-province analyses.

Students' access to and use of information and communication technologies at home are related to their socio-economic status. The PISA index of socio-economic status (SES) included several measures describing economic, social and cultural aspects of students' families. It was measured using a statistical composite of parental education, parental occupation status,² classical cultural possessions³ and educational resources⁴ in the home, and family wealth (based on household possessions).^{5,6}

What is an odds ratio?

Odds ratios measure the strength of association between two variables. The value of an odds ratio can range from zero to infinity, where an odds ratio of 1.0 indicates there is no association between the variables being studied. In this study, the odds of having home computer is one area examined in logistic regression models including several socio-economic and demographic explanatory variables. Sex, family structure and immigration status are categorical explanatory variables where the odds ratio represents the odds of having a home computer for

a group (e.g. girls) relative to a reference group (e.g. boys). An odds ratio of less than 1.0 indicates that girls have lower odds of having a home computer than boys after accounting for all other variables in the model.

Parental education, parental occupation status and the number of siblings are continuous variables included in the model. An odds ratio for them indicates the change in the odds from a one point increase in the continuous variable. For example, an odds ratio of 1.04 for parents' occupational status indicates that the odds of having a home computer increases by 4 percentage points for each one point increase in parental occupational status after accounting for all other variables in the model.

1. Organisation for Economic Co-operation and Development (OECD). 2001. *Knowledge and Skills for Life: First Results from the OECD Programme for International Student Assessment (PISA) 2000*. Paris: OECD.
2. The International Socio-Economic Index of Occupational Status was used to scale students' occupational status. It yields scores on a scale ranging from 16 to 90, where low values represent low occupational status and high values represent high status.
3. The Index of possessions related to "classical culture" was based on the availability in the home of classical literature (e.g. Shakespeare), books of poetry and works of art.
4. The Index of Home Educational Resources was based on the availability in the home of a dictionary, a quiet place to study, a study desk, text books and the number of calculators in the home.
5. The Family Wealth Index was based on the availability at home of a dishwasher, a room of their own, educational software, and a link to the Internet; and the numbers of cell phones, televisions, computers, automobiles and bathrooms at home.
6. Organisation for Economic Co-operation and Development. 2001.

higher than Finland (54%) and Japan (38%). Only Sweden (82%) and Iceland (81%) exceeded Canadian students' connectivity at home.

Education-related possessions influence literacy

International assessments of educational achievement conducted by the

International Association for the Evaluation of Education Achievement (IEA) and the OECD over the past 20 years have consistently shown a strong relationship between students' academic achievement and the number of books in the home.⁵ Similarly, the development of literacy skills and educational outcomes are associated

5. Human Resources Development Canada, Council of Minister of Education, and Statistics Canada. 2000. *op.cit.* p. 33; Organisation for Economic Co-operation and Development (OECD). 2002. *Reading for Change — Performance and Engagement Across Countries — Results from PISA 2000*. Paris: OECD. p. 131.

	Canada	Australia	Finland	Japan	United States
	% of 15-year-olds				
Computer at home	88	91	82	67	83
Link to Internet at home	69	67	54	38	69
Educational software	77	80	51	16	76
Calculator	99	99	99	99	98
Quiet place to study	94	90	93	82	91
Own desk	85	90	95	96	78
Musical instrument	72	70	70	80	67
Low family socio-economic status	8	8	12	13	14

Source: Organisation for Economic Co-operation and Development, Programme of International Student Assessment, 2000.

students in these five countries had their own desk and a quiet place to study, and about 70% had a musical instrument — Japan was the exception, with 80% of its students owning an instrument.⁶

Socio-economic characteristics make a difference

The diffusion of many new technologies in society has not been equitable. Researchers theorized that people who are innovative and quick to adopt new technology tend to be younger and better educated, and earn higher incomes than others.⁷ Recent studies suggest that disparities among socio-economic groups in their access to ICT are narrowing, but the current inequality between students of lower and higher socio-economic status remains a concern.⁸

Students whose parents had more prestigious occupations and higher levels of education were more likely to have access to both a computer and the Internet at home. For each additional year of parents’ education, the likelihood of having a computer at home increased by 18% and of having a link to the Internet by 15%.

