

Statistics Canada's Learning Resources: A Key Channel for Educators

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Statistics Canada is the federal agency responsible for collecting information on all aspects of the Canadian society and economy. We publish and make this information available in a variety of formats, including online on a website that boasts more than 1 million visits monthly. More than 40% of these visits are from educators and students. A special area of our website called *Learning Resources* is dedicated to providing the education community with theme driven data and articles, hundreds of curriculum based learning activities and expert advice on statistical skills.

Through this Learning Resources website and other grassroots initiatives, Statistics Canada is building a relationship with educators to encourage the application of data and data concepts in classrooms across the country.

Statistics Canada's role in enabling educators

At Statistics Canada, our business is data. Close to 6,000 employees work at perfecting the processes and outputs involved in surveys. Beyond that, Statistics Canada strives to make its data easily understandable to the Canadian people so that they can effectively apply them and make decisions based on them. We have a vested interest in creating an appetite for our data and in making them understandable and easily used.

Teaching the science of statistics, however, is not our role. Statistics courses are the business of teachers and professors hired by provincial education ministries and universities in Canada. As a central federal agency, Statistics Canada's role is to make information accessible in support of teaching and learning efforts – not only in statistics proper, but in all subjects. We provide resources that support provincial curricula and offer tools and expertise that empower educators.

Why we're involved in education

The numeracy of the Canadian public is important to Statistics Canada, not only to ensure the viability of our survey programs, but also from the broader perspective of developing statistically literate citizens who can participate in the global knowledge based economy.

Our goal is to help develop citizens who understand how to effectively use data. Citizens who recognize that timely and accurate survey response ensures more relevant data outputs—which in turn are needed to support the policies and programs that affect their lives. We want to encourage statistical literacy so that the media will report numbers in an accurate context. If citizens develop better data skills and engage in more critical thinking, they will be able to challenge the veracity of the numbers they read in the media. This can only help our programs, our citizens and our nation.

Availability of data should enrich public discourse but citizens need to understand how to effectively analyze and interpret it. www.innumeracy.com

The Canadian learning environment

Education in Canada is decentralized and each of the 13 provinces and territories is responsible for its own curricula and learning environments.

“Statistics and Probability” are a one of the five key strands of math in all provincial curricula, starting with data discovery in the earliest primary grades. Children as young as five years old do rudimentary statistics and make pictographs. It is important for us at Statistics Canada to work through elementary school teachers in order to reach young Canadians when they are awakening to an interest in numbers and are learning to apply data to their everyday activities.

Canadians’ involvement in math

Recent OECD data from the report *Education at a Glance* showed that Canadian students are among the best educated in the world. The results from PISA 2003 rank our 15 year old students third in the world in Math scores. Yet this high level of math achievement is not reflected in post-secondary enrolments. Canadians are enrolling in universities and colleges at a record rate, but enrolments in math and science have remained stagnant or decreased. Comparing the proportion of science degrees awarded in different countries is telling. In many parts of Europe and in eastern countries like Korea, science degrees (which include engineering, health, mathematics, computing, physical sciences, agriculture and life sciences) make up between 45 -50 % of all degrees awarded. In Canada, the proportion is a mere 30%.

That same OECD report shows that Canada’s unemployment rate among university graduates is higher than in any other advanced economy. This unemployment rate may increase as more students graduate from arts programs while more career opportunities open up in science and engineering. Our universities are not to blame since enrolment is based on student demand; science and math don’t appear to be “sexy” and students don't want to enrol in these disciplines.

The disillusion with math starts at a young age. Our challenge then, particularly in elementary and early high school, is to get students interested in math and to make it enjoyable. In most Canadian provinces, math is compulsory only until grade 10 when students are about 15 years old. Over 40% of these students then drop math from their agenda if they don’t plan to go on to a math or science program in university or college. Our Canadian education system needs to trigger in youngsters, from early on, the desire to be future engineers, scientists and statisticians. If more young students see the relevance of math activities and enjoy them, they may be enticed to further develop their interest in this discipline. These are our future labour pool from which the next generation of workers will be recruited.

Students who are actively engaged in the learning process are more receptive to further learning, according to a recent study by Statistics Canada entitled *‘Student achievement in mathematics- the roles of attitudes, perception and family background’*. Engagement builds students’ motivation and confidence in their ability to succeed and encourages their positive feelings towards math. This has a positive impact on course selection, educational pathways and later career choices.

