STATISTICS IN THE CLASSROOM
LEARNING TO UNDERSTAND SOCIETAL ISSUES

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The role of a National Statistical Office is to produce the official statistics for its country and to help citizens understand the issues underlying the society and economy. Reams of statistical tables cannot do the job alone: to become 'information', statistics must be analyzed and portrayed effectively for the target audience, i.e. citizens of all ages. Students (high school and university) can most easily be reached through the Internet. Not only has Internet access the highest rate among the young, but a website is also very cost-effective to make material available in formats and in quantities which would not have been possible in the paper age. The availability of such information, however, must be promoted to students and teachers and efforts must be made to show them the relevance of the material for the classroom. This paper will describe the activities, their results, and lessons learned from the statistical learning resource and education outreach programs in Statistics Canada.

1. Statistical information – more than numbers

The fundamental role of a National Statistical Office (NSO) is to provide relevant statistical information on the economic and social conditions of a country and its citizens. This activity is important to an open, democratic society, whether for developing government policy, making business decisions, or helping individual citizens make their daily economic choices.

A NSO collects information on most aspects of the society and economy of its respective country. But the job cannot stop there. It must also make certain that the information is published and made available to the public, in a variety of formats, for use by those who rely on it to provide services, set policy and make decisions—or who are simply interested in gaining a better grasp of their country or compare it to other countries.

Thus, a role of the NSO is also to help citizens understand issues. Reams of statistical tables cannot do the job: to become 'information', statistics must be analyzed and portrayed effectively. This information must be made easy to digest and use by a wide range of citizens.

In our knowledge-based society and economy, the average person is confronted with figures on a daily basis and is asked to form judgments based on the story they tell. The educational system has recognized for some time that the skills to understand and use numbers must be part of the curricula for children in virtually every grade. In this context, statistical literacy has been defined as the ability to:

- understand and interpret statistical data;

- critically evaluate statistical information and data-related arguments;
- use the information in context of daily life; and
- discuss or communicate one's reactions.

Data have become ubiquitous. The challenge is to be able to take these ever-present data and to translate them into real life, decision-making applications.

This need has been recognized by the educational system for some time. For example:

> "all graduates should be 'good consumers of quantitative information'…they ought to be able to understand statistics…[be able to] ...read a report that contains statistical analysis. They ought to be familiar with the logic that goes along with quantitative analysis even though they may never be mathematicians or statisticians." (John Waterhouse, Academic Vice President, Simon Fraser University, in The Vancouver Sun, November 25, 2002).

Statistics Canada has long recognized that it should be active in supporting the development of such skills. Initially, such support was concentrated mostly at the university level; but for more than 15 years the support has been broadened to include the high school level as well. More recently, additional impetus was provided by the new curricula adopted by all Provinces in Canada (education is a Provincial jurisdiction in Canada) which define statistics and probability as one of the four major teaching strands in primary and secondary education.

> "The need for lifelong learning is shifting the emphasis from a dependence on the 'what' of learning to the 'how' and 'why' of learning. Students need to 'learn how to learn' and should see the relevance of their learning to themselves and society." (Council of Ministers of Education, Canada)

As an example, Ontario's new Grade 12 Mathematics of data management course calls for students to apply a whole range of critical thinking skills related to statistics: researching a topic; designing a survey; collecting, compiling and analyzing data; and presenting the resulting information.

Statistics Canada's support activities in this area have been recognized and appreciated as the following quote shows:

> "It is important that our young people know about the wide-ranging kinds of information available to them (and us) through the work of Statistics Canada. It is equally important that they learn how to find this information, become comfortable and competent using it, make sense of it, and understand the issues raised by it. Of course, there are also many other ancillary benefits to working with this kind of information (e.g., in terms of developing numerical literacy, demographic understanding, extrapolation and problem solving skills). The spin-off potentials are virtually limitless." (The Executive Director of the British Columbia Trustees Association)

There is another strategic reason for Statistics Canada to be actively involved with students. Students are future users of our statistics and respondents to the many surveys we undertake which rely on the willing co-operation of citizens. Investing in their interest in statistics is planting the seed of our ongoing relevance and viability as the national statistical organization.

