
Progress on Where Are We Now Project

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In the last MSOR Connections [1] we introduced the Where Are We Now project, aimed at identifying and disseminating good practice in learning and teaching MSOR across the higher education sector. There we described our preliminary analysis using the Subject Review reports as the primary source of information. The next step is to concentrate on a number of areas of current importance, to identify good practice in these areas and disseminate that via a number of means. The areas are

- Access/widening participation, and its implications for student support
- Innovative use of CAL/IT and other methods in teaching and learning
- Student mentoring and peer tutoring
- Student record systems that help in early identification of potential progression problems
- Effective and innovative assessment
- Transferable skills

There are of course overlaps between these areas and with other LTSN projects such as *Evaluating and Enhancing the Effectiveness of Mathematics Support Centres* [1]. Also, the methodology used here can be effective in support of areas not included in the above, such as the ILT funded Staff Development Project [1].

Proven good practice in at least one of the above areas was identified in two thirds of institutions. We are currently establishing contact with them to commence the dissemination process. In particular, we are currently working on access/widening participation, and looking at examples of what people are doing in this area to:

- recruit from more diverse sources
- match curricula to a more varied intake profile
- support the wider range of non-standard (in relation to the university's normal provision) students
- retain such students and realise their potential

A report on this will appear in the next Connections, but the following indicates the sort of things that are coming out of the reports:

- An initiative at Bath university involving collaboration between the university and local schools and colleges aimed at investigating pre-university teaching and learning styles in mathematics
- Bolton Institute's IMA Polymaths course that offers substantial added value and a route into higher education for students lacking a strong background in mathematics
- The use of student questionnaires at Chester College of Higher Education to identify the specific needs of mature students and adapt the academic provision and support accordingly
- University of Huddersfield's effective teaching and learning on the Women Into Technology course, taken mostly by mature students and an exemplar of productive student participation and shared ownership
- Hull University's franchised foundation year delivered at Wyke College provides a well supported access route to university mathematics for students with a wide range of backgrounds and qualifications



A project funded by LTSN
Maths, Stats & OR Network

Such examples have impressed reviewers and are exemplars from which the sector can learn - and there are many more examples from other institutions that we shall be contacting shortly.

Although the QAA Subject Review reports formed the initial resource for information they will, of course, be followed up by discussions with providers and by peer

judgement and reputation. Also, it is probable that many good things were missed in Subject Review and so we need people to tell us what they doing.

References

- [1] *MSOR Connections*, vol 1, no 3, August 2001, LTSN Maths, Stats & OR Network

Statistics Education Downunder: a snapshot of a decade and a glance to the future

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Some tempting phrases considered for the title of this article included "...: the good, the bad and the beautiful" or "...: the increasing contrasts of statistical richness and statistical poverty". On reflection, the diversity and contrasts in statistics education indicated by such phrases, are not surprising given the roles played by the statistical sciences across so many areas and ages interwoven with social, industrial, scientific, business and government concerns. Features of the past decade include the excellent work of individuals in various areas at school, tertiary and continuing education levels in thoughtful response to needs of students and client groups, against a larger backdrop of increasing general awareness of the importance of statistical literacy contrasted with a general community lack of expertise and understanding of how to achieve it. The effects of the strange juxtaposition in Australia in the last decade of increasing appreciation within business and industry of the value of quantitative training versus an anti-quantitative movement arising from ignorance or a taking-for-granted, whether conscious or unconscious, are in need of community attention and awareness. Much of the ignorance lies in absence of understanding of the strong generic attributes of quantitative learning and how these are attained.

This article can capture only some of current and recent developments and challenges in statistics education in Australia. Positive developments have tended to emphasize statistical thinking, real problems and workplace/discipline linkages, student/worker ownership, effective use of technology, awareness of cutting edge issues, and increasing consciousness of generic skills. The achievements of individuals in statistics education have parallels in other quantitative, real world areas in mathematics, science, engineering, information technology, health, finance. In all quantitative areas, at all levels, there is a feeling of stretched resources, particularly people resources. Cooperation between quantitative people and areas is the key for a future that builds on achievements to date and continues to grow.

A snapshot of developments linked with the professional society

Briefly tracing the developments in statistics education in workshops, conferences and symposia provides an overview of the growing awareness of the importance of educational issues for the whole of the statistical profession, whether directly or indirectly through the education of future users, clients, co-workers, collaborators as well as that increasingly rare and valuable breed – graduate statisticians.