New technology, new students, new ways to learn

Statistics is one strand of math that can be very practical and interesting to young students, particularly when it's taught using computers. Technology leverages the power of numbers and today's students love to use it.

Technology allows students to visualize and experience math in previously impossible ways.
Pre-service math teacher 2005

Students today are the first generation of 'Digital Natives' (Prensky 2005) who have spent their entire lives surrounded by technological tools and toys. Computer games, e-mail, text messaging, Internet and cell phones are an integral part of who they are. They like to receive information hyper fast and to multi-task; they function best when networked; they prefer graphics to text and games to serious work; they thrive on instant gratification and frequent rewards. Because of their interaction with technology, today's students think and process information differently than in the past.

But what about their teachers and professors? Like Prensky's 'Digital Immigrants', they were not born into the digital world but have adopted some aspects of technology in an attempt to adapt to their new environment. They were socialized differently and prefer to teach the same way they were taught: step-by-step, one thing at a time and above all seriously. The digital environment challenges them to learn a new language and a whole new approach to teaching the 'Digital Natives' generation.

The Canadian school environment and StatCan's Learning Resources

Are Canadian teachers currently using technology to teach math? The answer is most likely no, not at this point in time, particularly in elementary grades (K to 8) where generalist teachers must use a cross curricular approach. Elementary teachers often exhibit anxiety or indifference about teaching math because of their own past experiences. However, Mumford (2006) argues that new technology can change the learning environment and make mathematics fun, tangible and visible. Elementary school teachers play a big role in getting students interested in math.

Statistics Canada is trying to reach elementary school teachers and provide them with math support through a network of part-time peer champions who visit classes. Our Learning Resources website also hosts hundreds of cross curricular lesson plans that promote fundamental data concepts. However, the average age of Canada's 310,000 elementary and secondary teachers is 45. These mid-life teachers, not born into the digital world, are using technology as a secondary tool, just enough to get along but not truly integrating it into classroom work. In fact, Russell, Bebel, O'Dwyer and O'Connor (2003) found that teachers most often used technology for lesson preparation and work related e-mail. They more frequently directed students to use technology outside the school than they themselves used it to deliver instruction in the classroom.

Canadian schools are equipped with the necessary infrastructure to integrate information and communication technologies (ICTs) into the learning environment, according to the 2004 study *Connectivity and Learning in Canada's Schools*. In 2003/04, over 97% of all elementary and secondary schools were connected to the Internet, as were 93% of their school computers. However, only 46% of school principals felt that the majority of their teachers were adequately prepared to engage students effectively in the use of ICT for learning. Training opportunities in new technology for teachers were cited as an extensive challenge by 40% of schools. For this reason, Statistics Canada has implemented an annual training program to bring technology, information and data support to almost 20,000 pre-service teachers in faculties of education, before they start their careers.

Developing electronic resources and teacher support

Statistics Canada has been providing teacher support for data and technology since 1987. That's when a group of plugged-in high school students from Richmond Hill, Ontario, contacted our chief statistician to request access to electronic data. In response, we developed E-STAT, our first electronic database, in a format called Telichart. E-STAT licenses were sold to ministries and school boards as Statistics Canada attempted to recover some of the production costs. Students might have wanted electronic data, but we found that few teachers were technology literate and Telichart proved to be the wrong medium for schools.

In the early 1990's, E-STAT was made available on CD-ROM. Because schools in Canada had two computer platforms (MAC and IBM) and two official languages (English and French), Statistics Canada had to produce several versions of the CD-ROM. Point and click technology was not yet a way of life. Teachers had to use DOS function codes to access the massive amounts of data provided on the E-STAT CD-ROM. Training manuals often got separated from the CD-ROM. Teachers who were already strapped for time found it overwhelming to learn a new program when they would only be using it for one or two classes per term. Even so, Statistics Canada continued to sell to a few 'early adopter' schools these CD-ROMs and their accompanying training workshops.