Having a home computer and a link to the Internet were nearly universal among students with high socio-economic status (SES), regardless of whether they were girls or boys. Rates of access were much lower

	Computer at home	Link to the Internet at home
	Odds ratio	
Girls compared to boys	0.85	0.87
Parents’ occupational status	1.04	1.03
Parents’ education (years)	1.18	1.15
Lone-parent families compared to two-parent families	0.40	0.54
Guardian families ¹ compared to two-parent families	0.33	0.44
Number of siblings	0.95	0.93
Immigrants compared to Canadian-born	1.50	1.77

1. A mother and a male guardian, a father and a female guardian or two guardians. This includes step- and foster families as well as families where grandparents or other relatives are guardians of the child.

Source: Organisation for Economic Co-operation and Development, Programme of International Student Assessment, 2000.

with other educational resources. For example, students have superior outcomes if they own software or a musical instrument, have a desk of their own and a quiet place to study. As educational systems fully incorporate ICT into curriculum and teaching, access to the Internet at school and at home may become as

important a predictor of literacy as the number of books in the home or other educational possessions.

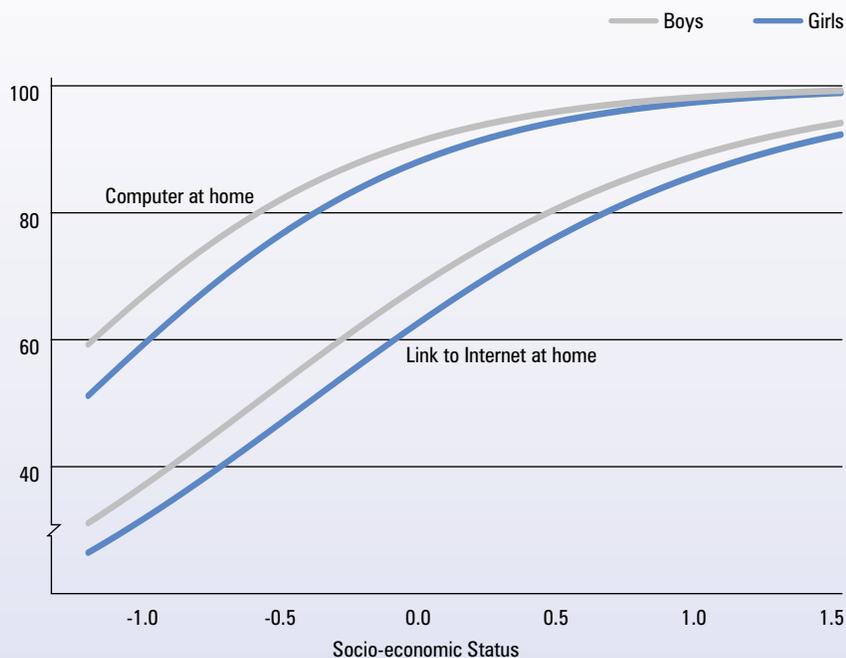
While rates of educational software ownership differed widely among Australia, Finland, Japan, the United States and Canada, other educational possessions showed considerably less variation. Nearly all 15-year-old

6. Canada was expected to fare well in these comparisons, as only 8% of Canadian students came from families with low socio-economic status — a rate similar to Australia’s but considerably lower than those of the other three countries.

7. Rogers, E.M. 1983. *Diffusion of Innovations*. Third edition. New York: Macmillan Publishing Company, Inc.

8. National Telecommunications and Information Administration. 2002. *A Nation Online: How Americans Are Expanding Their Use of the Internet*. www.ntia.doc.gov/ntiahome/dn/index.html (accessed September 9, 2002).

% of 15-year-old students



Source: Organisation for Economic Co-operation and Development, Programme of International Student Assessment, 2000.

among low SES students. In this group, the percentages of girls and boys with a home computer and a link to the Internet differed by approximately 10%.

