IASE matters

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This issue contains an overview of the IASE Roundtable on Technology in Teaching, held in Granada, Spain during July 23-27, 1996. It also contains a report on one of the statistics streams within ICME-8, held in Seville, Spain during July 14-21, 1996. Subsequent issues will contain more on the results of these important conferences.

IASE ROUNDTABLE CONFERENCE

Research on the Role of Technology in Teaching and Learning Statistics

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IASE has traditionally sponsored a Roundtable Conference on a specific topic in statistical education as a satellite to each meeting of ICME (International Congress on Mathematics Education). As this year ICME 8 took place in Seville, the host in this Roundtable Conference was the University of Granada, one of the oldest Universities in Spain, which throughout nearly five centuries of development and progress has become a focal point for scholarship and culture in the south of Spain. Researchers from different countries met there from 23 to 27 of July to discuss the educational problems set by technology and their implications for teaching statistics. The Conference received additional support from the Spanish Ministry of Education, the local government of Andalusia (Junta de Andalucia) and various institutions at the University of Granada.

The scientific committee, chaired by *Joan Garfield, University of Minnesota, USA*, was formed by *Gail Burrill, University of Wisconsin-Madison, USA, J. Michael Shaughnessy, Portland State University, USA, Rolf Biehler, University of Bielefeld, Germany, Anne Hawkins, University of Nottingham, U.K., and Carol Blumberg, Winona State University, USA. Carmen Batanero, Juan D. Godino and Angustias Vallecillos*, members of the research group on statistical education at the *University of Granada*, did the local organization of the conference.

In the opening talk, *Anne Hawkins* discussed the meaning accorded the term technology in the papers presented and discussed some myths and conceptions concerning technology in statistics education. Presentations and following discussions were arranged into the following five sections:

Section 1. How Technology is Changing the Teaching of Statistics at the Secondary Level.

Computers are changing not only the statistical content at secondary education, but also how this content is being taught and the type of assessment of student learning. *Dani Ben-Tzvi, Weizmann Institute of Science, Israel,* presented a statistics curriculum designed for junior high school which was based on the use of spreadsheets and analyzed four different modes of student thinking when working with this material. *Yasar Ersoy, Middle East Technical University, Turkey,* described a process of courseware development for teaching probability concepts to secondary students and a research project to compare the results of teaching based on the use of this software with other instructional methods on students' performance and attitude. *Suzanne Lajoie, McGill University, Canada,* described the Authentic Statistics Project, whose goal is to make statistics meaningful to secondary students and to assess the type of progress that students achieve in learning statistics. She also suggested how ASP and technology might ease both instruction and assessment by modeling performance standards for the statistical investigation process.

However, presenters also pointed to some dangers in the careless use of technology for teaching. *Gail Burrill* warned about the fact that statistics lessons often are not focussed on the task of processing information into useful and meaningful statements that can aid in understanding situations and making decisions. She suggested ways in which calculators could reinforce the statistical content and improve how this content is taught. *James Nicholson, Belfast, Royal Academy, UK,* wondered about the possibility of students having a lack of feeling for what is being done in data analysis when they use computers; he gave advice on different ways in which this problem might be tackled.

Section 2: Developing Exemplary Software

A second point of debate was the ideal requirements of software to help the teaching and learning of statistics, based on the analysis of some examples of didactic software. *Robert del Mas, University of Minnesota, USA*, presented a framework for the development of software for teaching statistical concepts, based on his experience in developing instructional statistical software. *Moya McCloskey, University of Strathclyde, Scotland*, described two projects developed in Scottish universities: Statistical Education Through Problem Solving (Steps) and Quercus, a complete set of interactive courseware to tutor bioscience students in the basic techniques of data analysis and report writing. *Steve Cohen, Tufts University, USA*, provided an Overview of ConStatS, designed for the purpose of offering students a chance to actively experiment with concepts in an introductory statistics course. An additional paper was sent by *John T. Behrens, Arizona State University, USA*, in which he describes GEESC, an integrated environment for students to explore statistical concepts with dynamic and interactive graphics.

Section 3: What we are Learning from Empirical Research

The examples of empirical research presented in this section served to discuss the findings, generalizability and methodological problems of research on the use of computers to teach statistics. *Kay Lipson, Swinburne University, Australia*, reported the findings of a study that looks at student understanding that results from participation in a computer simulation exercise and addressed the question of how this understanding may be affected by the design of the software used. *Clifford Konold, TERC and University of Massachusetts, USA*, raised the possibility that some of the difficulty people have in formulating and interpreting statistical arguments results from their lack of an adequate perspective to make sense of statistics. *Rolf Biehler* showed some difficulties students have in using software and in elementary data analysis based on the preliminary results from two research projects. *Carmen Batanero, Juan D. Godino and Antonio Estepa, University of Granada, Spain* described experimental research on how students' conceptions and strategies on statistical association were changed in a teaching experiment based on the use of computers. They identified different facets of understanding association which these students had in their learning process and pointed out some resistant statistical misconceptions. *Gilberte Schuyten, University of Gent, Belgium*, described the results of two research projects at her university. The first project investigated the computer as a learning environment to learn statistics, while the second one focused on students characteristics and individual differences in dealing with verbal explanations, graphical displays and formulas. Finally, *Peter Wilder, DeMontfort University Bedford, UK*, presented a paper discussing the effect of computer simulations on students' understanding of the concept of randomness.

