SHARING DATA VIA E-MAIL AT THE SECONDARY LEVEL

Hartley Hyde, Wirreanda High School (Adelaide), Australia
James Nicholson, Belfast Royal Academy, Northern Ireland

The authors started to explore the feasibility of exchanging data using e-mail between schools in different parts of the world in October 1996. They feel that is important that secondary pupils have an opportunity to work with real data describing issues that they find relevant They are interested in providing students with an experience of working with new technologies and discovering some of the power available when processing large amounts of data electronically. All communication and data exchange, even the preparation of this paper, were made using only e-mail and e-mail attachments. This paper traces the development of the survey questionnaires that the two classes developed in collaboration, the data analysis and something of the social effects observed when students had an opportunity to work with a distant group of students.

CLASSROOM EXPERIENCES

The authors are experienced secondary school mathematics educators who believe that computers offer an opportunity to enhance their students' experience of mathematics. Their aim, when organising this exchange of data, was to give students in both schools the experience of working collaboratively to explore and compare attitudes and personal preferences. They identified a number of stages which they felt would contribute to their students'statistical and social development. These stages required the students to:

- construct a questionnaire which both groups would be happy to use;
- collect data and register them electronically
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- exchange the data as spreadsheet files attached to e-mail;
- analyse the information in the data collected from the groups;
- evaluate the usefulness of information obtained using different question formats.

Course requirements for data handling at the lower secondary level are limited to various graphical representations and information extraction. Textbook examples are sometimes artificial, irrelevant or difficult to understand. It was hoped that by using real data which they had gathered, students would gain some insights into how data analysis is used to study real situations.

Lack of understanding between groups of people is often generated by fear. The political situation in Northern Ireland is characterised by intolerance between communities, while Australian students at Wirreanda have a very homogeneous background and little experience of relating to people from other cultures or classes. By learning something about Adelaide and Belfast, students at both schools recognised their different cultures and social classes, but discovered from the statistical analysis that they shared very many similarities. Recognition of similarities may reduce students' fear of people from other cultures; knowledge of differences may reduce contention. For this project, six topics were explored by the students, namely, Sport, Movies, Food , Music, Pastimes and Cars.

The initial contact between the two groups was an e-mail exchange of personal profiles giving each group some perspective on the other. Electronic photographs of pupils were attached to e-mail as picture files using the jpeg format: it was a particularly cold, wet and miserable wintry morning when the Belfast pupils saw Wirreanda students sitting on the lawn in the spring sunshine, watching volleyball, as they discussed their Sport questions.

Within each class, groups of students worked together on one of the topics and exchanged ideas, using e-mail with the corresponding group in the other country. The groups were small enough for everyone to be able to make a worthwhile contribution, thus, all students had ownership of the survey. There was an encouragingly constructive approach to this sort of group work, with a willingness to consider other people's viewpoints which, in the authors' experience, is not generally an observable characteristic in pupils at this age. For example, both classes took considerable trouble to define carefully what they understood by "football". The role of the teachers at this stage was supportive and encouraging. Since one of the purposes was for the pupils to 'discover' why certain types of question are more amenable to data analysis than pothers, the authors were prepared for 'poor' questions to be included. A more constructive approach was observed in the question preparation, compared with traditional mathematics lessons where there is a focus on a 'correct method' and a 'correct answer' to problems. A wide range of response formats appeared in the final version of the survey, ranging from free responses to questions such as 'What is your favourite movie?', to ticking response boxes, to very focused questions such as ranking a list of major sporting events which appear on television. The survey ran to five pages in total and took about 15 minutes to

complete. All students responded to the questionnaires and data were exchanged by attaching spreadsheet files to e-mail.

DATA ANALYSIS

Fortunately the Wirreanda syllabus called for little more that a knowledge of how to represent different types of data using appropriate graphical representation. Very few lessons were still available with this group, and most of the assessment of statistics had been completed. The spreadsheet was transferred to data files suitable for use with the Macintosh program *Statview*, which allowed the students to prepare graphs and compare responses very easily. While the analysis had interested the more able students, it was the overall experimental situation and their involvement which had motivated reluctant learners; students who had failed to prepare for previous mathematics tests were passing their statistical tests.

The Belfast pupils had more time available as they were in the same class after Christmas. They had time to 'explore' the data in an unstructured fashion, before undertaking more specific tasks. They were asked to find information from the large data set, and then summarise their findings about a particular survey item - a straight forward, but important skill. Their task also included higher level activities such as interpretation of their observations and their strategies for coping with missing results or data which were obviously incorrect. They were required to answer structured questions for two of the topic areas (sport and movies). For the food survey, students were asked to suggest a method of analysis that would be appropriate and write a brief report on what the detailed results for the two schools meant. For the remaining three topics (pastimes, music and cars) they were given a set of summary statistics and asked to write a brief report on what these showed them. Finally, they were asked to compare and evaluate different types of questions and response formats and make recommendations for improvement.