2. Making statistical data and information accessible

Teaching the fundamentals of statistics cannot be the role of a NSO. That's what teachers do. A NSO can however provide data and information in physically and intellectually accessible form to students and teachers to support the teaching and learning efforts not only in statistics proper but in all subjects.

Statistics Canada started to make electronic data files (in addition to paper publications, of course) available to universities for research and education in the 70's and 80's. At that time, there was a charge for each individual file. These costs were significantly reduced by forming a consortium in 1996 called the Data Liberation Initiative (DLI). DLI is a consortium of all Canadian universities with Statistics Canada. It ensures that all files from Statistics Canada (restricted to non-confidential files) are accessible to teachers and students of the participating universities at no individual costs to them. This project has met with enthusiastic response. (see Watkins and Boyko).

In the early 90's, Statistics Canada took another step by making available a detailed data base on a CD-ROM to high schools. In addition to detailed time series data and small area (neighbourhood) statistics from the Census, the disc linked graphing and mapping software to the data in an easy to use format. The disc became an instant hit with those professors and teachers who saw the potential of using it in the classroom. However, many high school teachers found it challenging to apply the tool on its own

It turned out that just having access to data was not enough. Statistical information is not an easily accessible subject. Statistical numbers have to be put into context such that the context drives the interpretation of the statistics. Teachers started to request lesson plans and teaching aids which they could apply immediately in the classroom. Over the years, a large number of such lesson plans have been developed, mostly by teachers themselves and then shared with Statistics Canada. The problem, however, was the prohibitive costs of distributing these lesson plans in the pre-Internet era. (For years, a limited number of teachers' kits had been made available on paper upon request.)

Enter the Internet. Statistics Canada (like most other NSOs) established its website in 1995 and since then has constantly added more contents. Statistics Canada sees its website as the virtual library for all information from Statistics Canada for all citizens and user groups. We know from our regular web surveys that 20% to 40% of visitors (depending on the time of the year) to our site are students. The Internet allows us to make information available in unprecedented volume and still target it to specific client groups.

In 1998, we introduced a special portal for students and teachers in high school, college and university on our website. We call this portal: Learning Resources. It points to general information on our site of interests to students and teachers and also provides information specifically created for them.

The Internet has allowed us to make searchable information in unprecedented volume and variety available free to teachers and students.

3. Learning Resources: Statistics Canada's web portal for students and teachers

The Learning Resources part of our website is an interactive portal offering Canadian information relevant to the classroom. Students and teachers connect to the site through separate entry pages:

- Students: linking high school students to Canadian content for help with their assignments;
- Teachers: offering numerous teaching resources for primary and secondary teachers;
- Postsecondary: supplying links to data and tools for advanced teaching and in-depth research at the college and university level.

Each sub portal is structured into a list of resources for the target audience. There is some overlap between the lists, but there are also significant differences. Many of the items on the lists point to information holdings found in other areas of Statistics Canada's website, but with explanations which make them more relevant to either students or teachers. In addition, there are information items which are designed to appeal to the specific audience.

Items of general interest:

- Canada at a Glance: presents a snapshot (PDF file of 24 pages) of statistics on demography, education, health, justice, housing, income, the labour market, economics, travel, finance and foreign trade, as well as international comparisons;
- Canadian Statistics: data on many aspects of Canada's economy, land, people and government in easy-to-read tables (450), most of which are updated daily;
- The Daily: Statistics Canada's official release bulletin, delivers the first and official release of statistical data and publications. Every working day an issue of *The Daily* is released at 8:30 a.m.;
- Census: information from and about the most recent census;
- Historical statistics of Canada: including many tables from the censuses 1665 to 1871;
- Community Profiles: a snapshot with display of data and maps for all rural and urban (6,000) Canadian communities;
- Thematic maps and population pyramids: animated display of changes in population distribution;
- Statistics - Power from Data: an electronic manual covering all aspects related to the use of statistics. It is aimed primarily at secondary school students of mathematics and information studies, and will also appeal to other teachers and students. (The text has been adapted from a publication produced by the Australian Bureau of Statistics.);
- Glossary: definitions of statistical terms;
- E-STAT data base: a dynamic interactive learning tool that offers an enormous warehouse of reliable and timely statistics about Canada and its ever-changing population. E-STAT contains socio-economic time series and detailed local data from the most recent as well as historical censuses;
- Links to popular, analytical articles on social and economic topics extracted from the regular Statistics Canada's publications, in particular the popular Canada Social Trends magazine.