The Statistical Society of Australia Inc (SSAI) has special interest sections with current membership (overlapping) as follows: Survey and management (229); Statistical computing (263); Medical sciences (260); Biological sciences (266); Education (215); Industrial statistics (168); Young statisticians (94); Earth sciences (55); Economic statistics (168). These have formed gradually since the early to mid-eighties, with the Young statisticians being the most recently-formed section, in 1994.

Australian Statistical Conferences (ASC's) are held biennially, with a variety of combined special interest meetings in the alternate years. At the ASC in Sydney in 1990, there was just one session on statistics education. In 1992, in Perth, a statistics education workshop was held before the conference, but it was not advertised in conference flyers, and there were no education sessions in the main conference. Statistics '93 in Wollongong featured education as a main strand, but again in 1994, there was an education workshop before the ASC but no sessions in the main conference. In 1996, the Sydney International Statistical Congress combined an ASC, an IMS special topics session, and Interface '96. A statistical education workshop not only preceded the conference as an official conference "satellite", but following my request, a strand of three sessions on education was part of the main conference. At the 1998 ASC on the Gold Coast, one session consisted of a panel and debate on education, with another session during the conference, while the 2000 ASC in Adelaide saw a satellite workshop plus plenary emphasis on education.

Chairs of the statistical education section have included Ken Sharpe, Brenton Dansie and Pam Shaw, while Brian Phillips was a member of the founding executive of the IASE and went on to become a vice-president and president. Following ICOTS5, Brian organised, on request from Australians unable to attend ICOTS, a "corollary" Oz symposium in Melbourne. This has continued as an annual event, now called OZCOTS. A recent symposia on teaching statistics in Newcastle is intended to be the first of an ongoing series helping university staff in networking, exchanging ideas and sharing resources. Members of other SSAI sections, particularly the Industrial statistics section, have increasingly contributed significantly to continuing education in workplaces.

The past decade has seen the SSAI both mature and face new challenges. A rewritten constitution, establishment of a meaningful accreditation process and a code of ethics, establishment of the Australian and New Zealand Journal of Statistics, have underlined the increasing sense of a statistical profession, and consciousness of

the practice of statistics. 2001 saw the introduction of society-sponsored professional development workshops, with the first two being in Advanced Statistical Consulting and Applied Resampling Methods. Ironically, simultaneous challenges for the SSAI have come from the departures of university statisticians (to industry, government or overseas) as government "clawbacks" undermined quantitative areas in particular, and the need for greater professional identity across the diverse workplaces of statisticians.

A snapshot of tertiary developments

The most striking contrasts in tertiary statistics education over the past decade in Australia appear to be between the curricula and approaches of those actively associated with the statistical profession, no matter who they are teaching and whether in a statistics group or not, and those who are isolated from the profession, whether through longterm isolation of their discipline, or through misguided beliefs that statistical understanding is not necessary to teach statistics within other disciplines.

The combination of: professional emphasis on the practice of statistics and hence of real problems, real data and real interdisciplinary interaction; general focus on tertiary teaching; greater awareness of linking with students' pasts, presents and futures, and hence of teaching as facilitating learning; enhanced opportunities through technology in both the using and teaching of statistics; diverse developments at the cutting edge of using statistics; and a refusal to allow resource deprivation and a decline in quantitative respect to affect commitment, has produced thoughtful and innovative developments by individuals across Australia. In addition, the inherent attributes of the good practice of statistics seem to encourage awareness of the importance of fostering generic skills in oral and written communication, and problem-tackling.

The ideas of problem-based learning and collaborative teaching packages (e.g. Dansie, 1998) have influenced statistical teaching but there seems to be general acknowledgement that an approach of structure and real problems in parallel (e.g. Sowe, 1991, 1998) helps students develop their concepts and practical confidence. The hands-on approach, ownership of learning and synthesis of skills have come through in a variety of approaches in own-context student projects, in mainstream mid-course (Mackisack, 1994), in introductory subjects both mainstream and service even for larger cohorts (MacGillivray, 1997), and in industry projects and apprenticeship consulting (Diamond and Hallett, 1998, Bishop and Jarrett, 1999). The management of large classes has not prevented

focus on student learning (e.g. Shaw, 1998), nor production of memorable vignettes that catch the imagination as well as stimulate statistical understanding (Petocz, Griffiths and Wright, 1996, Pierce and Roberts, 1998, Jones and Crowe, 1998).

