IASE matters

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HOT-FOOT FROM MOROCCO

The 4th International Conference on Teaching Statistics, ICOTS-4, was held in Marrakech, 25-30 July, attended by more than 300 delegates representing 45 countries. This report focuses on developments in two broad topic areas; Research and Technology. The next issue will include a report on Curriculum Developments. Further reviews will appear in the next issue of ***IASE Review*** *which will soon be distributed free to all members of IASE.*

Research into Teaching and Learning Statistics and Probability Concepts

Andrew Ahlgren and Joan Garfield [Address in 'News' section on page 4]

The central problem in statistics education is not how to optimise students' learning of statistics but how to help them to understand statistical reasoning *at all.* Research on isolated aspects of instructional technique cannot help with this problem. Yet research on statistics teaching tends to be a "cottage industry" of mostly unconnected, small-scale projects. The total number of people involved is also rather small. Progress on the central problem will require coherence among different groups' studies and perhaps even some consensus on priorities for what and how to investigate.

The research sessions organised for ICOTS-4 began to show the necessary concern for coherence and priorities. Rather than reporting on diverse, unconnected studies, researchers explored topics that address larger and cross-cutting issues on how students do or don't learn statistics and probability. A total of 23 papers were presented in three invited paper sessions and two contributed paper sessions, representing research conducted in 11 different countries on students at all educational levels.

In the first session, Marie-Paule Lecoutre [France] described the great variation found in students' conceptions of statistical problem situations. Carmen Batanero and Juan Godino [Spain] presented methods of displaying some fairly complex relationships among students' ideas. Rolf Biehler [Germany] shared concerns about how two of the major lines of thought - probability and descriptive data analysis - may produce in students conflicting ways of thinking. Manfred Borovcnik [Austria] encouraged the use of analogies as a general and powerful strategy for teaching understanding of statistical concepts. The discussant, Andrew Ahlgren [USA], recommended that analogies could be extended to more complex stories - like fables and myths - in which multiple issues and points of view could be represented.

In the second session, all papers focused on issues related to assessment. Brian Greer [Northern Ireland] reported on teachers' readiness to teach data handling. Kay Lipson [Australia] described the use of concept maps to assess students' "concept images" of sampling distributions. Jane Watson [Australia] reported on assessment of school children's understanding of statistical concepts. Joan Garfield [USA] used assessment to determine students' informal intuitions relating to statistical power before and after formal instruction. Flavia Jolliffe [UK] stressed the importance of students explaining "why" they selected a particular test answer if we are to understand their statistics reasoning.

In the third research section, coherence was achieved by a common focus on particular tests of probabilistic understanding - on the domains of knowledge they purport to represent, and on the properties of their scores. Claude Gaulin [Canada] and Juan Godino [Spain] reported on collaborative studies involving researchers from several different countries. We hope that increasing agreement on what and how to measure students' understanding will enhance the comparisons and mutual influences among different researchers' work in the future.

The two contributed paper sessions included several presentations on assessment issues as well as reports of large-scale empirical studies, informal classroom research, and in-depth interview approaches. Several papers reported work in progress that should lead to interesting results for future conferences.

International Association for Statistical Education

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The sharing of research findings on centrally important issues was further fostered by informal meetings of the International Study Group for Research on Teaching Probability and Statistics, convened by Joan Garfield. These will hopefully lead to collaborations, bringing even more coherence and focus on high-priority questions that will be evident at ICOTS-5.

Hardware, Software and Multimedia methods

This overview has been compiled with the help of a number of session organisers and other delegates.
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There is no unified approach to software development. Individual suppliers such as Minitab, SPSS, SAS, etc., continue to provide upgrades. Unfortunately, there is still very little learning design in these packages. Commercially available packages are usually inadequate for motivating students to learn statistics.

The use of video material is increasing, but linking this medium with the interactive facilities provided by MACs, PCs and other hardware equipment is in its infancy. Student-centred learning material is being developed, mostly for PCs, using authoring languages such as *Toolbook* and *Authorware*, the latter providing the facilities for easy transportation to and from MACs.

There is a clear desire to reach out to more students both physically (*via* distance learning) and mentally (to those with less than adequate quantitative/mathematical backgrounds). Self-paced learning software that is delivered to a TV from a remote PC, perhaps at the local college, university or school, may help to achieve these objectives. The explosion in information highway technology will assist and we may see the beginnings of its effects by ICOTS-5.

Paul Velleman and colleagues [USA] have embarked on a major multimedia project. Joyce Niland [USA] will be authoring biostatistical software for computer aided instruction using *Toolbook*. There has been considerable open learning development in Australia in the last two years, and more recently in Japan. The Australian project used national television extensively with the visual material linked to a statistics book, video and Minitab. Kathryn Voit [USA] reported a major change in students' attitudes to statistics on viewing a TV programme in the *Against All Odds* Series. The Open University [Jan Jaworski & Dan Lunn, UK] is to publish a series of videos linked to software and a new text for introductory statistics. The Statistical Education Through Problem Solving (STEPS) consortium [Neville Davies, UK] is producing modules for student-centred learning statistics materials, authored in PC, MAC and X-Windows environments.

