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Train to Gain: Statistics Canada's Strategy for Statistical Education

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As purveyors of official statistics in an era of Internet access and online data distribution, many national statistical organizations are taking on a new role in encouraging public statistical education. This new role requires the sharing at some level, of the skills and expertise that have traditionally been reserved for training their own employees. National statistical organizations are moving from the role of supplying data to a select group of policy-makers, to the role of encouraging statistical literacy at large. Members of the public who are now readily accessing detailed data from agency websites need to understand how to apply them for informed decision-making.

The immediacy of online access to data and publications obviously attracts additional users and also increases the spotlight on the producers of data. This opens a window of opportunity for the statistical organization to attain greater visibility in society, to become a trusted agent for the citizen in general and to be a key contributor to statistical literacy (Mittag, 2006).

The International Statistical Literacy Project, an activity of the International Statistical Institute, recently conducted an environmental scan of national statistical organizations and found that a number of them already participate in some form of statistical training for the public (including Canada, Finland, Australia, New Zealand, Portugal, Italy and South Africa). Their objectives have been to build capacity for future statisticians in order to guarantee the continuity of their data production and to increase the public consumption of the data they produce.

An additional goal, particularly in Canada, is to elicit a better understanding of the statistical system and to encourage the cooperation of respondents to the agency's many surveys and to the national census. Statistical agencies would not be in the business of producing and distributing data without the cooperation of survey respondents in the first place. If you educate people in the importance of statistics that summarize some of their concerns, they will be more willing to provide accurate and timely response to the surveys that collect those data. In particular, school-aged students are the nation's future

data users and survey respondents. By investing in their statistical education, national statistical organizations are planting the seed for their ongoing relevance.

This paper will present the Canadian model of engagement in statistical education, as practiced by Statistics Canada with three broad audiences: 1) the general public and media 2) elementary and secondary schools and 3) post-secondary institutions.

1. Statistics Canada's approach to training the public

For over ten years, Statistics Canada has had a strategy on public statistical literacy to ensure the long term viability of its survey programs through building the capacity of future employees and survey respondents.

The agency's website is its primary public face. Every major data release is published online, accompanied by analysis, charts and tables that explain the story in the numbers and by information on methodology to explain how they were collected. Each release places significant statistical findings in the context of long- and short-term trends and of the broader economic or social environment. Data releases explore relationships, causes and effects, showing readers the origins and significance of the latest information. Through Statistics Canada's website, the public is introduced to basic terms and concepts used in the world of data.

To provide a more in-depth understanding of data for anyone who is not an expert in statistical methods, Statistics Canada offers statistical training workshops which vary in length from 1 to 3 days, given in major cities across Canada. Workshop participants are generally:

- users of Statistics Canada data
- market researchers
- policy analysts and advisors
- social scientists and researchers
- research consultants and managers
- Journalists.

Instructors are professional staff with broad experience in survey methodology and analysis as well as training. The workshops suit many needs, from designing surveys to interpreting and using data in day-to-day operations. Titles of workshops include:

1. How to Use Census Data
2. Introduction to Basic Statistics
3. Making Sense of Survey Data
4. Processing and Interpreting Survey Data
5. Survey Sampling and Questionnaire Design
6. Surveys from Start to Finish
7. The Beyond 20/20 Browser
8. The Socio-cultural Variables of the 2006 Census: How to Find Your Way Around

9. The Geographical Structure of the 2006 Census, its Tools and Applications: How to Find Your Way Around
10. The Statistical Universes of the 2006 Census: How to Find Your Way Around
11. Turning Statistics Into Stories
12. Understanding Demographic Data
13. Understanding and Interpreting Data
14. Using the Input-Output Model to Estimate Economic Impact

Several electronic resources offer statistical support for the general public on the Statistics Canada website at www.statcan.ca, including:

- *Finding and Using Data*
- *Statistics: Power from Data!*
- *Teacher's Guide to Data Discovery*,
- Definitions, data sources and methods – website section

Beyond this, Statistics Canada has several 'outreach' programs aimed at increasing statistical literacy in special user communities by providing customized human support and expertise. These outreach programs target the media, aboriginal, ethnic and business communities and the education sector.

