TEACHING STATISTICS IN A CRISIS ZONE

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In February 2011 Christchurch, New Zealand, was hit by a large earthquake. Within weeks of this event we were challenged to provide learning and teaching in large tents or using on-line and flexible formats. With audio visual facilities limited to whiteboards and microphones, moving to an on-line environment was a better choice for the introductory statistics course. For two years we have used the lessons we learned to implement a blended learning environment with opportunities for students with different learning styles to achieve success. The on-line environment allows for monitoring engagement and for timely interventions to increase the level of student achievement. On-going improvements provide novel learning opportunities as technology upgrades offer new possibilities. In our presentation we discuss the changes we have made to the introductory statistics course, using feedback from the students to monitor the effectiveness of the learning experience.

INTRODUCTION

The first-year statistics course at the University of Canterbury (UC) is one of the largest offered by the university. The students in the course are very diverse, coming from all corners of the university, but almost all do not intend to major in statistics as is typical of many large first-year statistics courses at tertiary level. About forty-five percent of the students who enrol in the course intend to graduate with a Bachelor of Science (BSc) studying courses such as Biology, Geography, Psychology and Computer Science, and thirty-five percent intend to graduate with an undergraduate degree in a commerce subject. Smaller numbers of students are studying towards degrees in Engineering (8%) and Arts (4%), with the remainder studying Law or Education. Students who come to UC from a secondary education institute have usually been exposed to some statistics. Other students may be there because of the open entry system in New Zealand which allows entry to any person over 25, regardless of educational achievement. These mature students and some of the international students (comprising 5 – 10% of the class) may have very little, or no, formal education in statistics. We offer just one statistics entry-level, single semester (12 week) course at UC that runs in both semesters 1 and 2 each year, and needs to cater to this diverse student body. This course has also been discussed in previous papers (Brown & David, 2010; 2012).

COURSE STRUCTURE – PRE AND POST-QUAKE

Following the earthquake, which occurred at the start of semester one in 2011, the course was delivered on-line as campus facilities were limited. This move to an on-line environment prompted the teaching team to develop learning opportunities for students with different learning styles, and to provide pathways for self-regulated learning. However there was still provision for those students who needed face-to-face help, with daily labs provided in the single computer facility on campus. Also, as the weeks passed and more facilities became available, many students expressed a preference for the structure of the normal lecture style of teaching. This prompted the return to offering lectures in term two for those who wished to attend. The on-line alternatives were still available for those who preferred to work independently. In effect, the lessons we learned post-earthquake allowed us to improve the on-line capacity of the course and move towards a blended learning style. More details of the post-earthquake course can be found in David & Brown (2011).

The scaffolding, or structure, of the course is built upon two lectures per week followed by a lecture-style examples class, covering additional worked examples on the lecture material. All-day tutorials in large computer labs run on the two days following the lectures. These tutorials have proved popular with students who need help processing the course material. The Examples Classes are described (in the course outline) as "held in smaller classroom settings where emphasis is on working through examples from the material covered in the week's lectures". It is recommended to students that they try the examples beforehand and if they are completely familiar with the

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material, then they may not feel they need to attend. This keeps numbers down to those who feel they would benefit from the demonstration of the examples, making the class smaller which has the advantage of encouraging class interaction. This smaller class setting is complemented by the use of a student response system (clickers) which gives two-way feedback on student learning and exposes any areas which need further clarification. Clicker questions can be edited at short notice so they are tailored to a particular audience, and questions can be re-polled to see if the required learning has taken place.

To encourage and develop self-regulation, the post-earthquake structured STAT101 learning environment has clear learning objectives against which students can judge their performance (Nicol & MacFarlane-Dick, 2006), and on-line activities (computer-based tutorial quizzes and consolidation exercises) which allow for monitoring their own performance (Schunk & Zimmerman, 1994; Pintrich, 1995). Many studies have discussed the importance of feedback, including self and peer feedback, for students' learning (Black, 1998). A range of opportunities for students' feedback are provided, mainly using the on-line quiz questions but also in written assignments. Worksheet-style on-line consolidation quizzes provide additional learning opportunities on individual topics; for example, working through a hypothesis test step by step. Students can use these worksheets for extra practice if and when needed. These quizzes supplement the tutorials but do not count towards course assessment. The additional materials allow students with different backgrounds to successfully negotiate the course material. Some students don't need them at all, others need them occasionally and there have been students who have worked through all the consolidation quizzes before completing the assessed tutorial. Adding constructive feedback to on-line questions takes care and thought. Guidance to promote focussed review of material, rather than presenting solutions, enables students to consolidate and improve. The nature of the tutorial assessment (multiple opportunities to repeat – highest mark counts) encourages mastery. Getting the right balance of feedback is an on-going exercise but once completed is available for future occurrences of the course. This improved (and continually improving) on-line environment forms the basis of the current course.

Students are assessed by means of formative and summative assessment with on-line tutorials, on-line tests, written assignments and a final exam. The weekly on-line tutorials each count towards 1% of the assessment and can be repeated until mastery is reached with formative feedback following each submission. Formative feedback in the on-line tutorial questions is designed so that students can assess their performance against "good performance" and close the gap between the two (Sadler, 1989). This final step in the feedback loop is an important principle we use in our course.

