



Catalogue no. 11-522-XIE

**Statistics Canada International Symposium
Series - Proceedings**

**Symposium 2003: Challenges
in Survey Taking for the Next
Decade**

2003



Proceedings of Statistics Canada Symposium 2003
Challenges in Survey Taking for the Next Decade

CENSUSATSCHOOL: **COLLECTING AND DISSEMINATING REAL DATA FOR REAL LEARNING**

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ABSTRACT

In this paper we review the implementation of the international *CensusAtSchool* (www.censusatschool.ntu.ac.uk) and related projects, and suggest lessons that could be learned from them to better promote statistical education at all ages. We emphasise how the project's success has been due, in no small part, to the involvement and support of various levels of each country's government statistical services. These include the UK Office of National Statistics, Statistics South Africa, The Office of Economic and Statistical Research of the Queensland Treasury, the Australian Bureau of Statistics, Statistics New Zealand and Statistics Canada. Lastly, we suggest that the project has important lessons of good practice for learning statistics, not just in schools, but also in universities and the workplace.

KEYWORDS: CensusAtSchool; Curriculum Resources; Learning; Real Data.

1. INTRODUCTION

In the UK, and elsewhere, it is common to find statistics being taught with little reference to real data, in tenuous and problem-free contexts and giving few ways to motivate pupils to *want* learn the techniques. When data *are* used, and pupils may even have collected them, there is often no real purpose behind the collection. Consequently much of data handling and statistics teaching can be dull and uninteresting, often with techniques being presented that neither the teacher, nor the pupils can relate to in a real context. The UK National Curriculum and National Numeracy Framework both make reference to a *handling data cycle*, that links the specification, planning and solution of a statistical problem with the collection of appropriate data, the analysis of these data and the conclusions that can be reached. However, in the *details* of these National documents, data handling is broken up into small parts that, when taught in isolation, tend not to stimulate learners or teachers, simply because the data handling cycle is not followed as an integral part of the teaching. The real data projects we describe in this paper, in our view, go some way to helping to alleviate what we regard as fundamental weaknesses in teaching statistics.

Since the autumn of 2000 the *CensusAtSchool* project has developed a cohesive approach to data handling and has been addressing some problems with teaching and learning from the set curriculum. Through this project we have attempted to change the nature of teaching data handling and statistics in schools by emphasizing the importance of, wherever possible, using data about school pupils *themselves*. The main philosophy is that data that interest children will motivate them to carry out further statistical inquiry. In short, the data are *collected for several purposes*. The evidence from the implementation of the project in four countries, involving several million pupils, is that they *are* motivated and excited both in the data collection process and by the subsequent learning and teaching material that can be generated. They realise that data handling techniques are necessary in order to get information from those data - the data being real, and not contrived or made up, is a real bonus. Also, pupils can investigate data from other pupils, use and apply their mathematical and statistical techniques and come to valid conclusions along with generating ideas for further investigation.

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2. THE UK *CensusAtSchool* PROJECT 2000

During 1999 a partnership was formed between the Royal Statistical Society (RSS) Centre for Statistical Education at The Nottingham Trent University in the UK, the Department for Education and Employment (DfEE)-funded UK Maths Year 2000 initiative and the UK Office for National Statistics (ONS). The ONS was responsible for conducting the April 2001 UK national population census and saw the *CensusAtSchool* project as a valuable precursor to it, raising its profile and encouraging a more positive image through association with a school-based event that is pupil-friendly and up to date.

The on-going aims of the project are to:

- involve young people, ages 7-16, in schools in collecting data about themselves, a real life activity that has interest;
- improve young people's data handling ability within all relevant school subjects;
- Encourage effective Information and Communication Technology (ICT) learning and teaching, including the use of the Internet for educational purposes;
- provide data and contextual material for teachers and pupils to use in their schoolwork across the national curriculum;
- demonstrate the purpose and processes involved in national censuses and get pupils to appreciate the problems involved in collecting census data;
- make comparisons between the responses in different countries.