The media program is aimed at journalists, who construct the world around us as much with numbers today as with words —so it is important that they accurately portray official statistics. To that end, Statistics Canada's website hosts a 'Media Room' that offers internationally comparable indicators, spotlights on current issues of interest and special advisories to help put statistics in context. For major releases, Statistics Canada holds media lock-ups where journalists are briefed just shortly before the data are released. They can craft their stories, with a statistical expert available to answer questions, in the quick turn-around time required by their companies. In this way, journalists receive immediate and relevant statistical training and Statistics Canada supports an accurate translation of its numbers.

Statistics Canada also has an ongoing 'Education Outreach Program' that targets the elementary and secondary school sector.

2. Education Outreach Program for elementary and secondary schools

The Education Outreach program aims to develop statistical literacy and data management skills among Canada's youth by providing free services to the education community - both online resources and human support.

Rationale for statistical training in early grades

The Canadian school system recognizes that the skills to understand and use numbers must be part of the learning outcomes for students in virtually every grade, from kindergarten to the end of high school.

Statistics Canada has long acknowledged its need to support the development of such skills. Teaching the fundamentals of statistics, however, is not the role of the national statistical organization, it is what teachers and professors do. As the national statistical agency, Statistics Canada's role is to ensure that data and information are accessible—both physically and intellectually—to students and teachers in order to support the teaching not only of statistics proper but of all subjects. It is in the agency's interest to translate its considerable knowledge into learning resources that are relevant to the actual problems and projects within the school setting and to offer human support training to teachers as intermediaries to the students.

In fact, beginning statistical training at a young age is important to Statistics Canada so as to encourage students to choose careers in mathematics. Recent OECD data from the 2007 report *Education at a Glance* showed that Canadian students are among the best educated in the world. In addition, the math scores of Canada's 15-year-old students rank among the top four countries (Korea, Finland, Hong Kong-China and Chinese Taipei), according to the results of the 2006 Program for International Student Assessment (PISA). 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%. The 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 pursue 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 statistics and to make these disciplines enjoyable. In most Canadian provinces, math is compulsory only until the end of grade 10 when students are about 15 years old. Over 40% of Canadian students then drop math from their course load as they don't plan to pursue a postsecondary math or science program. So the education system needs to trigger in youngsters, from early on, the desire to be future engineers, scientists and statisticians.

In Canada, education is a provincial undertaking with different curricula and learning environments in each province. To approach this large but regional market, the Education Outreach Program was structured on two pillars: online resources that harness technology for mass distribution and online knowledge transfer, and a network of regional champions that leverages Statistics Canada's human resource and expertise. The primary target market for Education Outreach is students. Statistics Canada's website market research shows that the largest user group is students who are searching for information to help in their assignments. We reach the students through their teachers.

The first pillar – the Learning Resources website

The first pillar of Education Outreach is the Learning Resources website at www.statcan.ca/english/edu. It is an important portal, with three separate entrances designed specifically for students, teachers and the post-secondary community. It brings together a vast array of useful resources: teaching tools, data and information to support curriculum. Over 150 lesson plans in every school subject are listed by level and created in a standard format to help save time for teachers. Teachers can also sign up to receive an electronic bi-monthly bulletin direct to their desk top that keeps them plugged into everything that is new on the site.

Three key products on the Learning resources site provide statistical training online in a way that marries applied content and support:

E-STAT <http://e-stat.statcan.ca> is an interactive data visualization tool containing Statistics Canada's entire data warehouse of social and economic data (CANSIM) as well as Census data (up-to-date and historical). On a topic like immigration, for example, students can map recent data from the 2006 Census at different levels of geography, right down to their own neighborhood. Or they can use time series data covering several decades to create a graph that illustrates historical trends. Over 10,000 of Canada's 16,500 schools are registered to use E-STAT.

Statistics: Power from Data! www.statcan.ca/english/edu/power/toc/contents.htm is an online manual on surveys from start to finish. Each of its 13 modules is an independent tutorial, on aspects of statistics from collection and measures of central tendency, to data interpretation and analysis. While this e-learning package was designed to address demand from high school students, Statistics Canada's employees are finding it a helpful refresher.

