

DISSEMINATION OF GOOD PRACTICE IN TEACHING, LEARNING AND ASSESSMENT OF STATISTICS IN HIGHER EDUCATION

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The Association of Statistics Lecturers in Universities (ASLU) was founded in 1983 “to foster and support the development of statistical education”. This paper aims to demonstrate how this has been achieved through the Association’s regular conferences. These bring together teachers of statistics in HE institutions to highlight teaching, learning and assessment issues and how these respond to a changing student intake and the knowledge and skills required by employers. Speakers are invited from those lecturers who can demonstrate good practice or who have novel ideas in teaching, learning or assessment that may benefit ASLU’s members. Other presenters are those who can report on wider issues in statistical education such as funded research.

INTRODUCTION

In the early 1980s there was a growing interest in developments in teaching, learning and assessment methods used in statistics in higher education (HE) in the UK. This led to the formation, in 1983, of the Association of Statistics Lecturers in Polytechnics (ASLiP) to be a forum for discussion of pedagogic issues and dissemination of good practice. In 1992, when the polytechnics were given university status, ASLiP was transformed to ASLU still with the aim “to foster and support the development of statistical education in HE”.

Changes in statistical education at tertiary level have been informed by research which increasingly emphasises statistical understanding, thinking, reasoning and literacy, the use of real data in context and a problem solving approach, all influenced by technological advances. As Garfield (1995) points out “Statistical educators need to determine what it is they really want students to learn, to modify their teaching according to suggestions from the research literature and to use assessment to determine if their teaching is effective and if students are developing statistical understanding and competence”.

ASLU has held regular conferences at various UK universities and at the Royal Statistical Society headquarters in London. Topics covered are of general interest in the areas of statistical education, including computing and vocational links applied to statistics, as well as enabling dissemination of current thinking in statistical education research. Thus speakers have ranged from practitioners who have developed good ideas for use in the classroom, to those who report on the outcomes of a particular project in statistical education. The conferences inform and update the membership about innovative practice in teaching, learning and assessment and wider issues in statistical education. The following sections highlight some of the contributions made to developments in teaching and learning, in assessment, and in a wider view of statistical education in the UK, as evidenced from ASLU conferences.

TEACHING AND LEARNING

Some of the greatest changes in the way that statistics is taught result from the huge expansion in the availability of computers and the internet, including access to a wealth of data. Investigating and modelling real data, in an appropriate context is acknowledged to increase students’ interest in, and enjoyment of, their statistics course. This is particularly so for those whose main subject is another discipline. The problem solving approach, with its emphasis on collecting, processing and interpreting data, with the ability to communicate results effectively, can enable students to develop statistical thinking and reasoning skills. The collection and manipulation of data has become less difficult with technological advances and readily available computer packages. Thus students can use exploratory data analysis easily and, for the more advanced, model the data using quite complex methods.

Over the years, particularly since 2000, ASLU conferences have included several presentations on innovations in teaching and learning that have used various computing techniques. The growth of interest in computer aided learning led some of the Mathletics developers (www.mathletics.co.uk) to also address the pedagogic issues in setting objective questions in statistics; they presented their work at the 2003 conference, giving an overview of online mathematics and statistics tests. In 2005 Richard Castle from Brighton University demonstrated using Excel in teaching to help with problem-solving, creativity and imagination, teamwork and collaborative learning and active learning. Thus spreadsheets can be used as an interactive tool for teaching and learning which helps the less mathematically able. At the same conference, Sidney Tyrrell, a National Teaching Fellow, demonstrated using animations to make statistical concepts more accessible to students including those with disabilities. Charles Taylor from the University of Leeds introduced participants at the 2007 ASLU conference to the benefits of teaching using R. These included that it is free, open-source software that runs on a variety of operating systems. It has good help facilities, excellent graphics capabilities and is generally very flexible, including being easy to extend or migrate to S Plus.

In line with a problem solving approach, the Statistical Resources from Real Datasets (STARS) (stars.ac.uk) project, which was funded by the Higher Education Funding Council for England for three years, aimed to make available real datasets and associated scenarios applicable to a range of disciplines and to develop learning and assessment materials to accompany these datasets for use with various statistical packages. One of the main challenges of this project was the identification of suitable, real datasets and the determination of the accessibility of the corresponding databases. Outcomes from the project were disseminated at different stages of its development at both the 2003 and 2005 conferences, including trialling some of the materials.

The different ways in which undergraduates and school students think statistically was shown in a study by Hannah Lewis and Jane White of Bath University, who compared aspects of probability teaching across the school-university interface. The main areas considered were the student/teacher interaction, the type of examples given and the support required. The main differences between A level and undergraduate students were found in notation, rigour and formality so that symbols are always stated explicitly in undergraduate material.

ASSESSMENT

A report on teaching, learning and assessment in Mathematics, Statistics and Operational Research (MSOR) in England and Northern Ireland stated that assessment was one of the most problematic areas. However, it noted that “Student engagement and performance has often been greatest when dealing with well-focussed problems of a practical nature (MSOR Overview Report, 2000). A follow-up study by Bidgood and Cox (2002) reported that good practice involved a wide range of assessment instruments to be used to address learning objectives so that students, with their different strengths and approaches to learning have a variety to demonstrate their abilities. There have been many changes in the assessment of statistics at the university level, reflecting that students are increasingly driven by assessment and that computer software is becoming an integral part of the evaluation process. This means that students can be asked to implement more advanced techniques and those with a weaker mathematical background can also be taught when such techniques are appropriate and how to interpret the output. Assessment methods have featured at several ASLU conferences over the years, including that of 2009 which focussed on assessment, as it showcased some of the outcomes of the Variety in Statistics Assessment Project.