It is undoubtedly true that the financial costs of multimedia technology are not insignificant. Student access to computers continues to be a challenge, especially access to state-of-the-art hardware, and especially in developing countries. E-mail has been a marked step forward, but it is not available to everybody.

For some teachers, reliance on technology could cost them time as well, if student groups are too large for "one sitting" in the computer laboratory. It also takes time for teachers to evaluate different packages and systems of teaching. Computers are not good at evaluating students' progress and needs. These aspects still need the "human element". For some, time spent in guiding students could be greater than they would have spent in teaching them. There were, however, teachers who felt that their workload was decreased as students relied more on their own intellectual resources. For example, by the time students formulate a query for transmission over e-mail, they may well have found the solution themselves. Alternatively, more resistant problems can usefully be turned into e-mail group exercises.

Multimedia systems can give students anonymity, making them more willing to access available on-line remedial help. It is certainly also the case that good videos and multimedia methods and materials can help to give students a realistic impression of statistics and of the way in which statisticians work. Experience can precede theory so that theory, when it is covered, is more easily assimilated.

There are dangers to avoid. Some students "cannot see the statistics for the technology". Software should not obscure the concepts, and hypertext links may not correspond to conceptual links. Software should provide access to up-to-date data, allowing real-life issues to be investigated. It should also teach students to make choices. Looking to the future, perhaps software will enable computers to understand natural speech, to diagnose students' errors and to adapt automatically to students' levels.

Copies of the pre-conference proceedings (2 volumes) are available; INSEA, PO Box 6217, Rabat-Instituts, Rabat, Morocco, price $US 60 including postage.

A BIASED VIEW FROM AN OUTLIER

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Every cluster of statisticians has its outliers. The vast majority of ICOTS-4 delegates were university teachers of statistics - some teaching

for a particular specialism, some general purpose statistics teachers and others training teachers of statistics. The remainder of the delegates were a handful of statisticians from industry or government departments and a very few school teachers. It is a pity that there were so few of these outliers. ICOTS is an opportunity for exchanging ideas, for seeing what happens to students after school, and for teachers to influence those involved in developing statistical education. Of the subject specialists, the majority seemed to be involved with economics, management, social sciences or psychology. There were fewer in medical and agricultural sciences and almost none from biological sciences. This is a pity because biology, and geography, are perhaps the two school areas which are most strongly linked to statistics. They can form good platforms for cross-curricular statistics in schools.

I must confess I went to Marrakech a little in fear of being treated with condescension from the academics but this fear was ill-founded. Most researchers in statistical education appreciate that teachers have profound knowledge of teaching, even if that knowledge is not published in research papers, nor necessarily coherently organised! Indeed, many teachers at university who deliver statistics service courses teach at a lower mathematical level than do A-level statistics teachers. I was impressed by the organisers who took the trouble to speak to me personally and make me welcome.

An eye-opener for the teacher is to see how the conference system works. For the most part, provided a university teacher's paper is accepted for delivery at the conference, it appears that the university will meet the costs of the conference for that lecturer. The British school teacher lives in a different world, with almost no chance of the institution funding a place at the conference. Undoubtedly ICOTS would be a richer forum with more school teachers - solutions to this problem would be welcome!

One theme was *The Statistics Curriculum: towards the year 2000.* Several different language groups deliberated. It was clear that the cultural, political and economic differences between countries make a single ideal curriculum an impossibility. Currently some countries do not have adequate teaching or computing resources, and others are working under strict political control where an open-ended learning style is seen as subversive. In other places, student pressure demands a traditional didactic approach which is seen as the key to exam success, career prospects and money. The wisest thing, I feel, was the notion that a suggested ideal curriculum be developed by IASE (though by the year 2000 is probably too ambitious) and that countries take from this the parts that they could benefit from at that stage. Having seen the resentment that an imposed curriculum can cause, I can see only advantages in offering a model curriculum but not forcing it upon unwilling people. It would be very easy to criticise the lack of willingness to progress far being shown by people in some countries. However such meetings give an understanding that a little progress under difficult conditions is better than a grandiose plan with no chance of any success.

It was interesting to compare differences and similarities between the constraints on statistics teaching in different places. Almost everywhere there were pressures on the statistical curriculum from political masters, often resulting in conflicts between assessment as a teaching tool for teachers and as a monitoring tool for the politicians. Many countries are moving towards a national curriculum. Hopefully, international forums, such as ICOTS, will help other countries to implement the valuable features of a national curriculum without the administrative chaos that has dogged the British model.

A number of conflicts became apparent. The nature of teaching statistics is changing, from giving a high level of statistical skill to a few, to giving statistical literacy to as many as possible. This creates tensions for mathematics teachers (the traditional deliverers of statistics). Their approach must change from formal mathematical rigour to a more interpretative approach. Successful teaching may now require understanding of other subject disciplines (for statistics is of little value to most people unless applied to something). Teaching such applications may lead maths teachers into discussing political or social issues - an area where they feel poorly qualified. Conversely subject specialists often may not have the mathematical background to handle statistics well. Cross-curricular work is clearly the answer, provided all parties are willing.