The construction of the survey and data collection were undertaken with enthusiasm and an encouraging openness to the views of others. In the first section, where the questions were almost recognisable as 'mathematics' (i.e. specific answers to well-defined questions), almost everyone performed well and used language which was appropriate. Wirreanda had ranked 12 sports completely, whereas Belfast had been asked to tick six out of the 12 sports. Students now faced a spreadsheet with the Belfast results coded with a one when it was ticked, and a zero when it was not. Belfast students

responded correctly when asked if they could tell how the question had been asked at Wirreanda. Typical responses to whether or not this sports question could still be analysed were:

- "You can compare the results by taking the smallest total of Wirreanda results, which would be ranked first, while the one with the most amount of one's in the Belfast results would be ranked first", and,
- "One way to compare the results would be to count the first six ranked one to six (Wirreanda) as 'yes' and the last six ranked seven to 12 as 'no' and then compare Belfast's response to that of Wirreanda".

When more open questions were tackled, there was greater variation in the quality of response and some of the enthusiasm lessened amongst the weaker pupils. In most cases it seemed to be the ability to express mathematical ideas in words which was the greatest source of variation. This level of communication is valued by mathematics educators in a way that is not reflected in assessment procedures. It is undoubtedly much more difficult to assess than the traditional mathematics examination question, but has become a skill which is not achieved by a majority of students and about which industry and commerce continue to criticise school leavers. There is now a greater requirement in the British curriculum for interpretation of information, an area which has been a problem for many students who see mathematics as much more to do with calculations. Many of these students were able to offer much better interpretations than had been observed with the more traditional curriculum materials. It is hoped that the classroom discussions, in which peers put forward their simple observations from the data, may encourage the less able students to gain confidence to handle similar material in the future.

FINDINGS AND RECOMMENDATIONS

The procedures described above were used with two classes during 1996 and another two in 1997. In 1996, difficulties were experienced in transferring large spreadsheets. Most data files consist of eight-bit binary data which must be encoded as seven-bit data before being transmitted on the Internet. Shepard (1996) identifies three different file encoding and decoding systems used to attach binary files to e-mail: UUencode and UUdecode, MIME , and BinHex. Since data were being sent from a Macintosh in Adelaide and received using a Windows based machine in Belfast, the

BinHex system was used. When a BinHex interpreter was added to the Belfast machine, file transfers were much more reliable; it is still unclear how data were transferred before the interpreter was added. The delay due to file handling difficulties in 1996 led to the administration of slightly different questionnaires. When organising a project across time zones ten hours apart, it is easy to become confused about who is doing what, when. In this situation e-mail has advantages over telephones or facsimile machines as the files rest quietly on a service provider's hard disk until the recipient is awake. In 1997 the process began earlier in the year. Separate spreadsheets were used for each topic and classes were restricted to two topics. A split screen was used in the Excel window with the questions appearing in the left-hand frame; responses from previous students were hidden behind the question frame. Students entered their own data together with responses elicited from students in other classes.

A significant limitation of this project was the inadequate availability of e-mail and Internet access for each class. Students were keen to *e-pal* (the e-mail equivalent of *Pen Pals*), and the social effects of this would have been of benefit in broadening their horizons. In South Australia, the government is moving slowly to enable Internet facilities for every classroom, however, many schools such as Wirreanda have purchased limited interim access via commercial providers. The UK government is encouraging the development and use of Internet resources in schools, and pricing structures are appearing which make it a realistic possibility for a class resource. Equivalent upgrading of internal networking systems within schools must also occur, and this anticipated investment in on-line access will mean a corresponding expectation that teachers will make use of these facilities. The results of this project support such developments. Using the limited resources available, students became highly motivated and curious. Obviously there was a Hawthorn effect: student enthusiasm and performance were being observed more closely than usual. It was also inevitable that the medium became the message - some students were more interested in the technology than in the statistics. Clearly, the authors were keen for this project to succeed, however, they did observe a change in students' enthusiasm for mathematics. It has been known for many years that students learn more effectively within an appropriate social setting (Vygotsky, 1978). Here were two groups of people who might be slow to find friendship if forced to share the same campus, but, because they were separated by 16,500 kilometres and the electronic interaction between them was carefully controlled, they felt safe. In this social setting there were undoubted

benefits both mathematical and social. The students used mathematics to explore their differences in preferences and attitudes, and were surprised by how much they had in common. They liked the same films, music and food, but clearly had different sporting opportunities. Australian students seem to spend more time outdoors but many have never seen ice and snow, let alone had an opportunity to play winter sports such as skiing and ice hockey.

This e-mail exchange project has been described as “groundbreaking”. The authors are content to recognise that it has been something of a cultural icebreaker. It has resulted in nearly two hundred separate e-mail communications many relating to students and teachers getting to know one another. Involvement of more that two schools would be complex, and unrestricted e-pal would be likely to overload existing facilities. The Internet provides other structures which cater better for more complex social settings. The authors are experimenting with a World Wide Web page, and hope that this will provide an environment within which students from a wider selection of cultures can participate (http://www.ozemail.com.au/~hhyde/real.data). In reporting the exploration of social and knowledge-linking advantages of the Web, Edgar (1995) claimed that: *the PC is to Piaget as WWW is to Vygotsky*. It is easy to establish links so that students can be directed to on-line material relevant to the questions being discussed; essays written by students can be linked as additional pages. Teachers and students can get to know each other by using chat groups. Spreadsheets can be linked to a Web page and down loaded; it is possible to establish Excel as a helper application within various Web browsers. Separate pages can be built to provide information in different languages. In one scenario of the emerging global classroom it will be possible for data to be contributed by schools across the world. Students could then use statistics to explore and understand some of their differences and their common aspirations.

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