Section 4: How Technology is Changing the Teaching of Statistics at the College Level

The changes produced by computers are even more visible at the University level and the papers presented showed the range of technology implications on teaching statistics. *Susan Starkings, South Bank University, England*, identified areas where technology has been introduced for teaching statistics, reflected on how teaching has changed to adapt to the new technology and how the experience that developed countries have gained could be of use to developing countries. *Allan Rossman, Dickinson College,USA*, presented the project Workshop Statistics, which has involved the development and implementation of curricular materials to guide students to learn fundamental statistics through self-discovery. *J. Laurie Snell, Dartmouth College, USA*, remarked how the Internet adds a new dimension to the teaching of statistics and illustrated this by describing the Chance course and other resources and by suggesting ways in which Internet may be used in the near future to teach statistics. *Jane Watson, University of Tasmania, Australia*, explored the Development and Research aspect of the expanding use of technology in teaching and learning statistics in an Australian experience associated with a professional development project of teachers of statistics. *Peter Jones, Swinburne University, Australia*, examined the educational potential and the actual misuse of computer based technology in statistics.

Section 5: Questions to be addressed on the role of Technology in Statistics Education

In spite of the results presented at the conference, there is still much research work to be done and the last section raised some relevant problems in this respect. *Michael Wood, University of Portsmouth, England*, referred to the motivation for learning statistics by students for which understanding statistics is not and end in its own right and made some proposals for changing the teaching method and the technology for coping with the problem of the lack of interest. *Michael Glencross and Kamanzi Binyavanga, University of Transkei, South Africa*, examined the role of technology in statistics education in relation to a developing country, identifying those who need statistics education and those who should provide it in different educational levels. They also explored the role of statistics education in helping these countries in relation to their business, industry, government and scientific progress.

Beyond the presentations and the time dedicated to software demonstrations and explorations, two panel discussions were held. In the first one *Brian Phillips, Swinburne University of Technology, J. Michael Shaughnessy, Portland State University, Manfred Borovcnik, Universitat Klagenfurt, Austria, and Carlos Vasco, National University of Colombia* gave their impressions of the Topic Group on Statistical Education at the recent ICME 8. The second panel, with the title *What have we learned, where do we do from here?*, summarized the work at the

Roundtable and listed projects for future roundtable conferences. This discussion was under the guidance of *Gabriella Ottaviani, Universita degli Studi di Roma "La Sapienza", Gail Burrill, Rolf Biehler, and Carol Blumberg, Winona State University, USA.*

Social events included a reception by the City Hall at the Carmen de los Mçrtires, a visit to Alhambra and a farewell dinner.

ICME-8 Working Group 14 LINKING MATHEMATICS TO OTHER SUBJECTS

Substream on Statistics

[The complete program with all the abstracts is available on the WWW: http://128.243.200.1/ICME/wg14.html]

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Building a Theory of Graphicacy: Where Are We Now?

Frances R. Curcio, New York University

Graphicacy, the ability to read graph, is a critical component of mathematical literacy, necessary for functioning in our highly technological society. Various perspectives for studying graphicacy have contributed to explaining aspects of the graph comprehension process as well as aspects of the structure of the visual displays used to depict data. For example, psychologists have focused on features and characteristics of graphs, analyzing the components by parsing, and speculating how the features influence comprehension. Building on these ideas, several studies have focused on different features of graphs examining the influence on comprehension, and reading researchers have analyzed the nature of graphs to propose a theory and taxonomy supporting instruction and assessment.

Statisticians and statistics educators have focused on the nature of data and how data determine the type of visual display created to communicate messages and patterns. To maximize the effects of these theories and perspectives on curriculum and instruction, an attempt to identify similarities among these perspectives and to formulate an evolving cohesive theory of graphicacy is the subject of this presentation.

Curcio has identified three components of graph comprehension that are useful in framing questions and eliciting readers' levels of text processing and understanding. The first two components, that is, reading the data and reading between the data, focus on elementary levels of questioning that involve data extraction and data comparison, respectively. The third component, reading beyond the data, a higher-level thinking skill, involves extending, extrapolating, and making predictions from the data.