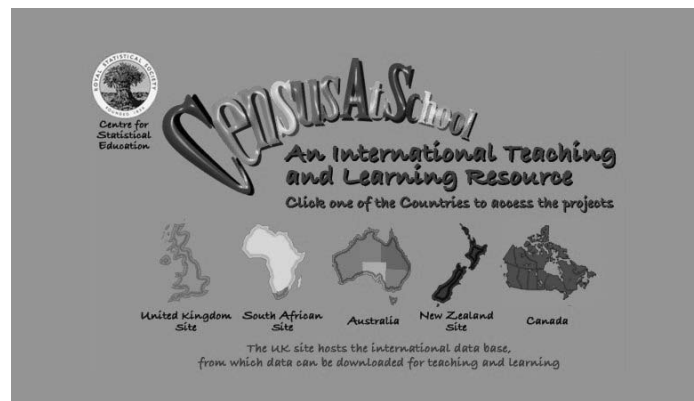


Figure 1 The *CensusAtSchool* web portal

Figure 1 is an image of the web site portal giving access to all participating countries. An early description of phase 1 of the project is given by Connor et al (2000) and some other developments are described in Connor and Davies (2002). Phase 2 of the project, conducted in the autumn of 2001 used a questionnaire based upon a combination of questions from the early international versions run in South Africa, Queensland, Italy, and Norway. This was to enable comparisons to be made between the questions that had been added by different versions to reflect local culture. We are now producing a new questionnaire each academic year (September to August) in the UK. Phase 3 took place during 2002/3 and Phase 4 is taking place in 2003/4. All UK questionnaires are available online on the UK *CensusAtSchool* website. We leave all previous documentation on the web site so that schools that wish to get involved, but have not previously participated, can go back to those questionnaires if they wish to.

The project is based around an Internet site that encourages schools to increase the use of computer technology. Teachers can access the *CensusAtSchool* website and find the information and documentation needed to conduct the project in their school. All material is easily downloadable from the site. Online questionnaires can be completed using web forms, but hard copy of them are encouraged for use in the classroom so that pupils can prepare for data entry.

In all phases, a *simple* questionnaire is used that physically fits onto one standard size sheet of paper. For example, in phase 1 we came up with 18 questions, occupying three columns on a single questionnaire sheet. The first column contained questions about the children themselves, the second their household and the third their school. Some of

the questions were made deliberately identical to those asked on the 2001 UK population census, while others were designed to appeal to the child's own interest and enthusiasms.

Over two and a half thousand schools and nearly half a million children registered on the website. And during November and December 2000 over 60,000 data records were received. We received much praise from teachers about the simplicity of the website. They felt that it was very user friendly and convenient. This was very rewarding for us because, for many teachers, it was the first time they had used the Internet for direct educational use. The interaction needed with the technology meant that they increased their own levels of knowledge and skills but in a context that had impact on their work in the classroom. We provided a help line for them and often found that *talking* procedures through with individuals resulted in sending their first ever e-mail attachment or receiving their first ever download from the Internet. The project succeeded in its aim to provide teachers with a way to access and use the web as a learning environment.

The initial results of the Phase 1 were launched in February 2001, just prior to the UK population census being run and there was extensive media coverage. *CensusAtSchool* attracted comment from every UK national daily newspaper, national and local radio and television; media web sites and regional newspapers. Some of the headline results we found were: Manchester United was the UK's favourite team, even in the South of England; Cats just topped dogs as the most common pet; Overall 40% of the children had their own mobile phones, rising to 60% in the 11-16 age range; Over 80% had access to a computer at home; The most common distance to school was less than 1 km taking 10 minutes to get there; Most common methods of travel were walking in England, bus in Wales and car in Northern Ireland.

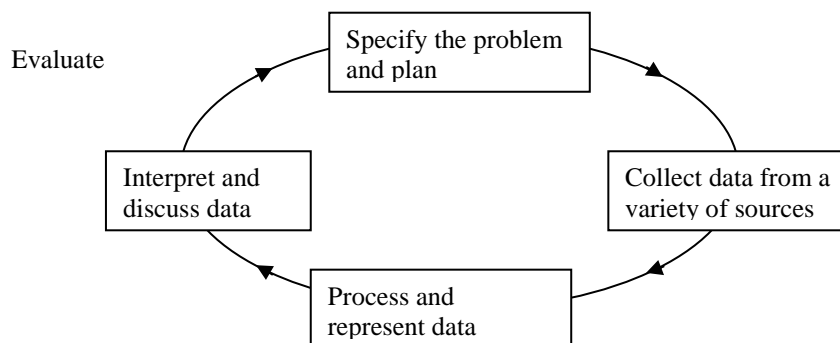
3. THE INTERNATIONALISATION OF THE *CensusAtSchool* PROJECT 2000 - 2003

The success of the project in the UK, and the feedback from teachers participating has shown us clearly that the project has wide appeal. It is flexible enough to be run equally well using paper methods, computer technology or a combination of the two. The questions we pose on the questionnaires can be asked of school children in other countries, with some adjustments needed to take into account local culture and traditions. Scrutinising how data handling and statistics are taught in many countries shows there are remarkable similarities and a convergence of views about both the content and the processes that should be used. We present the following four statements that are taken from national curriculum specifications in South Africa, Australia, UK, and New Zealand, respectively:

South Africa: *In this age of rapid information expansion and technology the capability to manage data and information is an indispensable skill for every citizen. There is an ever-increasing need to understand how information is processed and translated into usable knowledge.*

Australia – Queensland: *Students are encouraged to develop a working knowledge of the practicalities and concepts involved in collecting, handling, preparing, describing, presenting and summarising data.*

UK: *Data handling is best taught in the context of real statistical enquiries and in a coherent way so that teaching objectives arise naturally from the whole cycle. (See diagram).*



New Zealand: *Students should be planning manageable and relevant statistical investigation using strategies such as plan, do, check and act. (Deming Cycle).*

Interest in *CensusAtSchool* continues to grow and we now give some more details of each country's implementation of the project.

3.1 Australia: Queensland

The Office of Economic and Statistical Research (OESR) at the Queensland Treasury, together with the School of Mathematical Sciences at Queensland University of Technology, ran the project in Queensland schools between June and August 2001 (www.oesr.qld.gov.au/censusatschool/). They promoted the activities through posters and flyers, taking part in National Science Week there, having a presence on local TV stations and writing articles for the local Brisbane newspaper. They also ran a state-wide poster competition for schools that decided to take part in the project.

- Over 330 schools from all education districts across Queensland registered electronically on the web site hosted by the OESR and responses were received from 176 schools, representing 52% of those registered;
- There was a total of 14,665 individual responses - 8,128 primary and 6,537 secondary pupils;
- The first ranked sporting team was the Brisbane Broncos, followed by Manchester United, and this was true for both boys and girls who responded - this result did cause some consternation for some sport-mad Australians!

The OESR conducted the project for a second time during March 2003 in collaboration with Sport and Recreation Queensland. All Queensland schools (Government, Catholic, and Independent) were invited to engage Years 5 to 10 students in the census, which was designed to educate students and staff in the collection and use of statistics and provide an avenue for online learning and statistical literacy. Primarily a web-based activity, another objective of the project was to develop interesting and applicable teaching resources that teachers at both primary and secondary level could use in teaching.

The questions were written to elicit information on sport and physical activity undertaken at school, during and outside class time. The questions were also designed to link with objectives within the Health and Physical Education Key Learning Area of the Queensland Education curriculum. This was to enable integration of the census activities into teaching and learning practices within the classroom. Children nominated the sport specialisms they wanted of the athletes who were due to visit their schools. Results from this question will inform the *Get Active Queensland Schools* project.

More than 330 schools responded to the opportunity to take part in their own 'real-life' data collection activity, and registered on-line, downloading information and materials. Teachers, and in some cases students, collated their information into spreadsheets which were then forwarded by electronic mail to OESR. To encourage participation and to add a competitive edge to the activity, schools that returned their spreadsheets by the end of March 2003 were entered in a random draw to win prizes.

Information was returned on 16,122 students, including 8,267 primary and 7,855 secondary school students. These returns came from three metropolitan and nine other regions, covering the State. The census and associated activities provided a positive platform towards achieving OESR's goal of improving statistical literacy within the Queensland community. To attempt to overcome teachers' apprehension about the technology and to supply these teachers with links to extra support material, the *CensusAtSchool* information was linked to the Communication Network site in Education Queensland.

3.2 Australia: South Australia

The South Australia version of the project focused on senior school pupils, aged 12 – 16, and the questions were devised in conjunction with the pupils themselves (www.censusonline.net/). Data collection using web forms started in March 2003 and by September 2003 the number of responses recorded in the database was 21,500. The site has received about 12,000 hits from teachers and pupils, many of them using the random sampling facility provided on

the site. Currently the site is hit about between 100 and 300 times a day during school hours, but there is not much activity out of school time.

The sampling facility has been one the real keys to the success of the project - it allows totally individual approaches to the analysis of the data as the student can select a sample with the characteristics their question requires. The feedback from teachers has been very positive indeed - many Year 12 students have been able to complete meaningful projects for their final assessments, thanks to getting involved in this project. Previously they were obliged to use data that were artificial, sometimes difficult and overly time-consuming to collect and consequently produced meaningless assessments and projects.

There is much anecdotal evidence that many teachers in South Australia have learned or renewed their statistics knowledge through the professional development project that was run, based on the *CensusAtSchool* project and data. Teachers expressed surprise at how seriously the pupils took the survey – the responses had fewer than 20 swear words in all the free field responses!