Census at School - Canada www.censusatschool.ca is the Canadian component of an international project in statistical enquiry. Participating students complete an online survey and then analyze their own class results and compare them to data in Canada and other countries. Because of its learning by doing approach, grade school students become like 'little statisticians', completing a survey through the whole cycle from data collection to analysis. Because they are responsible for their own survey, they learn the need for accuracy when collecting data. About 35,000 students participate each year, mostly at the intermediate grade levels (ages 10 to 13)

The second pillar - human support in the regions

The most visionary part of Statistics Canada's Education Outreach Program is its second pillar, the human support component. Five dedicated **regional education representatives** provide training at teacher conferences and professional development days, as well as individualized support to educators. They keep their finger on the education pulse and understand the different curricula and environments in their assigned provinces and territories. They work with regional educational organizations such as

teachers' federations, ministries of education, curriculum specialists and IT consultants. The regional education representatives leverage resources and create relationships with educators, who in turn pass on information to their peers on behalf of Statistics Canada.

Each regional representative visits many of the 60 faculties of education in Canada each year to introduce teachers-in-training to Statistics Canada's online resources. Some faculties require their teachers-in-training to do a five week internship with an education-related business or government organization, in addition to their in-class practicum. Many of these student teachers have asked to do their internship with Statistics Canada, to get better familiarized with its resources. For the past 4 years, the Toronto and Ottawa area offices have received about 20 teacher interns per year for five-week placements. These teacher interns provided workshops on Statistics Canada resources to local classrooms. The interns were exposed to new curriculum, technology and working environments in different schools, as well as to student reactions to using statistics. They also took advantage of learning opportunities and data management expertise available at Statistics Canada. As they continue in their future careers, these teachers will act as ambassadors for Statistics Canada and advocates for statistical learning in schools.

An important benefit of the regional education representative's work is to allow Statistics Canada to engage in interesting partnership initiatives. Some examples include:

- Professional development of teachers through new media: Online courses were developed in conjunction with Ministries of Education, as well as videos showing how Statistics Canada information is being used by students.
- Curriculum development initiatives and inclusion in new textbooks: Over 75 new textbooks include Statistics Canada data or direct students to the agency's website. With representation on the working group that created the new Grade 12 course on Data Management in Ontario (Canada's most populous province), Statistics Canada was able to have its resources written into this curriculum. The course requires students to do a major data analysis project and recommends Statistics Canada as a data source.

Statistics Canada's human support and training services are gaining visibility and there is increasing demand placed on the regional education representatives. In fact, for the past few years, several **part-time statistical resource teachers** have been hired with additional funds from senior managers. When invited to visit classrooms, these Statistics Canada Resource Teachers bring census information and applied survey and technology skills to school children, at a stage in their lives when they are interested in numbers. At the same time, these Resource Teachers are helping develop knowledge among in-class teachers and dispel their fear of data. Statistics become visible and tangible, as the resource teacher explains the importance of data in everyday life. As certified teachers, they have the pedagogical expertise needed to directly engage students in learning-by-doing exercises, increasing the likelihood that these students will develop a lifelong interest in data.

This network of Statistics Canada Resource Teachers currently consists of 10 contracted teachers (mostly newly retired) who are paid the equivalent of a substitute day's teaching wages (\$300) for each full-day workshop. They are trained and managed by Statistics Canada's regional education representatives. Working through local school boards, Statistics Canada's Resource Teachers gave workshops in classrooms to almost 25,000 students from 2006 to 2008. There is an increasing demand for their statistical support services and Statistics Canada is investigating potential partnerships that might share in supporting this initiative.

Two other Education Outreach initiatives leverage the expertise of about 150 agency employees located at national headquarters. Through the Classroom Outreach Volunteer and Expert Speakers initiatives, employees can get involved in supporting teachers and students on a weekly basis.

The **Classroom Outreach Volunteer program**, for elementary schools, encourages employees to work up to two paid hours per week in local classrooms, assisting teachers and helping kids. They are matched up with a school program or activity according to their skills, interests and home location. Some assist with a variety of subjects such as basic numeracy, reading skills, informatics and web research, others mentor students on a one-to-one basis in math. In 2007-2008 Statistics Canada contributed over 2,500 hours of support to local schools.

This program provides a unique learning opportunity for participating employees. They learn first-hand about the education system and develop skills in presentation, communication, training, time management and critical thinking. They are also practicing civic participation and demonstrating pride in Statistics Canada as a learning organization.

The **Expert Speakers** program, aimed at intermediate and high schools, allows subject matter specialists to provide real-life expertise, answering questions, doing presentations and helping with statistical projects. Thousands of students hear first hand about such topics as health, international trade, environment, how to create a survey or what a statistician does. Some presentations are being digitized so that they can benefit students across Canada. A model of this is a video of Dr. Ivan Fellegi, Canada's former Chief Statistician, discussing emerging social issues, which was released in 2002 as part of a Teacher's Kit in the Learning Resources website.