Teaching Statistics to Reluctant Learners

Sue Gordon, University of Sydney

The Mathematics Learning Centre at the University of Sydney was established in 1984 with the aims of increasing access to mathematics as well as improving the completion rates for students studying mathematics and statistics. Students of the university attend the Centre voluntarily to get help with a range of mathematics and statistics courses. One of the largest groups of users of the Centre are students studying statistics as part of other subjects, for example Psychology or Public Health. Statistics, which provides a tool for dealing with complex and real life data, appears to be an eminently suitable link between mathematics and other subjects. It provides a bridge between abstract concepts and processes and the physical and social world. However, many of the students I teach are not interested in mathematics or have little background in it. Some of them experience considerable difficulty learning statistics. My research into these and other university students' learning of statistics is based on activity theory.

This approach posits a systemic view of learning in which goals, subjective perceptions and socio-historical factors are interwoven. While teachers try to emphasise the usefulness of statistics, the activity framework suggests that no one can persuade a student of the power of a tool. This discovery depends on the students' experiences of its functionality. The link between mathematics and other subjects must be an internal one - in the students' minds.

This presentation uses the lens of activity theory to look at the perceptions of some psychology students who attended the Mathematics Learning Centre to get assistance with statistics. I suggest that for statistics to be an effective link with other subjects we must aim to educate our students beyond competency. That is, in addition to teaching technical skills and abilities and assessing these against set standards we must aim to enhance their statistical "capability" - the capacity of students to use their knowledge and skills in statistics creatively and confidently.

Bringing the Real World into Statistics Assessment
Sharleen Forbes, Wellington, New Zealand

In the final year of secondary schooling New Zealand students may choose to sit a national qualification, Bursary (and up to 1990 an additional 'elite' Scholarship examination). In 1991, Mathematics with Statistics was the most popular subject choice for Bursary by males (taken by 63%) and Mathematics with Calculus (taken by 48%) was their third choice after English. Mathematics with Statistics however, was the second choice for females (taken by 49%) after English, and Mathematics with Calculus the fifth choice (taken by 31%) following Biology and Geography (Ministry of Education, 1992).

For some years Mathematics with Statistics has consisted of an internally assessed component (20%) and a tradition end of year three hour written examination component (80%). Female students, on average, perform better in the internal assessment than the in examination. The reverse is the case for male students (Forbes, 1994). The two assessment procedures test different skills and the differential performance may, in part, be the result of the different subject combinations of male and female students.

The 'real-world' context of the statistics questions in these Bursary and Scholarship papers for the years 1986 -1995 is analysed both in terms of 'gender-neutrality' and 'relationship with other subjects'. For those years (1986 - 1988) for which the data is available, the relationship between gender differences in question selection and performance and question context is analysed. As male and female students at this level have different subject combinations the contexts used in examination questions may produce gender biased performance results. The difficult issue is how to make such assessment interesting, but fair, to all groups of students.

Student Analysis of Variables in a Media Context
Jane M. Watson and Jonathan B. Moritz, University of Tasmania

Assessing statistical claims from the media is fundamental to being statistically literate. In making an assessment it may be necessary to visualize the claim being made. Such is often the case when cause and effect assertions are made for two or more variables. The contexts in which such claims are made can be quite varied and overlap other areas of the high school curriculum than mathematics. It is important for mathematics teachers to be aware of the contexts which can motivate an understanding of the statistical principles and it is important for teachers of other subject areas such as science, social science, health, and technology to be aware of the mathematics necessary to make sense of statistical claims in their own areas.

A media survey using newspaper extracts covering different topics in statistics was administered to samples of grade 9 and 10 students in Tasmanian government schools. The survey included the item shown in below, which is the item analysed in this report.

Family car is killing us, says Tasmanian researcher

Twenty years of research has convinced Mr Robinson that motoring is a health hazard. Mr. Robinson has graphs which show quite dramatically an almost perfect relationship between the increase in heart deaths and the increase in use of motor vehicles. Similar relationships are shown to exist between lung cancer, leukaemia, stroke and diabetes.

> Draw and label a sketch of what one of Mr. Robinson's graphs might look like.
>
> What questions would you ask about his research?

The analysis of the responses is in two parts. The first considers the types of graphs used by students to illustrate the relationship claimed in the article. These responses are classified by type and summarised by grade level. The second part of the analysis considers the types of questions which were suggested for the researcher. These were classified in several categories, including those related to the context but not any statistical question, those which considered some aspect of the statistical setting, those which questioned the relationship of the variables, and those which suggested alternatives.

The discussion includes reference to the statistical skills and concepts required to adequately deal with an item such as this from the media, the teaching implications for the mathematics class, and the implications for other subject areas such as social science and health.

CONTRIBUTIONS WELCOME!

Readers are invited to submit news items or short articles on statistics education for possible printing in this column. Please send your contributions to:

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