3.3 Australia: Northern Territory

In 2002 Northern Territory University ran a training course for teachers based on the UK *CensusAtSchool* data and the training material that the RSS Centre created for its ICT-Data Handling course, first run in November 2001 (see section 7). As well as receiving hard-copy of the material, some of it was made available on the Internet e-delivery system *Blackboard*. This enabled easy contact with the participants, many of whom lived across a wide area of Northern Territory (NT). Subsequent publicity by the Territory's Mathematical Association generated much interest with teachers and the Department of Education, and plans were made to run the *CensusAtSchool* project in many NT schools. However, lack of funds has delayed the implementation of the project.

3.4 South Africa

Statistics South Africa ran the project most enthusiastically from June - December 2001, and continues to do so (www.censusatschool.org.za). They spent R5.5 million promoting a pilot and subsequently the full version in 22,000 of the 26,000 schools in South Africa in October 2001. A promotional video was produced with prizes for schools that took part and, most importantly, the Director General for Education in South Africa gave his full support.

The results from their pilot of the *CensusAtSchool* project are from a properly designed sample of 277 schools that were drawn from a list of schools registered with the Department of Education. Some of the findings from the pilot were:

- 94% of scholars have a radio in their home, but only 46% have a tap inside the dwelling;
- 9% of children take an hour or more to reach school each day;
- 25% of boys and 29% of girls in Grades 8 to 12 chose English as their favourite subject, while 15% of boys and 12% of girls chose Mathematics;
- 48% of boys chose soccer as their favourite sport, as against 10% of girls, but 40% of girls chose netball as their favourite sport, as against 1% of boys.

The UK web site has a database of a 20% sample drawn from the 3.5 million responses obtained in the full *CensusAtSchool* project conducted in October 2001, covering the full range of schools throughout the nine provinces in South Africa. Returns are still being analysed and the department of education have taken ownership of this phase of the project and are currently writing units of work for data handling across seven of the eight learning areas of their innovative *Curriculum 2005*.

3.5 New Zealand

CensusAtSchool New Zealand is hosted by the Department of Statistics at the University of Auckland and is coordinated by a secondary Mathematics teacher as part of a NZ Science, Mathematics and Technology teacher fellowship, awarded by the Royal Society of New Zealand. During 2003 the team planned and launched the project and the first phase of *CensusAtSchool* NZ was completed by the end of the year (www.stat.auckland.ac.nz/census/).

From February to March 2003 questions were planned, sponsorship sought and a pilot website was constructed. In May a pilot survey was run in a few Auckland schools, the website was designed and further media support was sought. In June and July evaluation of the pilot took place and the web site completed. The project was launched during national *Maths Week* in the middle of August 2003 and schools were given one month to take part in the survey and submit their data. By September 18,000 responses were received from nearly 400 NZ schools. Between September and October, schools were provided with sample data to use as classroom resources, some summary data were released and classroom materials developed. Subject to funding, there will be a phase 2 of the project in 2004.

3.6 Canada

Statistics Canada (StatCan) are running the *CensusAtSchool* project from October 2003. Amongst other things, it will act as a sensitiser for the adult population census in 2006 by raising awareness among the adult population through children getting involved in data collection, handling and analysis using Internet technology. StatCan has a *CensusAtSchool* Steering Committee comprising senior managers who provide guidance and resources. Also, a *CensusAtSchool* Teacher Advisory Board was established under the management of the Fields Institute, a not-for-profit mathematics research and education organization. Members represent four regions of Canada: Atlantic; Quebec; Ontario and Western. This group suggested content for the elementary and secondary questionnaires and is creating 24 curriculum-relevant lesson plans. These will be posted onto the site in both official languages, English and French. They are also promoting the project at Professional Development days and through peer associations.

The questions for the elementary and secondary online questionnaires were field-tested with English and French speaking students in Ontario and Quebec during late September. The Data Access and Control Division provided consultation and project advice. Due regard is given to confidentiality, privacy and disclaimer by stating that the information from this project is *not* being collected under the Statistics Act and will not be used in studies at StatCan.

An electronic database of 17,000 schools in Canada with unique identifier numbers has been created by StatCan's Centre for Education Statistics. Industry Canada's SchoolNet has set up a special project-funding category that allows for \$300 for *each class* that completes a *CensusAtschool* project. The objective of is that 1,000 Canadian schools will participate this school year. Mathematics consultants and IT coordinators have been contacted regarding the project. StatCan is also working on setting up other Canadian not-for-profit partnerships and endorsements. StatCan will be creating a rich bank of activities on statistical literacy through a wide variety of teaching and learning materials, including, for example, questionnaires for comparability studies and complex data analysis projects which will be complete with teacher PowerPoint training components.