Items designed specifically for students:

- Canada Quiz: questions to explore the website and learn about Canada and Canadians;

- Ask an expert: students can submit a question to Statistics Canada;

- Kid's zone: online activities for the very young include a colouring book, word searches, and link to the quiz.

Items designed specifically for teachers:

- Resources for social studies courses: linking to data and lessons plans organized by province, grade, and major topic according to the specific curriculum of each Canadian Province/Territory for grade 7 and up;

- Learning Resources bulletins: bimonthly e-mail newsletter featuring the latest resources available to teachers through our website;

- Teacher's kits: accompanying publications and introducing specific data sets. They offer activities for different grade levels, including student worksheets, to assist in understanding the Canadian population characteristics. (Teacher's kits are the electronic versions of the traditional paper based teacher's kits);

- Lesson plans: containing case studies and exercises that help students consolidate their understanding of the material. There are about 200 lesson plans on our website. Most of them have been created by teachers for teachers, and they provide numerous classroom activities that demonstrate how to use the statistical information which is freely available on our website. These lessons are listed by level of schooling or by course subject and cover a variety of topics such as:

    - the first census in Canada, inspired by the actual results collected in 1665;
    - characteristics of the Canadian population;
    - health and lifestyles of 13 year-olds around the world, where students research and compare habits such as smoking, exercise, alcohol consumption and lifestyles from various countries around the world as a stimulus to adopt personal goals that reflect healthy lifestyles;
    - analysis of the babysitting job-market based on local community data;
    - rural versus urban communities using the statistical profiles (population, education, income, work, families, dwellings, births and deaths) of 6,000 communities in Canada including cities, towns, villages and aboriginal communities;
    - analysis of the colonial ship building industry in Nova Scotia in 1861;
    - Chinese immigrants in British Columbia in 1870;
    - the foods we eat.

- Teacher support: a discussion forum where teachers can get in touch with each other to exchange experiences in using our resources. They can also find information on funding opportunities for web page projects that use Statistics Canada data. In addition, they can contact a Statistics Canada education representative in every region across Canada who can provide free workshops and professional development. Furthermore, many other

government organizations offer resources for use in classroom, and our site links to them, such as the Canadian Communities Atlas Project operated by the Ministry of Natural Resources of Canada.

The above resources are easily (and without cost to the user) accessible on our Internet site. But we learned very quickly that just having information easily accessible is not sufficient to get into the classroom.

4. Outreach program

Students and teachers have to be made aware of the usefulness of the statistical information for actual problems and projects in the school setting, and thus we introduced our educational outreach program. The human resources assigned to this program are rather modest, so by necessity we prioritize programs which have a multiplier effect. Currently our outreach program has the following aspects:

- University liaison program: We have discovered that the best way to reach teachers is when they are being educated at university. At several institutions we have established contacts with professors (for example see Lundy) who have embraced the idea of training students to use statistical information as a teaching aid in the classroom setting. The students will carry the method of using factual information into their future classrooms; the professors inform their colleagues about the success of using statistical information in training students. Some have published papers about this. (see Canadian Statistics in the Classroom). As well, Statistics Canada has supported use of our data in other faculties, such as geography, economics and statistics. Statisticians are now developing case studies which are offered as part of the annual conference of the Statistical Society of Canada.
- Regional education representatives: These are five staff members of Statistics Canada located in offices across Canada. Their task is to reach out to teachers in their communities, wherever and however they can be reached, and make them aware of our Internet resources and how the information can be used in actual classroom settings. There is phenomenal demand for their services of presenting at teacher workshops. As well, our regional representatives ensure that Statistics Canada is involved in the Provincial associations and organizations that support the education community;
- Teacher champions: We are discovering teaching champions who will assist us in increasing our visibility at conferences, pre-service faculties of education, and at professional development events;
- Classroom outreach program: Social Scientists, mathematicians, clerks, analysts and computer specialists working in Statistics Canada share their expertise for up to two paid hours per week in local classrooms. Their activities relate to basic literacy, numeracy, technology and web design and the development of other skills and knowledge. While their activities are on a basic general education level, their presence in schools allows them to promote the information on our website to students and teachers. The classroom outreach program leverages Statistics Canada's expertise to benefit the community in which we work;
- Competitions for best use of statistics in class projects: These are competitions and awards organized in co-operation with other partners. For example:

  - A "web page contest" challenges students to create a web page which displays data visually and illustrates conclusions that can be drawn from the data;
  - The Environment and Resources Study Group of the Canadian Association of Geographers (CAG) and Statistics Canada have created an award to be given to an undergraduate student in geography and/or environmental studies/science for the best paper examining impacts of human activity on Canada's environment;

- Asking an expert: Our general inquiry service available from our website through email is being promoted to students and teachers as "asking an expert" in Statistics Canada. Simple questions (most of them involve where to find the right information, or not being clear on the labelling, or difficulties with data base navigation, or with mapping features) are handled directly by the Statistics Canada general inquiry service staff. More complex questions are indeed forwarded indeed to the appropriate "expert" in Statistics Canada. This feature is being used on a daily basis;
- Partnerships: We partner with faculties of education and other educational organizations, for example, the Critical Thinking Cooperative of British Columbia school districts;
- Newsletters: We have created a colourful newspaper style hard copy broadsheet, Learning with Canadian Information, (which is distributed both on paper and in electronic form) that is designed to provide testimonials and applications of Statistics Canada information to engage teachers and excite them into visiting our web site. As well, we work with over 75 national and Provincial associations who provide information on behalf of Statistics Canada to their members through their newsletters or web sites.

5. Results

Getting visibility in the school environment is a challenge. There is a lot of competition for the time and attention of teachers. But we have made strong inroads as the result of

- the new teaching approach in schools (from rote learning to learning by discovery);
- our efforts in making our website easily understood and relevant; and
- reaching out to teachers in person.

One of the key areas of potential long lasting effect has been the inclusion of Statistics Canada representatives on working groups to create curriculum in provinces (new grade 12 Data Management Course, for example) and subsequent to that the inclusion of Statistics Canada data in textbooks that support the new curricula. Examples of such textbooks are:

- McGraw-Hill Ryerson: "Statistics, A First Course" (University/College) - first textbook involved in the E-STAT initiative where students who purchase the textbook are directed to the book's website and then link to E-STAT on the Statistics Canada website;
- McGraw-Hill Ryerson: "Mathematics of Data Management" (Grade 12) - secondary school level textbook which has E-STAT exercises in the book;

- Nelson Thomson Learning: "Fundamentals of Social Research" (University/College) – a subset of micro data from General Social Survey on Technology Use is accessible on a Nelson Thomson password protected website for students who purchase the textbook.

Most encouraging are the samples of actual activities in the classrooms of which we have become aware. The latest issue of the School Libraries in Canada magazine (The Journal of the Canadian School Library association) is exclusively devoted to the use of Statistics Canada information in the classroom. Several articles document case studies in which our information was used. For example:

- Mathematics of data management grade 12: Define an issue, formulate questions, locate, extract and analyze data found on Statistics Canada's website, and make supported inferences and predictions from statistical measures. (Students are often interested in the topic of crime which provides ample opportunity to debunk popular myths caused by sensational reports in the media);

- Social Issues in mathematics grade 9: Activities to review linear relationships using topics such as smoking, equality at the workplace, life expectancy;
- Classroom projects in grade 10 Mathematics:
    - Assignment 1: Relationship between women with full-time jobs and the incidence of childbirth in Canada, 1976 - 1999. Hypothesis was that the increase of women working full time would result in a decrease of birth rates.
    - Assignment 2: Relationship between annual beer production, consumption per capita and the percent of males age 20 -24. Is there a link between average beer consumption and percentage of males age 20-24?

The teacher's observations were that students, who normally performed poorly in a traditional classroom, did better in this project oriented environment. These students understood concepts and methods faster, and sometimes better than the best students. Students were very motivated.