In 2000 Peter Holmes, from the Royal Statistical Society Centre for Statistical Education (RSSCSE) highlighted the rise in emphasis on assessment and warned of the dangers that teaching and learning could be dominated by assessment, thus distorting the process: “the aim of education is that students should be educated, not that they should be able to meet the assessment criteria”. He also advocated more innovation in the assessment methods used—this echoed the growing thoughts at that time and since that different kinds of assessments are appropriate for different purposes and a mix of these might be desirable (Holmes, 1997).

The growing awareness that good assessment can aid learning and the increasing use of computing led Chris Ricketts in 2003, to demonstrate computer-aided assessment (CAA) that he used in large service courses in Business and Biology. Generally, his students preferred CAA and

found it more motivating and “fun” to use; CAA could be used for both formative and summative assessment if managed correctly. The ARTIST (Assessment Resources Tools for Improving Statistical Thinking) (delMas et al., 2006) software was demonstrated at the 2007 conference by Ann Ooms, who had worked with the originators from the USA (delMas et al., 2006). The ARTIST project is a good example of funded educational research bringing about a change in assessment practice. Its goal is to help lecturers assess statistical literacy, reasoning and thinking in introductory courses in statistics and the website provides a variety of assessment resources for teaching such courses. The 2007 conference also saw results from the PiSA (Plagiarism in Statistics Assessment) project, which had been sponsored by the RSSCSE. One of the outcomes of this project was the realisation that many statistics lecturers had developed methods to individualise assignments in an attempt to avoid plagiarism, which is an increasing problem in HE particularly with easy access to websites and other electronic sources.

Individualising assessment is also one of the four themes of the ViSA (Variety in Statistics Assessment) project, the others being relating assessment to the real world; assessing statistical thinking and successful assessment strategies. The 2009 conference was devoted to this project and representative speakers from each of the themes were able to update ASLU members on current thinking in each of the areas. For example, Neil Spencer from the University of Hertfordshire demonstrated an individualised assessment system that he used in introductory statistics modules in Business courses and Neville Davies, director of the RSSCSE, gave an overview of current thinking on good assessment strategies. It is perhaps appropriate that Peter Holmes, who spoke about assessment in 2000, should write the foreword of the forthcoming book on the findings of the ViSA project and state “assessment is amongst the most useful things that we do for ourselves and our students... It is harmful when it is seen as an end in itself” (Bidgood et al., 2010).

THE WIDER VIEW

In 2000, Flavia Jolliffe informed ASLU members of the outcomes of the IASE Round Table on training researchers in the use of statistics. At that time, she concluded that there were many encouraging developments world-wide to help statisticians meet this challenge. ASLU was one of the sponsors of a major project on the teaching of statistics in UK universities (Smith et al., 2007). This report had ten major conclusions, including that the training of statisticians is inextricably tied to the Mathematical Sciences; other subject areas such as economics and psychology train “metricians” and medicine, one of the largest employers of statisticians, do not train their own at undergraduate level. The number of statistics staff in UK universities has declined and is likely to continue to do so and currently the UK is not producing enough PhDs in statistics to satisfy this market or the workforce in general.

There has been a growing agenda for widening participation in the UK since 1997 with Government strategy to increase participation in HE. Many students come to university lacking the skills required to help them through their statistics courses, including the underpinning mathematical and computing skills. At London South Bank University, Sue Starkings manages the Skills Unit Team which runs several courses and drop-in sessions to help students, whatever their degree route, to acquire the requisite numeracy and literacy skills. She spoke of her work at the 2003 conference, showing examples from statistics including interpretation of graphs and finding summary statistics, both of which are useful skills in many fields. In 2005 seventy four Centres for Excellence in Teaching and Learning (CETL), including three in the mathematical sciences, were set up at universities throughout England. The work of the CETL in Mathematics and Statistics Support, based at the universities of Loughborough and Coventry, was described at the 2007 conference; dissemination of good practice is an important aim of any CETL. This one has established a statistics-focussed centre at Loughborough and its activities included drop-in facilities and diagnostic testing for students to identify and then improve their statistical skills; general training courses and workshops; focussed support for targeted non-specialists; pedagogic research; development of teaching and learning methods and the creation of learning materials. Thus the 2007 ASLU conference was one way of disseminating the work and outcomes of the CETL, which also had the remit to encourage and help others to set up support provision.

CONCLUSIONS

Since the 1990s there has been much reform in statistical education, with a growing emphasis on data-driven educational strategies; on active learning; on the nature of statistical thinking, reasoning and conceptual understanding; and on the roles of technology in statistical education (MacGillivray, 2004; Rossman & Chance, 2002). Increasingly, the view is that statistics is best taught through a problem-solving approach, using real, or at least realistic, datasets in the appropriate context of real problems (Gibson et al., 2007). Teaching and assessment materials which emphasize the importance of using real data and realistic situations have been developed to support these reforms. ASLU, mainly through its conferences has helped practitioners to publicise their work and to bring to the attention of fellow lecturers best practice and innovative ideas in teaching, learning and assessment in HE. These are being informed by statistical education research in statistical thinking, reasoning and literacy and increasingly ASLU conferences have included reports on such aspects.

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