4. EXAMPLES OF MOTIVATING SCHOOL PUPILS WITH DATA

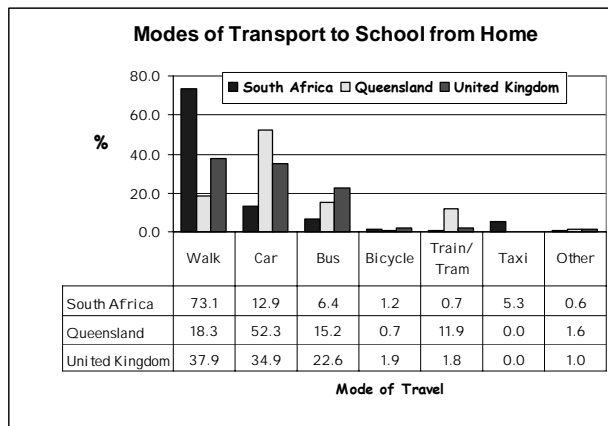


Figure 2 Comparison of modes of travel to school

The data that have been collected from different countries allow some interesting comparisons to be made between them, and can enhance statistical understanding as well, through capturing the imagination of pupils. We now give two examples of graphical displays of data that we have found can motivate pupils into carrying out further statistical inquiry.

Figure 2 shows the comparison between the modes of transport to school in the United Kingdom, Queensland and South Africa. The differences between the countries are easy to spot and children can be encouraged to try to come up with explanations for these differences. They can then go on to look for evidence to support their ideas, encouraging further research and investigation. They may decide, for example, to concentrate on just their own country and look for regional differences there or alternatively predict what the category 'other' may hold. There are rich possibilities for engaging in statistical inquiry from these data.

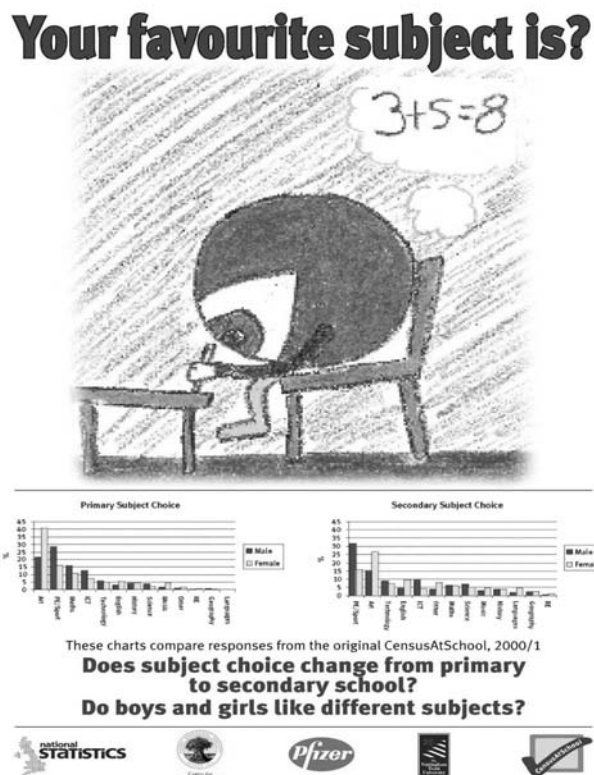


Figure 3 School Poster about Favourite Subjects

On a statistically more sophisticated level the relationship between height and right foot length of pupils can be examined between countries using overlay scatter plotting, and a simple linear model may be explored for each country's data. When random samples from the UK, South Africa and Queensland are scrutinised, there are a number of Queensland responses that, for increasing *foot length* between 10 and 13 cm, have on average, no apparent increase in *height*. This feature is not evident for the other two countries' data. However, an important issue, that can be used to illustrate the need to examine the data more closely, is that foot sizes of 10 –13 cm are *unusually* small. Questions arise as to whether the data have been mis-recorded, or that there are other, possibly ethnic, issues that may explain the small foot sizes. We believe that bringing data alive can help pupils develop statistical inquiry skills. The study and interpretation of visually stimulating diagrams and charts is one way of making the data behind the diagrams live.

We have produced a number of classroom display posters using some of the data we have collected in various phases of the project. These can help pupils understand the importance of looking at data, and relating them to environments with which they are familiar. The posters were distributed to all UK secondary schools for use in teaching and learning data handling during 2003/04.

Figure 3 shows two charts that enable a comparison to be made between primary and secondary schools, and male and female pupils within them, with regard to their favourite subjects.

5. CURRICULUM RESOURCES

Hanging out the Dirty Data

When you have got some data the first thing you need to do is to check it out and get rid of any obviously wrong or false data. This is called "Cleaning the Data".