Statistics Canada had to provide a considerable amount of technological user support for its E-STAT database. The costs incurred for this support, as well as for marketing and sales, were indeed a barrier to E-STAT's development and access. Though students were ready to use E-STAT, the teachers were not, or they couldn't find the time for the necessary training. And school boards had to find the funds to purchase the CD-ROMs and the training workshops. In this context, librarians became our biggest allies in adopting E-STAT, particularly teacher librarians. These information specialists in the schools looked after the purchase of texts and supplementary books and were dedicated to servicing student information needs. We started to build a relationship with librarians which has continued to this day.

Starting in 1994, schools in Canada began getting connected to the Internet, with funding from the federal government. The Internet became the opportunity for Statistics Canada to publish massive amounts of information, at an incremental cost, and reach out extensively, particularly to Canadian schools and school librarians. Statistics Canada launched its Learning Resources website in 1997 and transformed E-STAT from a CD-ROM to an Internet product in 1999. E-STAT then became free on the Internet to educational institutions through a password protected access.

E-STAT, a key component of Statistics Canada's Learning Resources

E-STAT is now highly used at the secondary and post secondary levels. Over 10,000 Canadian schools are registered to use E-STAT, including 60 post secondary institutions. This success was achieved through communication with curriculum developers and text book publishers, adoption of Internet point and click technology, and training of pre-service and in-service teachers.

E-STAT offers access to Statistics Canada's entire data warehouse for social and economic data as well as Census data (both recent and historical). Students and teachers can easily find subjects of interest on Canada's economy, land, people and government. They have quick access to articles, data and dynamic mapping and graphing. They can learn how to retrieve, sort and organize the information in a meaningful way and perform calculations or functions.

Significantly, E-STAT continues to apply a considerable amount of resource to user support, because of the password protected access and the limited use licensing requirements imposed by Statistics Canada's business directives. While E-STAT started as a way to give students access to electronic information, it has become a very powerful data presentation tool through the development of online graphing applications. These allow a dynamic and visual display of E-STAT information that is easily integrated into today's statistics courses. Students can now choose to graph their data in bar charts, stacked bar charts, scatter graphs, box and whisker plots and histograms or can map data using thematic maps.

"My Grade 9 math students use the large bank of current data in E-STAT to develop their skills in interpreting statistics, analysing ways of gathering information, and displaying data."
Secondary mathematics teacher, Prince Albert Sakatchewan

E-STAT offers teaching support through a bank of lesson plans and tutorials, as well as frequently asked questions and online help. Now accessible directly from home by students, E-STAT is being increasingly used for project assignments because of the proliferation of Internet connected computers in Canadian households and because of new curriculum directives.

New curricula opportunities in Canada

In response to the information age, curricula being developed across Canada support the application of real life data in the classroom in all subject areas. Students are required to develop problem solving techniques, higher order analytical and critical thinking skills, and the ability to manage massive amounts of information.

These initiatives in curriculum development have provided the opportunity for Statistics Canada data to be mentioned in over 50 new textbooks. Publishers have become aware of our resources through our promotional efforts and our ongoing grassroots program of workshops for teachers and resource librarians. As students become more sophisticated users of data, publishers are requesting the inclusion of micro data in their textbooks, particularly at the post secondary level.

Micro data use at the senior high school level

Micro data is also increasingly in demand at the senior high school level. A new Grade 12 data management course in Ontario, Canada's most populous province encourages students to use E-STAT and micro data from Statistics Canada. Students are required to do a major research data project which is worth 20% of their final mark. Teachers have asked us for help in directing students to useful data for these projects.

In response, we now provide public use micro data files online in several easy to access formats. As a federal agency, Statistics Canada must be non exclusive and non partisan about providing data or technical support for any particular software, even if the software is licensed by a provincial ministry of education. It's a challenge to service 13 provinces and territories that each license different analytical and spreadsheet software for use in their schools.

Students get instructions on how to use micro data, information on the methodology and a detailed list of attributes. They can group and manipulate the variables to suit their research requirements. To ensure the anonymity of the respondents, geographic identifiers have been restricted to the provinces/territories and large metropolitan areas.

Students using micro data for project work are getting their first taste of sophisticated applied statistics.

Statistics: Power from data—a primer on surveys

Particularly suited to high school students, *Statistics: Power from Data* is an interactive online learning tool hosted on our Learning Resources website. Covering the fundamentals of how to collect, compile, analyse and display data, this learning tool is based on a similar print product originally developed by the Australian Bureau of Statistics. Each of its 13 chapters is independent, complete with a glossary, learning activities, student worksheets and case studies.