Reaching out to High Schools

As Statistics Canada resources become better-known among high school students, they may start to think about the possibility of future careers as statisticians or analysts with the agency. For example, in Ontario, Canada's most populous province, students of the Grade 12 mathematics course on data management have been introduced to Statistics Canada, since 2003, as a prime source of relevant data for their research projects. This data management course teaches students how to apply sampling, modeling and statistical analysis techniques to everyday topics, with 20% of their final mark based on an analytical data project. Statistics Canada's educational representatives work with teachers

and students to demonstrate how to manipulate and make sense of various datasets. As a result of this direct involvement with students and in order to promote their exemplary projects, Statistics Canada sponsors annual student **Data Analysis Fairs** at Statistics Canada. These give participating students a chance to meet and discuss their work with Statistics Canada professionals.

3. Reaching out at the Post-secondary Level

Each year Statistics Canada provides students with work experience through coop assignments and through summer employment opportunities. Students with substantial work experience at the Agency can transition to full-time employment via the federal government's Student Bridging Program, and join one of the recruitment programs after graduation.

At the post-secondary level, professors of statistics are well trained in data concepts and their course materials are often proprietary in nature. While professors may point their students to Statistics Canada's online resources, the more detailed microdata that is not available to the general public is most suitable to university and college-level project work. To service this market, the Data Liberation Initiative was developed.

The Data liberation Initiative for under-graduate students

Besides its official website, Statistics Canada has numerous dissemination channels to make detailed data and statistics available to specialized users. The Data Liberation Initiative (DLI), a partnership between Statistics Canada and Canadian post-secondary institutions, promotes and facilitates access to Canadian data for educational and academic research purposes. There are 74 universities and colleges that are members of the DLI and more and more colleges are joining. Participating member institutions pay a small annual fee for access through their libraries to a large number of public use microdata files. Their librarians also receive direct support, through a LISTSERV, for any questions on the DLI collection. The microdata are transferred by FTP to the institution's library site, where a designated librarian is responsible for their upkeep and promotion and for helping students access them.

An Education Committee, formed from the DLI membership, is responsible for developing a data services curriculum for library staff who support the DLI in each institution. The committee also supports national and regional training activities. It monitors all aspects of the DLI Training Program including: frequency of training workshops, budget allocations, curriculum, trainers, special training requirements, etc. The Education Committee is also responsible for promoting statistical and data literacy to the wider community connected to the DLI, namely library directors, data users, Statistics Canada survey managers and other groups. This means promoting not only the DLI program itself, but also providing a deeper understanding of its data holdings and of statistical and quantitative reasoning.

The annual training provided to the university and college library community is regional in nature and includes experts from Statistics Canada. The complete training program is based on a ‘Train the trainers’ model which has proven to be very successful.

Research Data Centres (RDCs) for post-graduate students

The Social Science and Humanities Research Council (SSHRC) and Statistics Canada established a joint task force of leading Canadian researchers and statisticians in 1998 to address the three fundamental barriers that either hampered or prevented access to the rich sources of social science data available in Canada.

1. Because of too few trained researchers in quantitative social science in Canada, there was a need to train new researchers.
2. Access to detailed microdata was required to examine emerging social and economic issues that were critical to the development of Canadian society. Such data were only accessible in Statistics Canada offices, primarily in Ottawa.
3. Effective linkages needed to be established between researchers and those involved in public policy development. (Statistics Canada, 1998)

The joint task force made the following recommendations, which form the basis of the Canadian Initiative on Social Statistics:

1. To launch a diversity of granting programs in order to increase the numbers of researchers engaged in quantitative research and also to promote research and training that make full use of social statistics. These programs will concentrate on training the younger generation to ensure a “relève” in the field and on bringing together researchers from different disciplines and institutions to work together.
2. To create a network of Research Data Centres throughout the country, where it will be possible for researchers to access Statistics Canada data and still maintain the confidentiality rules required under the Statistics Act.
3. To develop a social statistics communications strategy to maximize research and public policy interface and strengthen linkages between policy makers and the community of researchers¹.