Lectures begin with motivational examples using, where possible, New Zealand examples and are interactive, using simulations where appropriate by means of a local mirror to CAST@Massey on-line resources (http://cast.massey.ac.nz/collection_public.html), and Statschat (http://www.statschat.org.nz/) a topical web site maintained by the University of Auckland Statistics department for example. The lecturers strive to encourage the students to participate by asking and answering questions. Partially populated lecture notes (PPLN) (Tonkes, Isaac & Scharaschkin, 2009) are posted on-line for students to print. These allow students to write in some sections during lectures, a system that researchers suggest supports learning (Isaacs, 1994; Marsh & Roche, 1994; Tynjala, 1998; Weimer, 1993). The many advantages of PPLN include allowing students to reflect on the material and annotate concepts in their own words; undertake problem-solving processes in real-time; work on exercises during lectures; actively engage in learning processes within the lecture, and read lecture notes prior to the lecture (Tonkes, Isaac & Scharaschkin, 2009). Annotated notes are posted after the lecture has taken place. All lectures are recorded by means of the in-house "Echo" lecture capture technology whereby the computer screen showing lecture notes and the lecturer's voice, are recorded and made available on-line via the learning management system (LMS) Moodle platform. The recordings are well used either by students who cannot (or did not) attend the lecture but more often by students who did attend and want to clarify their understanding, or for review.

The use of Excel as a teaching and learning tool makes it possible to move away from time spent on extensive computations and towards developing understanding of the concepts. Study groups are encouraged and the forum facility of the Moodle platform allows for on-line discussion

threads. In these forum discussions students are giving feedback to others and in doing so developing skills to assess their own work (Boyle & Nicol, 2003). Additional regular drop-in help sessions initiated from student feedback are offered. Many students do well on the computer-based assessment but find the written assignments a challenge. As well as good writing skills the assignments require the students to think through a complete example, including "which test should I use" and "how do I write my conclusions in plain English". These prepare the students for the final examination which is non-calculator based and is designed to test understanding of the statistical concepts taught in the course. To assist the students who find this area more challenging we recently introduced dedicated sessions where students book in for a help session (typically 20-30 students) and are given multi-part assignment-style questions to step through in advance of the session so they can come prepared with queries. Team teaching ensures the students can ask in-depth questions and really assess their ability to respond to the material. Group discussions were encouraged and some students booked in week on week as they found this type of learning beneficial.

With so many materials available on-line by means of the LMS environment, we are currently piloting a summer school version of the course, using guided on-line learning and tutor-supported, face-to-face labs. Twice-weekly classes offer opportunities for group discussion and individual assistance. A small group of mature students are accessing the course remotely, an interesting return to the post-earthquake provision, and showing the versatility of the course structured as it is within Moodle.

CONCLUSION AND STUDENT FEEDBACK

One of the advantages of using a learning management system like Moodle post-earthquake is that students can be easily contacted and their on-line behaviour monitored and researched. We have also sought regular feedback from students both in formal course evaluation surveys and by means of informal on-line surveys, through class representatives, and directly by encouraging a dialogue with students via emails or face to face. The teaching team is very "hands on" and makes suggestions for improvements which means the course is always evolving, incrementally. The feedback from students has been very positive and informative. Students have been engaging with the course in many different ways, and results from surveys show that there is no one teaching style that suits all. Most students continue to use the lectures to structure their study (Gysbers et al, 2011), and no single learning resource is ideal for all students.

Analysing the data from the Moodle platform shows a number of interesting trends in student behaviour. Students seem to be prompted to access lecture notes and lecture recordings more by assessments (both assignments and skills tests) than at the time of the lectures themselves (or the subsequent weekly tutorial quizzes). A reasonable conclusion seems to be that assessments (assignments, and skills tests) are an important part of getting students to look at lecture material, and that perhaps more than half of the students are prompted to look at the notes for the first time by an assignment. Others who have looked at the lecture notes earlier are prompted to look again by the assignments. Some students are making their first view of the lecture notes in the run-up to the exams. This is particularly the case for lectures towards the end of the course.

In addition to making "real attempts" at the on-line tutorials, students learn to access the tutorial quiz feedback by submitting quiz attempts without any answers. We call these "experimental" attempts. The number of "experimental" attempts on the weekly quizzes increases up to week 11 inclusive, but the actual number of students attempting the weekly quizzes at least once and the number of "real" attempts made falls over the semester.

Use of lecture recordings (by views and by the number of unique students viewing the recordings) is much lower than the use of lecture notes. Most students only access the lecture notes and not the recording at all. A sizeable minority access both lecture notes and recordings at least once. Very few (but some) access only the recordings, not the lecture notes.

The main message from extensive exploration into the way the students use the on-line resources is that in order to improve outcomes we need to work with the students' behaviour – not try to radically change it. If feedback is delivered when an on-line quiz is submitted students will learn that they can submit the quiz and make use of the feedback, whether they have attempted the questions or not. The benefit of quality on-line resources is there are many ways of using them for

effective learning and, once developed, they can be enhanced as and when the need arises without having to start again from scratch. If the on-line resources are of benefit to just a small proportion of the students, the fact that they are available has enhanced the course for those learners. By providing guidance on pathways of study for different learning styles, one course can meet many students' needs.

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