- Debating with talented and gifted students on topics such as "social policy on juvenile delinquents" using authoritative information from Statistics Canada as evidence in comparison to the United States;
- Data processing grade 12: assignment is to create a website for a fictional business using information from Statistics Canada such as unemployment rate, household income, educational levels, male/female populations, age cohorts, population projections;
- Science grade 10: Climate change and human activity using the Statistics Canada publication Human Activity and the Environment 2000 as a starting point;
- Family studies grade 12: Family life cycle - reviewing changes to committed relationships, parenting, child development, and growths into middle and old age using demographic data from Statistics Canada.

6. Issues

Statistics Canada is very pleased with the progress made so far in introducing Canadian statistics into the classroom. However, there are some impediments, as well as new opportunities, which we need to be aware of and adjust our approach accordingly.

Internet access in schools: Canada is very fortunate in having one of the highest access rates to Internet in business, home, and school. Thanks to various government programs, all schools have computers and Internet access. Canadian students rank among the highest in the world in terms of access to computers both at home and at school. Data from the Programme for International Student Assessment (PISA) showed that a typical 15-year-old Canadian student in 2000 attended a school at which there was one computer for every six students. This is well above the average of one computer for every 13 students within member nations of the Organization for Economic Co-operation and Development (OECD) and on par with the United States, Australia and New Zealand.

Canada is close to achieving universal access to high technology at home. Nearly 9 out of every 10 young Canadians (15 years old and at school) had a computer at home, and 7 out of 10 had access to the Internet at home. (see Statistics Canada, The Daily)

However, convenient access for all students and teachers to the Internet at school is not yet the norm. Often the only few computers available in schools are placed in the library or in the computer lab. On the other hand, the majority of students have Internet access at home. Thus, the information on our Internet site must be such that it can be used in a non-classroom environment, particularly for individual project work.

Workload and interest of teachers: To reach students, we need the interest and cooperation of teachers as the facilitators. But teachers have to cope with increased workloads, reduced resources and pressure to implement new curricula. They have only limited time to acquire new knowledge and skills for items that are not directly related to the prescribed curricula. In addition, because of the general age structure of the teaching body in Canada, teachers may not be familiar or comfortable with computers and Internet to the degree required to access information on the Internet and to formulate project assignments for their classes. The feedback, we received, indicated a large variation in ability and interest, limited time to find resources and adapt them to the classroom, a feeling that they already have a "filing cabinet full of lessons", and a certain level of tech- and stats-phobia. The challenge for us is to package the statistical learning information into simple and ready to use lesson plans so that teachers perceive a good pay-off for their time invested. Another avenue is to work even more with textbook publishers to incorporate information from our website into their textbooks both paper and the emerging e-books.

Online learning courses: Most post secondary institutions offer the option of completing digital courses in order to service a growing number of students who for many reasons choose to acquire a degree or course upgrades learning from home. For example, Ontario in-service teachers (those already working in classrooms) are being asked to re-certify. Over the next few years, teachers must complete ministry approved courses. With little time to do so while working, teachers are looking for online courses that they can complete from home in the evening or on weekends. Statistics Canada has created two online courses on how to use our data in conjunction with the Toronto District School Board and the Ontario Ministry of Education. By completing these courses, teachers acquire credits to their re-certification. At the secondary school level, Provinces are putting much of their curriculum online and supporting that with links to endorsed Internet materials, encyclopaedias and e-books.

Metatagging: Statistics Canada is ensuring that our digital resources are included in online learning courses by metatagging our information according to standards adopted by the Canadian education community and in a way that makes our information easy to search and retrieve. Recently, we have become involved with a few projects which have the potential to distribute Statistics Canada's resources and training through broadband networks:

- EduSource is a Canada wide cooperative program working with many universities, schools and centres of learning as well as federal and provincial departments and Council of Ministers of Education to. EduSource will create a test bed of linked learning resources across Canada.

- Abel (Advanced Broadband Enabled Learning) is a professional development program that engages a new culture of teaching and learning through the use of broadband networks and information communications technology. This project is funded through the Government of Canada's high speed network program CANARIE and assisted by partners including universities, school boards, and television and cable companies.

As broadband technology grows and as teachers and students demand more online courses and become more sophisticated users of technology, we anticipate an increased involvement in digital education projects and initiatives which can only help to encourage statistical literacy in Canadians.

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