Although the socio-economic background of families influences access to ICT resources at home, differences in other family and personal characteristics also affect access. After accounting for other factors,⁹ girls are less likely to have a computer at home. The odds ratio of 0.85 indicates that the odds of a girl having a computer are 15% less than the odds of a boy having one. The difference between the sexes for Internet access is of a similar magnitude.

Family structure also influences access to ICT at home. Children living in lone-parent families or families headed by non-parent guardians had much lower odds of having a computer

at home or Internet access. The odds of both these groups of children having a home Internet connection were only about one-half those of children in two-parent families. In addition, the number of children in a family also influenced ICT access: for each additional sibling, the odds of having a computer at home decreased by 5%, and the odds of home Internet access by about 7%.

The odds of having a computer were 50% higher for students who had immigrated to Canada, and the odds of having a home link to the Internet were 77% higher. This is partly due to the concentration of immigrants in urban areas, especially Toronto, Montréal and Vancouver, where home computers and home Internet access are more common. In addition, many immigrants, who have come to Canada seeking greater

opportunities, invest heavily in their children's education to ensure that they have the skills to take advantage of these opportunities. Although family wealth of immigrant students, as measured by an index of family wealth derived from common household possessions, is lower than that of Canadian-born students, immigrant families have more home educational resources and cultural possessions and their children spend more time on homework.

Computers used less frequently at school than at home

In schools across Canada, the number of students per Internet-connected computer varies considerably. Averages range from 15:1 for elementary schools in Nova Scotia to 5:1 for secondary schools in Manitoba.¹⁰ Two-thirds of the computers in Canadian schools are located in computer labs and libraries, and only about 5% of teachers have adopted computers for inquiry-based learning where students seek information or knowledge by asking questions.^{11,12} Moreover,

9. Other factors include parents' occupational status, parents' education, family structure, number of siblings and immigration status.

10. Canadian Education Statistics Council and Statistics Canada. 2000. *Education Indicators in Canada: Report of the Pan-Canadian Education Indicators Program 1999* (Statistics Canada Catalogue no. 81-582-XPE). www.statcan.ca/english/freepub/81-582-XIE/free.htm.

11. Laferrière, T., A. Breuleux and R. Bracewell. 1999. *Benefits of Using Information and Communication Technologies (ICT) for Teaching and Learning in K-12/13 Classrooms*. Report prepared for the SchoolNet Program. Ottawa: Industry Canada.

12. SchoolNet. 2000. *SchoolNet's On-line Connectivity Survey: Final Report*. Ottawa: Industry Canada. [www.schoolnet.ca/home/e/Research_Papers/Research/SchoolNet_Research/Final_Survey_Report_2000\(English\).htm](http://www.schoolnet.ca/home/e/Research_Papers/Research/SchoolNet_Research/Final_Survey_Report_2000(English).htm) (accessed February 25, 2002).

researchers have found that over 75% of students use computers most often at home,¹³ suggesting that using ICT to improve students' skills and knowledge requires increased access at home.

According to the 2000 PISA survey, over 50% of students used home computers almost every day and more than 20% used them a few times each week, while only 13% never used them. In contrast, 18% of students used school computers nearly every day, with 21% using them at least a few times each week.

Schools broaden computer use

Students in low socio-economic households may have less home access to ICT for various reasons, ranging from economic issues to a lack of parental interest in technology. The primary policy response to this in Canada has been to provide access to Internet-connected computers in schools and other public areas, such as libraries. While this is a positive step toward improving students' access to ICT, the amount of time available at school for computer

use is insufficient and inconsistent among schools.¹⁴

Nonetheless, the availability of computers at school enables many students to use them, and is particularly useful for those who do not have a computer at home. For example, while students in lone-parent families were less likely than those in two-parent families to use computers at home, both groups were equally likely to use them at school. Similarly, students with siblings were less likely than only children to use a computer at home, but the opposite was true of computer use at school. While immigrants were much more likely than non-immigrants to use computers at home, the differences were not as pronounced for their use at school.