It was not simple to create and is far from complete! Over two years in the making, many divisions at Statistics Canada, from subject matter to methodology, were involved in its writing. Contributors, subject specialists and editors had to be reminded that it was aimed at a high school and not a college-level market. *Statistics: Power from Data* is definitely a work in progress, as we continue to hear from teachers what they would like to see in new chapters.

Data discovery online—it's elementary!

At the elementary school level in Canada, students learn to work with data and draw conclusions from them. The statistics and probability strands in elementary math curricula identify some of the following outcomes:

- With assistance, kindergarten and Grade 1 students (approximately 6 years of age) collect, organize and analyze data based on first-hand information.
- By Grade 4, students assess and validate the data collection process.
- Starting in Grade 5, students develop and implement a plan for the collection, display and interpretation of data to answer a question.
- In Grade 8, students (approximately 13 years of age) should be able to evaluate and use measures of central tendency and variability.

Sometimes teachers need data to explore topics in science, social science or other subject areas. Students need to understand the terms and processes used in data collection, data compilation, data display and analysis. Statistics Canada put its expertise online to service this fundamental data discovery.

Census at School—a practical application of data concepts

For teachers who want to involve their young students in a web-based, practical application of data concepts, Census at School is the ideal class project! Students from grades 4 to 12 anonymously fill out the Census at School online questionnaire about their lives and activities—including their height, pets, and favourite school subject. Responses become part of a national and an international database. Started in 2000 in the United Kingdom, the project now includes Australia, Canada, New Zealand and South Africa.

Teachers can access the results of their own class' survey in the form of a spreadsheet to use in teaching. Students can compare their class data with Canadian results on the website or with random samples of responses from the international database. This project combines fun with real, applied data learning. Students love to discover and interpret data about themselves as part

of their classroom learning in math, social sciences or information technology. They also learn about the importance of the national census in providing essential information for planning education, health, transportation and many other services. This link to the national census was key to Statistics Canada's decision to join the project in 2003, particularly as we were preparing the first e-census in 2006. The student online survey would help promote Statistics Canada's upcoming online census form.

The Canadian Census at School project was the first Statistics Canada product that was developed in conjunction with an advisory group of teachers representing the different regions in Canada. From the outset, this group ensured the survey questions related to curriculum and created a series of learning activities on concepts such as graphing, measurement, central tendency, ratios, etc.

Census at School had to overcome a few hurdles. First, as a national statistical agency, we had to make it clear that this was a voluntary classroom project, not a survey falling under our data collection mandate or the Statistics Act. We had to make only summary data available and to explain to the public and media that these data were not representative of Canadian youth as a whole, because of the methodology that was used. In addition, as we were dealing with students under the age of 16, no identifiable information could be asked on the survey. Because of the interactive nature of Census at School, we needed a dedicated server for the active server page technology that was not congruent with the regular Statistics Canada server. Also, senior management was concerned that with the upcoming 2006 e-census in parallel, there could be confusion if parents thought that their children were completing the family census forms at school. Finally, some teachers were having difficulty with the online registration process.

All of these concerns were addressed, due diligence was followed and user support was provided. The outcomes are incredible! Two years after its start-up, Census at School is written into Canadian curriculum in several provinces and in new math text books at the grade 6 to 8 level. We have built a community of over 5,000 teacher users, to whom we send bi-monthly notes that keep them informed of new resources and ask for their feedback.

This is the wave of the future: an online practical application that lets kids have fun while they learn math and that encourages an ongoing relationship with educators.

What's on the horizon for Statistics Canada's Learning Resources?

As we move further along our journey to a more statistically literate society, Statistics Canada will continue to augment and adapt its Learning Resources website to best suit the education community. Plans include the launch of an audio podcast that gives students assistance with their choice of data for their project work, in an MP3 format that they can listen to anywhere. Other plans include a Teacher's Guide to Data Discovery, online data fairs to motivate, reward and showcase students work and new online learning components.

Through products like these on our Learning Resources website and our grassroots initiatives, we are making math and statistics more relevant and fun for this new generation of Digital Natives and, as much as possible, supporting the professional development of Canadian educators.

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