In Spreadsheet "Dirty" several playful pupils have been deliberately tampering with the data. See if you can spot which rows and cells have been interfered with and by which of the following characters:

Pointy Pete - who moves Decimal Points around and adds unnecessary ones.

Unlucky Ben - who puts in very obvious errors.

Silly Semantha - who thinks it is funny to answer the question "Name?" As "Donald Duck".

Devious Dave - who thinks up clever ways to change the data.

Download the Excel spreadsheet or find a copy of it on page 2.

Can you make some decisions about what to do with the dirty data? Investigate the Spreadsheet further and try to come up with a

Sparkly Clean Final Version!

' Dirty ' Spreadsheet

Row	Sex	Date of Birth	Home	Height (cm)	Weight (kg)	Fav Subject	Distance to Home	
Row 2	Boy	12/04/91	5	England	142	28	Art	1.2km
Row 3	Girl	11/02/92	4	England	132	22	Science	New Dean 2 km
Row 4	Girl	14/01/91	5/00	England	142	23.5	PE/Sport	2.5423km
Row 5	Boy	02/09/90	6	England	138	25	Art	1.2km
Row 6	Boy	13/12/91	4	Wales	129	24	PE/Sport	1.2km
Row 7	Boy	14/02/91	5	England	142	27	PE/Sport	New Dean 1 km
Row 8	Girl	06/05/90	7	Wales	142	24	Art	3.8km
Row 9	Girl	15/09/90	6	England	138	21	Art	8km
Row 10	Boy	20/02/92	4	England	132	23	PE/Sport	1.2km
Row 11	Girl	16/05/90	6	England	142	26	Maths	1.2km
Row 12	Maths	24/05/92	7	Plaid Day	48	21	Geography	3000km
Row 13	Boy	08/10/91	4	Scotland	128	21	English	New Dean 1 km
Row 14	Girl	18/12/90	5	England	138	21	Geography	New Dean 1 km
Row 15	Girl	16/07/91	5.5	England	132	22	Art	3.8km
Row 16	Boy	02/09/90	4	Wales	129	21	Art	New Dean 1 km
Row 17	Girl	12/02/90	7	Wales	148	23	Art	1.2km
Row 18	Girl	15/06/90	7	England	130	22.5	PE/Sport	1.2km
Row 19	Girl	07/08/90	7	England	142	24	Art	New Dean 1 km
Row 20	Boy	06/09/90	7	England	142	24	Computing	New Dean 1 km
Row 21	Boy	20/11/87	10	England	120	22	Computing	5.12km
Row 22	Boy	16/07/90	6	England	142	26	Japanese	2.8 km
Row 23	Girl	25/04/90	6	England	142	26.5	PE/Sport	1.0 km
Row 24	Boy	22/02/92	4.1	England	132	24.5	Maths	New Dean 1 km
Row 25	Boy	26/02/92	4	England	130	21	PE/Sport	New Dean 1 km
Row 26	Girl	08/07/90	6	Wales	142	22	Art	2.8 km
Row 27	Boy	22/03/90	6	England	151	26.5	Maths	2.8 km
Row 28	Boy	01/03/87	9	England	142	25	PE/Sport	New Dean 1 km
Row 29	Girl	07/09/91	4	England	130	21	History	2.8km
Row 30	Girl	05/09/92	4	England	130	21	English	New Dean 1 km

Figure 4 The Dirty Data Worksheet

The UK web site contains over 60 curriculum resources in a variety of formats. There are worksheets, downloadable in both .pdf and .doc formats, which enable pupils, aged 7 – 16 to carry out activities in data handling across a broad range of curriculum subjects. Many can be adapted for a teacher’s particular group of pupils. Most can be used directly on the computer using the embedded hyperlinks for further investigation, or presented as paper worksheets without recourse to a computer.

The worksheets are based on simple ideas and many of the tasks that the pupils carry out are aimed at areas not covered by many textbooks. For example, the *Dirty Data* worksheet (see Figure 4) is designed to get pupils to appreciate that real data can be messy and that sometimes, in order to proceed with just simple and routine data handling, the data have to be scrutinised for unusual or mistaken data records. Some of the worksheets are flexible enough to allow the teacher’s own data to be imported to the worksheet, with only minimal alterations having to be made to the text of the worksheet.

The wide variety of tasks that can be carried out across a broad area of learning means that the worksheets often cross normal subject barriers – indeed data handling is a good tool to connect different subjects. The generation of international data offers a rich source of new opportunities for between –country data handling exercises. For more details, including example worksheets, see Connor and Holmes (2002). On the UK web site there are also various tables, graphs and interactive resources that teachers can integrate into their lessons. There are helpful hints on how to use Excel successfully in school and also worksheets created by teachers themselves.