As expected, computer use at home was positively related to parents' occupation and education. However, these parental factors were not strongly related to computer use at school, indicating that socio-economic factors have little influence on availability of computers at school. While living in a lone-parent family or a family headed by a non-parent guardian or having a large number of brothers and sisters reduced the odds of using a computer at home, computer use at school showed little difference between lone- and two-parent families. Guardian-headed families had higher odds of using a computer at school than two-parent families, and having more siblings increased the likelihood of using a computer at school.



Use of computers more frequent at home than at school

Frequency of use	At home % of 15-year-olds	At school
Almost every day	52	18
A few times each week	21	21
Between once a week and once a month	10	23
Less than once a month	4	22
Never	13	16

Source: Organisation for Economic Co-operation and Development, Programme of International Student Assessment, 2000.



Broader range of 15-year-old students use computers at school than at home

	Use a computer at home	Use computers at school
	Odds ratio	
Girls compared to boys	0.68	0.64
Parents' occupational status	1.02	1.00
Parents' education (years)	1.12	1.01
Lone-parent families compared to two-parent families	0.60	0.98
Guardian families ¹ compared to two-parent families	0.56	1.52
Number of siblings	0.92	1.06
Immigrants compared to Canadian born	1.70	1.37

1. A mother and a male guardian, a father and a female guardian or two guardians. This includes step- and foster families as well as families where grandparents or other relatives are guardians of the child.

Source: Organisation for Economic Co-operation and Development Programme of International Student Assessment, 2000.

13. Tsikalas, K., E.F. Gross and E. Stock. 2002. *Applying a Youth Psychology Lens to the Digital Divide: How Low-income, Minority Adolescents Appropriate Home Computers to Meet Their Needs for Autonomy, Belonging and Competence and How This Affects Their Academic and Future Prospects*. Paper presented in New Orleans at the Annual Meeting of the American Educational Research Association.

14. Canadian Education Statistics Council and Statistics Canada. 2000.

However, the availability of computers at school does not change the difference in use between the sexes: girls were less likely than boys to use computers both at home and at school.

Most 15-year-olds frequently use the Internet and electronic communications

Students most frequently used computers for accessing information on the Internet, communicating electronically (e.g. e-mail, chat rooms),

doing word processing, and playing computer games. Only about one-third of all students reported using computers to help them learn school material, and less than one-fifth regularly used educational software such as computer-based encyclopedias, dictionaries, math tutorials or reading exercises. About one-quarter of all students reported using a computer for doing programming, drawing, painting or graphics, or for analysing data with spreadsheets.

Summary

In 2000, nearly nine out of every 10 Canadian 15-year-old students had a computer at home, and those who did used them regularly. However, students from families with low socio-economic status were less likely to have access to computers and the Internet at home. Disparities between the sexes were negligible for students in families with high socio-economic status but were noticeable for students from low socio-economic status families.

Secondary school students regularly used computers to obtain information from the Internet and to communicate with others. Almost as many students used computers for playing games as for word processing, and less than one-third did so to help them learn school material. Moreover, school computers provided broader access to students in lower socio-economic families who may not have had computers at home. However, frequency of school use lagged behind the use of computers at home.

CST Government initiatives

Policy makers in Canada expect that the introduction of ICT in schools will improve academic performance, promote equity among students and, ultimately, equip young people to use and apply technology and software in their jobs. Co-ordinated federal policies and programs provide access to ICT in every school and every community in Canada. For example, the SchoolNet program was responsible for connecting every school in Canada to the Internet and is now aiming to ensure that every classroom is connected. "Computers for Schools" channels recycled computers, donated from government and corporations, into schools in low-income areas. In addition, Community Access Programs provide public access to the Internet on evenings and weekends.

CST Nearly three-quarters of students use the Internet at least a few times each week

Activity	At least a few times each week	
	% of 15-year-olds	
Internet	71	
Electronic communication (e.g. e-mail or chat rooms)	60	
Word processing (e.g. MS Word or WordPerfect)	52	
Games	48	
Learning school material	32	
Programming	27	
Drawing, painting or graphics	27	
Spreadsheets (e.g. Lotus 1-2-3, Excel)	21	
Educational software	18	

Source: Organisation for Economic Co-operation and Development, Programme of International Student Assessment, 2000.



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