Although introductory teaching is group and client-oriented, the distinction is less now between “mainstream” and “service” than between different quantitative orientations. Most Australian introductory statistics courses either combine mainstream with other groups or facilitate ease of movement between mainstream and quantitatively-oriented service courses. In focussing on student needs and the practice of statistics, statisticians realised they were focussing on teaching statistical thinking and fostering quantitative generic skills. That is, these educational strategies are inherent to an overall approach rather than existing on their own or as abstract concepts. In statistics, ownership and synthesis of concepts, skills and judgement are pivotal to statistical confidence. These were core motivations in the STEPS project and continue to be core (e.g. MacGillivray, 1998).

Computing technology has expanded horizons for both learners and teachers, through greater accessibility to techniques, demonstrations and visualisation, enhancing both skill and conceptual development. However statisticians have quickly learnt that an educational strategy is more important than elaborate technological “bells and whistles”. For example, demonstrating the interpretation of confidence intervals requires no more technology than what is readily available in a statistical package such as Minitab. The simple dynamical demonstration of least squares in C.I.T. (Bowman and Robinson, 1990) is as effective still as subsequent more elaborate versions of the same educational strategy, and although students find the computer vehicle of GASP (Graphical Aids for Stochastic Processes) amusingly old-fashioned, they appreciate the excellent demonstrations of its graphics screens. Statisticians have also worked constructively with the limitations and frustrations of Excel and graphics calculators in order to maximise student access to at least some statistical technology (e.g. Boyle, 2000, Lipson and Jones, 1997).

Although the above are representative of achievements and there is still much to develop, the educational lag in statistics courses with no or negligible links with statistics itself, has increased with the accelerated focus on education by the statistical profession. Apart from classic bloopers such as testing that two data averages are equal, and assigning a code of zero to Not Applicable because “there’s nothing at zero”, statistics teaching

that is isolated from statistics tends to now demonstrate, ironically, more theoretical and abstract approaches and less contact with real problems, as well as rules and jargon that hide rather than reveal statistical thinking.

Most attention has been given to data analysis, but in quantitative areas in business and information technology as well as in engineering and areas of the mathematical sciences, the use of basic stochastic processes is increasing in importance, and the teaching of these with their data analysis and associated inference is potentially educationally rich and rewarding.

A school glance

The school scene is generally characterised by acknowledgement of the importance of “Chance and Data” but also by significant absence in knowhow and resources to support this, and sometimes even to identify what can or should be done. The work of individuals such as Watson (1997) in developing modern resources and approaches, tends to emphasize even more the old-fashioned and restricted nature of examples and descriptions in many curricula documents such as the National Numeracy Benchmarks for grades 3, 5 and 7 (these benchmarks are intended to mark the lower limit of acceptable achievement) and in many school texts. Marbles, coins and sterile data and approaches still abound, while at the senior school level, the persistence of examples, jargon and misrepresentations from many years ago is inhibitive to both students and teachers. The deterministic/scientific background of many maths textbook writers is very apparent. The many teacher requests for help from statisticians, and the positive reactions to the creation of rich resources such as the Census-at-School project, are indicative of teacher awareness of the need for updating approaches and developing relevant and modern resources.

A glance to the future

The challenges within statistics education are never trivial but offer opportunities inherent to the richness of statistics as a discipline and a servant. The external challenges current in Australia are many, including: too few tertiary statisticians and statistical majors; university structures that tend to encourage competition rather than cooperation between faculties and thus tend not to reward good service teaching; the juxtaposition of a general decline in quantitative preparation versus increased quantitative needs of business and industry.

The pressures across Australia on mathematical/quantitative training are real and potentially damaging (eg MacGillivray and Moody, 2001). Recent

developments in mathematics education are motivated similarly to statistics, with emphasis on modelling and mathematical thinking, real problems, links with industry and other disciplines, awareness of the generic attributes developed by mathematical training. There is increasing awareness that cooperation across the quantitative areas is becoming essential to reverse a general tendency to quantitative decline in Australia and to facilitate economic and social progress.

The awareness in the statistical profession of the importance of statistics education and the commitment of individuals to their students and the good practice of statistics, have laid excellent foundations for the future. The challenge of increasing awareness and acknowledgement across the community needs cooperation with mathematical sciences and across the quantitative disciplines.

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