Chapter 8

Clickers in a First Statistics Course

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ABSTRACT

This chapter reports on a three-year project to study to improve student outcomes in an introductory statistics course. Collaboration with a language expert led to the introduction of a variety of student-centred activities during the course. Some were online such as matching terms to definitions and multiple choice quizzes. Some were face-to-face such as the introduction of a student response system (commonly known as clickers). Results show a small but significant increase in grades following the introduction of these two interventions. A meta-analysis of research into the use of clickers was also conducted. This shows a small but significant increase in exam marks for students who used clickers in class. A Statistics Concept Inventory (SCI) was also used to assess students’ understanding of the course concepts. The usefulness of the SCI was partially supported, as many questions were better answered by more able students. The SCI was also used to assess retention from one semester to another. Again, the usefulness of the SCI is partially supported, in that students who remembered more of their introductory statistics study did better in a second statistics course.

INTRODUCTION

A first or introductory statistics course forms a compulsory part of many undergraduate degrees. This may be because of professional requirements e.g. psychology, or university-wide requirements for a wide range of first-year courses. Because of the large numbers of students taking these courses, the course has already been the subject of a large body of research in the last few decades. One of the most recent outcomes of this research has been the Guidelines for Assessment and Instruction in Sta-
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The first course in other scientific disciplines has also received attention. Zhang and Lidbury (2006) identified difficulties with language as contributing significantly to problems students experience in studying Genetics at the University of Canberra (UC). They identified ten strategies from the teaching of foreign languages, and implemented a selection of them in a Genetics classroom with much success (Lidbury & Zhang, 2008). (Zhang, Lidbury, Schulte, Bridgeman, Yates, et al., 2008) applied the same principles to first year Biology, Chemistry and Physics at a number of Australian universities. A selection of language teaching strategies was also implemented in Introduction to Statistics at the University of Canberra (UC) (Richardson and Zhang, 2008a, b). The strategies are given in Table 1. This paper reports on initial attempts to assess retention of knowledge from that revamped introductory statistics course to subsequent courses.

Other successful activities were found in Schaeffer, Gnanadesikan, Watkins & Witmer (1996) including the living boxplot, similar to the living histogram created and photographed by Joiner (1975).

Successful completion of a concept inventory is one of the possible ways of assessing whether learning outcomes of courses have been met. A concept inventory consists of a set of multiple choice questions that test understanding of key concepts in a discipline. The answers are carefully designed to include common misconceptions amongst the distractors. The first one was developed for forces in Physics (Hestenes et al. (1992)) and others soon followed in other science disciplines. These include more general Physics (Yeo & Zadnik, 2001), Biology (K hodor, Halme, & Walker, 2004; Michael, 2007; Michelle K Smith, Wood, & Knight, 2008) and Chemistry (Bowen & Bunce, 1997; S. Krause, et al., 2004; Michael, 2007). The Comprehensive Assessment of Outcomes in Statistics (CAOS) inventory consists of 40 questions (DeI Mas, Garfield, Ooms, and Chance et al., 2005) covering all the concepts instructors would like to see instilled by the end of a first statistics course.

The Statistics Concept Inventory (SCI) (Stone, Allen, Rhoads, Murphy, Shehab, and Saha, 2003) consists of 25 questions, concentrating on descriptive and inferential statistics with a few graphical and probability questions (Table 2). The topics appear in a haphazard order in the SCI, which is reproduced in full in Appendix A.

Our study will employ the SCI, with three questions omitted that pertain to topics not included in our course.

Clicker technologies were first used in educational settings in the 1960s (Judson and Sawada, 2002). Before that they had been used by businesses to collect data in meetings, and by government to collect and display votes in parliamentary settings, for example. Much academic literature makes reference to television programs that also use audience response systems, such as “Who wants to be a Millionnaire?” Lowery

### Table 1. Language teaching strategies implemented in introduction to statistics

| 1. | Providing a list of terms and placing these terms in relation, in groups. |
| 2. | Using warm up activities such as matching terms to definitions for revision purposes. |
| 3. | Using online language exercises such as crosswords, gap-fill (Cloze) exercises. |
| 5. | Providing stimulus questions for lecture and tutorial materials online, thus encouraging students to prepare before the lecture. |
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