Many papers addressed software for statistics. A wide variety of approaches were discussed, ranging from those eliciting the comment "More colourful banality is not an improvement", to open ended learning packages which more fully exploit the potential of computers. Simulation is generally seen as a powerful weapon that can be used to impart understanding of variation or, perhaps more importantly, for bootstrapping or resampling approaches to hypothesis testing. An important feature of computers is that they should have an easy user-interface and multiple dynamically-linked windows. The British user of Acorn RISC machines can feel a little smug here, although sadly most of the software development effort is concentrated on the PC. A wise statement was made "Learning to use the software must be much easier than learning the statistics it is used for".

Spreadsheets were seen as an invaluable tool.

Unlike much computer software they are not perceived as black-boxes - more like *boîtes-blancs* one lecturer proposed. They can also be adapted easily and are non-intimidating, lending themselves to "What if?" explorations. They are not the complete answer, but do go a long way towards it.

Naturally, many papers were concerned with how children learn (or fail to learn), delivered by experts in teacher-training and in researching statistical education. Most speakers were deeply aware that teachers trying to come to terms with the demands of the increase in statistics in schools need help and support, not condescension. They were also clearly keen and able to learn from teachers. On the other hand, there were a few who were not like this. After all their research into the efficacy of various teaching styles, their conclusion was usually that interactive problem-based learning was more effective than traditional lecturing. Transfer of learning is, however, often a problem, particularly among these people it seems, who still manage only to tell others of their results in a traditional lecture. Some of these seemed to be very introspective and to base their conclusions on not only small but also unrepresentative samples (the 30 students in their class). I would like to propose a principle of data analysis which should be followed by all involved in educational research - the number of analyses that are carried out on a sample should not exceed the sample size!

It is increasingly important that statisticians communicate. However, we must be very careful not to be seen as holier-than-thou. Over breakfast one morning, one delegate [Rolf Biehler] told me "If someone tells how I ought to do things, I do not listen. If someone describes the problems and difficulties they have found, then I learn". Sound advice indeed!

Several speakers noted that people in general always look for causes rather than accepting that unusual events may happen by chance alone. For instance, each year somewhere in the USA the media report on a town which has an unexpectedly high incidence of some illness. Causes are investigated and generally not found. The outbreak is a mystery. A statistical explanation is, of course, chance. There are many towns in the USA, and many possible illnesses. It would indeed be surprising if nowhere was there a town which had an outbreak of some illness well above average. We all know that, but it was sad to hear a statistician express surprise that there is just one country in the world where males do worse in statistics tests than females and so further research is required to investigate this country. There are many countries in the world! Shouldn't a statistician expect an oddity or two just by chance?

Was it worth a week of school holidays, away from the shade and tranquillity of English woodland? Yes. I have new ideas and wider perspectives, a clearer vision of why and how to teach statistics. Possibly some questions are answered, but more fruitful ones are asked. Four years seems too long to wait for ICOTS-5.

NEWS

***** ICOTS-5 ***** will be held during the summer of 1998 at a venue in South-East Asia.

50th Session of the International Statistical Institute, Beijing, 21-29 August 1995

IASE sessions: The Relative Roles of Universities and Employers in Training Professional Statisticians; Networking Innovations and Resources - the Internet as Toolbox; Teaching Statistics in Asia; Teaching Statistics in Geographical Courses - Links with GIS (Geographical Information Systems); Statistics at School Level; Training Statistical Staff and Continuing Education in Developing Countries; Statistical Literacy in Educational Programmes; Statistics Service Courses at Higher Education level.
Other Sessions include: Statistics in Education; Research in the History of Statistics; Improvement of Manuals for Statistical Program Packages and Distribution of Software.
Bulletin 1 is available from Executive Secretariat of the 50th ISI Session, c/o State Statistical Bureau, No.38 Yuetan Nanjie, Sanlihe, Beijing 100826, Republic of China. [Tel: +86-1-38-10965/10051; Fax: +86-1-3810035; E-mail: wangjl@bepc2.ihep.ac.cn]

IASE Round-table, Summer 1996, Granada, Spain. Research into the Role of Technology in Teaching and Learning Statistics. *Contact Joan Garfield, General College, University of Minnesota, 140 Appleby Hall, 128 Pleasant St S E, Minneapolis, MN 55455 [E-mail: jbg@vx.cis.umn.edu].*

There will also be Statistical Education sessions at **ICME-8,** (International Congress on Mathematical Education) **Summer 1996, Seville, Spain.**

FREE!! Proceedings of 1st Scientific Meeting of IASE, Perugia 1993. (postage cost of $US 5 payable) *Contact; Giuseppe Cicchitelli, Dipartimento di Scienze Statistiche, Via A Pascoli, 06100 Perugia, Italy [Tel: +39-75-5855242; Fax: +39-75-43242; E-mail: stat7@ipguniv.bitnet].*

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2nd IASE Scientific Meeting, Cairo, 20-21 July 1994, Teaching Statistics and Informatics at All Levels. A report on the proceedings of this Arabic-language meeting will appear in the next edition of the IASE section of *ISI Newsletter* (distributed free to all IASE members).