In implementing these recommendations, Statistics Canada and its partners² established a network of Research Data Centres that provide the opportunity to train a new generation of Canadian social scientists and to improve the skills of the existing ones. Leading universities across Canada have developed several formal graduate courses in advanced research methods³, which include access to the complex survey data available in the

¹ Final Report of the Joint Working Group of the Social Sciences and Humanities Research Council and Statistics Canada on the Advancement of Research Using Social Statistics, December 1998

² The partners include 43 universities across Canada, SSHRC and CIHR.

³ Courses are currently offered at the following universities: McMaster University, McGill University, the Université de Montréal (in partnership with the Université du Québec à Montréal and the Institute national

RDCs. Graduate students in either Masters or PhD programs in all the quantitative social sciences are increasingly incorporating RDC projects in support of their thesis or dissertation research. In fact, approximately one third of the more than 1,800 researchers with projects in the RDCs are graduate students. In addition, formal symposia and workshops on advanced research methods are offered by Statistics Canada and many of the partner institutions in the RDC network.

Students and academic researchers are able to work with complex Canadian social data and advanced methods in the course of conducting their research. This contributes substantially to developing the human capital required for a strong cadre of Canadian quantitative social scientists. The RDC network has resulted in the emergence of a cadre of highly skilled social scientists who are knowledgeable in advanced methods of analysis and innovative use of complex data. The younger members of this cohort are finding employment as academics, and also as researchers and analysts in both the public and private sectors. In addition, the RDC network is helpful in recruiting highly qualified academics and students to the institutions that are hosting the centres (a form of “brain gain”).

Some of these RDC researchers are being recruited as well by Statistics Canada. For example, from 2001 to 2008, there were 47 graduates of the RDC program hired at the national statistical agency; 28 employed as analysts or economists, most entering our workforce at the middle management level (ES 04 and ES 05). These ' RDC recruited analysts' accounted for 10% of the overall total number of new hires at these levels.

Students with substantial work experience at the Agency can transition to full-time employment via the federal government’s Student Bridging Program, and join one of the recruitment programs after graduation.

Conclusion:

Should national statistical organizations be involved in statistical training?

There is no question that national statistical organizations should be involved at some level in statistical literacy initiatives and training. Some would even argue it is an obligation to our public. If this is valid, then how much resource and what type of resources should be applied to this? Should official statistical agencies be hiring special pedagogically trained resources to assist in this objective? These are questions for discussion but most certainly intrinsic to future human resources strategies. Currently at Statistics Canada, fewer than 1% of its staff is involved in this type of direct statistical training activity with the public.

Statistics Canada’s Education Outreach Program, which won the 2003 Institute of Public Administration of Canada (IPAC) gold award for knowledge management and innovation, has proven to be a key program for reaching students early in their schooling.

de la recherche scientifique), Laurentian University, University of Waterloo, York University, the University of Alberta and the University of Calgary.

In terms of benefit to statistical agencies, it is difficult to measure the short-term paybacks of undertaking statistical literacy training with the public. The real return on investment will be in the long term. Some of the activities for example that we have implemented with the education community are global in nature and benefit Canadians as a whole. David Bond, a journalist with the Vancouver Sun put it like this in his 1999 article:

“We will not know the results of this work for a generation or two and even then it will be difficult to establish direct causality between early training and better response rates among adults. But the effort is a worthwhile one, if for no other reason than it will make the statistical system less remote, more friendly and more interesting for future Canadians. This type of long-term investment and planning is rare in government. But it’s just another example of why Statistics Canada has been rated the world’s best by the Economist magazine three years in a row.”

It is our conviction at Statistics Canada that young people’s formative school years are the best time to provide guidance and tools for their future success. It is never too early to start acclimatizing young students to think about post-secondary courses that include math and statistics. In fact, in Canada, it is important to provide students with engaging math and statistics activities early in their learning process so that they will enjoy math and not decide to drop it later in high school and limit their career choices.

References

Educating the Public-The Role of E-Learning and Visual Communication of Official Data; Hans-Joachim Mittag, Paper for Conference of European Statisticians, Paris, June 2006

Education at a Glance 2007 - OECD Report. www.oecd.org and www.cmec.ca

Programme for International Student Assessment (PISA) www.pisa.oecd.org

International Statistical Literacy Project (ISLP) of the International Statistical Institute
<http://www.stat.auckland.ac.nz/~iase/islp>

Statistics Canada's Learning Resources <http://www.statcan.ca/english/edu>

Statistics Canada would be pleased to share information on our strategy for statistical education. For information, please contact Mary.Townsend@statcan.ca.