6. ACCESSING REAL DATA

Within the UK National Curriculum the focus of statistical inquiry is slowly shifting towards requiring students to use real data for learning data handling and statistics. However, there are few sources of real data, of sufficient size, available for general use. Students may collect their own primary data, but they also tend to find the sample limited, mainly due to its size, and they are often unable to draw meaningful conclusions from them. The Internet is a rich source of raw data, but contexts and content tend not to be interesting enough for school pupils. In the *CensusAtSchool* project we have developed a web-based tool that enables teachers and pupils to sample the real data that have been collected from the project and placed in a number of databases.

Currently the UK web site has five databases containing over 800,000 responses, suitably anonymised, from which random samples can be taken using web browser technology. The web site has a facility for random samples to be taken from any of the four countries' data (UK, South Africa, Queensland Australia, New Zealand) as well as from a combined data set of all responses, using a *random data selector*. An email address is needed and a .csv file, containing the random sample, is sent to it. The .csv file can be saved locally and read into statistical or spreadsheet packages, so that further exercises and analyses can be performed. Since publishing the first version of our random data selector in September 2001, over 6000 emails have been sent to colleagues in schools and elsewhere requesting random samples of responses. New databases of pupil responses will be placed on the UK web site as future phases of the project are completed.

7. A TEACHER PROFESSIONAL DEVELOPMENT COURSE

Motivated by the data generated from the project, we have designed and delivered a course for teachers that wraps ICT training with data handling specifications across a broad range of curriculum subjects. The course uses the databases of responses and resources and employs a unique approach to provide training and support for teachers. It provides for training in the development and use of web-based teaching materials and enables teachers to use and interact with the Internet for cross-curricular data handling activities. The course also teaches the use of basic computer-based tools, such as word processing, emailing, using spreadsheets and the Internet, and uses them to develop existing or new web-based teaching and learning materials. The teachers benefit from extensive hands-on experience with all of these tools, and they use their own specialist curriculum knowledge to develop web-based teaching resources specific to their disciplines.

The course is based upon a two-stage approach to learning for the participating teachers. Stage 1 comprises a face-to-face interactive training course lasting one or two days, while stage 2 is spread over about a month and involves self-learning and home-based activities. The participants are expected to create computer-based material and activities that are subject-specific and can be used in classes with their pupils. The ICT knowledge gained and skills acquired in this phase enable teachers to take a lead in the use of technology in the classroom. The worksheets are added, as appropriate, to the international resources available on the UK *CensusAtSchool* web site.

8. THE UK *ExperimentsAtSchool* PROJECT

Based on the experience gained from running the *CensusAtSchool* practice of collecting data from pupils, and disseminating them, using the Internet, we have launched a new project to collect data from experiments done by students across the whole age range in primary and secondary schools. We are calling the project *ExperimentsAtSchool* (www.experimentsatschool.org.uk), and we have invited all UK schools to participate from September 2003 – July 2004.

Many experiments in science subjects such as chemistry, physics, biology, environmental science, sports science and general science, and other subjects such as psychology and geography can yield data that: (i) can be collected over the Internet and stored in a database for use by *all* schools; (ii) will be of value to teachers and pupils within a participating school; (iii) will be a rich source of material to create learning and teaching resources within and between subjects. Our plans include getting information from the data, creating activities linked to ICT, developing lessons, homework tasks and projects. The web site lists all the experiments we have devised to date.

Our aim is to involve as many teachers as possible in the project, both by getting students to carry out experiments and contribute data to a national database, and to design and write experiments that we can add to an electronic portfolio. Support for the project in the UK comes from the Association for Science Education, the British Association for the Advancement of Science, The Royal Society, and the Specialist Schools Trust.

9. REAL DATA AND LESSONS FOR STATISTICAL SKILLS

In this section we consider more generally what lessons can be learned from using real data to improve statistical literacy. Rice et al (2001) recommended a real data approach be taken in teaching in UK higher education using *publicly available* data. Employers and employees in business and industry could similarly benefit from training programmes that use real data: in a recent report by Hoyles et al (2002) large sections of the UK working population were shown to be poor at applying even the simplest data handling and statistical techniques. A key observation within the Hoyles report is that a real-data and work-related approach are crucial for improving statistical numeracy of employees. Indeed we propose that a joined-up approach to building statistical numeracy skills should be taken throughout a person's working life: we would like to see national and international research projects designed and set up to investigate the effectiveness of taking a real data approach to learning, teaching and training in statistics from an early age, throughout schools, in university and into the work place.

9.1 Schools

The following positive lessons could be learned and used to benefit schools:

- *CensusAtSchool* and similar projects bring real data home to pupils and teachers in a way that is not a threat;
- The sense of belonging to the databases is an exciter and motivator for pupils;
- Resources are likely to be well liked by pupils and teachers;
- Schools could benefit from many more innovative projects that could excite pupils and teachers with data, their handling and getting information from them.

To take advantage of these, for school/higher education we propose that:

- the transition from primary to secondary school should be connected by collecting data in each, and relate them through mathematics/statistics learning and teaching resources;
- in secondary school, data should be collected from and about the students using, for example, the Internet-based *CensusAtSchool* and *ExperimentsAtSchool* principle, and learning and teaching resources should be created to help promote excellence in teaching and learning;
- data should be collected during, before and after transition from school to university/college and appropriate learning and teaching material should be written.

9.2 Higher Education

Fewer and fewer students are opting to study statistics in UK Higher Education, with mathematics and/or statistics departments closing, or being absorbed by others. It is becoming increasingly difficult, in the UK at least, to recruit teachers of statistics into higher education. There is some evidence that a similar picture exists in Australia. Why is this, and what should be done about it?

Students often tell us that statistics is too hard and dull, and that they do not see the relevance to their 'home' subject. Statistics has a bad name, and very often the teachers of the subject in higher education are labelled similarly. It is our belief that much bigger efforts should be put into stimulating interest by focussing on a real-data approach to teaching. If the experience at school level can be applied to higher education, a similar and radical, but unified approach could well help to rectify the problems. In higher education and between it and the workplace we propose that:

- real and relevant subject-specific data be *always* used to teach statistics to students in HE;
- data should be collected to support and better plan for the transition from higher education to the workplace, and training material should be produced;
- in the workplace graduates could be used to help use and integrate relevant, publicly available data into training material for employers and employees;
- data should be collected to support the enhancement of productivity for businesses, with relevant publicly available data made easily accessible on a dedicated part of the Office of National Statistics web site.

9.3 The Workplace

The report by Hoyles et al (2002) presented evidence that, in seven UK business/industry sectors, major mathematics skills problems exist, with at least 50% of the identified problems being statistical/simple data handling. The Hoyles report suggests that improving such skills could be through *data that the employee can*

associate with. This resonates with our suggestion that a radical approach should be taken with training in the work place.

The lesson should be that a new national workplace programme of training in statistical skills should be driven by real data, relevant to the business or industry of the employees. It will be a huge and very expensive job to do and it will be imperative to first carry out a properly designed national needs analysis. In order to enhance statistical education in the workplace we suggest that we need to:

- carry out a statistical numeracy audit/needs analysis;
- employ regional general practitioners (GPs) of Mathematics and Statistics and create a one-stop mentoring, advice and consulting centre in every region for matters mathematical and/or statistical;
- create self-tuition modules and e-training material in print and electronic formats, for example (i) How do I devise questions for a survey? (ii) How can I interpret data tables? (iii) How can business become more competitive using publicly available data;
- write and deliver a national set of train-the-trainer courses for improving statistical literacy;
- train employers wishing to take responsibility for improving the statistical numeracy of their employees.

Some of these are implicit in a project that will be run from 2003 – 2007 in the UK. The government-funded Teaching and Learning Research Programme (TLRP) has awarded funding for the project, to be run at the Institute of Education, London, entitled *Techno-mathematical Literacies in the Workplace*.

10. CONCLUSIONS AND SUMMARY

The *CensusAtSchool*, and other related projects, provide unique ways to develop statistical numeracy and thinking skills for both teachers and school children. For the school children that take part and use the materials produced they are motivational and can be fun, whilst also being educational. They are helpful for the professional development of teachers, both to enhance their statistical knowledge and the associated ICT skills that can be an integral part of participating in the project.

The involvement of government statistical organisations has proved to be key in the promotion and success of the implementation of such projects in all countries that have participated. It links democratic government activity, such as the need for national surveys and censuses, with the use of real data to produce information to help people to make evidence-based decisions. It is a conjecture on our part that using real data produces more *effective* teaching and *deeper* learning of data handling and statistics at all ages. We would like to encourage research projects to be undertaken within and between those countries that have implemented the *CensusAtSchool* project.

The new *ExperimentsAtSchool* project has the potential to make a large contribution to promoting statistical numeracy within and between a wide range of school subjects. Over the next few years we intend to run several more phases of both projects and increase the number of countries that take part, thus expanding the potential to enhance the data handling and statistical skills of an increasing number of pupils and teachers, and others in the population who need to use such important life skills.

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