THINKING OUT OF THE BOX IN TEACHING STATISTICS

Tim Low
University of Cape Town, Cape Town, South Africa
tim.low@uct.ac.za

Students entering University in South Africa are generally diverse in cultural background, motivation, academic orientation, learning sophistication and stages of emotional maturity. They may have home or first languages other than the language of the tertiary classroom. The home language may possibly also be without a published text in statistics, or even without a statistical vocabulary of its own. Students' interests and the school curricula to which they were exposed mean they will also vary in access to and experience of technology of any kind (smartphones, pc, internet, etc.). This presentation will describe ideas used to capture the imagination of students, using classroom examples and techniques to create the experience of small learning environments where every student matters even within large lectures.

CONTEXT

This paper seeks to address the learning experience of students entering the University of Cape Town (UCT), who come from diverse backgrounds, and whose mother tongue frequently differs from the medium of instruction at the university.

Students are offered a fairly intensive introductory Statistics course in one forty-five minute class per day over a single semester, amounting to a total of sixty lectures. The material covers probability, random variables, a number of probability distributions such as the binomial and normal, inferential statistics and finally correlation and regression. All students will have passed an introductory mathematics course as a pre-requisite, building on their school mathematics.

Lectures are reasonably large with two hundred and fifty to three hundred students packed into a single venue. This paper suggests some of the ways that, despite the large class size, individuals can be helped and supported with learning taking place in small groups within the large lecture, in such a way that every student still matters.

THE STUDENT AND MOTIVATION

At the beginning of a course, especially an introductory course, the students may know nothing or very little of the intended curriculum, other than a formal list of topic names in a course outline. Given that the whole purpose of teaching is that the students learn, all else is subsidiary.

It is useful early in the course, to open up the matter of motivation so that students can explicitly address their initial orientations to the course. Direct approaches require students to diagnose or identify their initial or current motivation for the course, and to consider ways by which they may reassess and reform that motivation. Indirect approaches include authentic enthusiasm by the lecturer for the challenge, usefulness and advantages that arise from mastery of the curriculum.

In discussing motivation with students its useful to partition motivation around three poles, taken as distinct for simplicity: extrinsic to the person (e.g. meeting an imposed requirement of a curriculum or degree), instrumental (e.g. attaining an achievement that will support a personally meaningful objective) and intrinsic (e.g. seeking within a course to resolve meaningful questions and explore associations by mastering and using the knowledge and skills that a course promises).

BELIEFS ABOUT HOW STUDENTS LEARN STATISTICS

Throughout school students have developed their own ideas of the structures of mathematics. They must now develop these ideas for statistics. This construction is encouraged and guided by exploration, interaction and discussion, to improve understanding of a network of concepts, as students take charge of their own learning. The environment for learning statistics needs lectures that develop conjecture, exploration, holistic tasks, various approaches to learning, discussion and arguments (Ollerton & Watson 2001).

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TEACHING GOALS AND PHILOSOPHY

Many academic development students come from impoverished homes far from Cape Town. Many are concerned about the basic conditions of life of their parents and siblings. Some send parts of their bursary and scholarship funds for family needs. Most of these students initially lack the requisite quantitative, writing, English language, study and learning skills. At school they generally have been obliged to learn by rote, often without understanding the material or appreciating the importance of how or why as standard tools of learning. Habits from schooling can and do severely impede statistical learning.

Given sufficient support, most academic development students can succeed at university, if we create an environment in which students can develop their confidence to succeed, and even enjoy statistics. But, inspiration and motivation, although necessary, are only part of what is required to cope with the demands of academic life. Courses must be designed carefully to build students' confidence, support hard work and enable mastery of skills.

DELIVERY: TEACHING-LEARNING METHODS

Statistics is a subject many students fear. For forty-five minutes each day we must create a relaxed environment in which real learning can take place. Students must feel able to hazard answers, ask questions and develop their understanding of the material (Lee 2006). Lectures are not just about content and key statistical concepts but should ensure that each student sees how the key concepts are related to one another and how concepts became natural hierarchies of knowledge. The lecturer acting as a role model, demonstrates skills and processes, and then as a coach helps students develop and apply their skills and knowledge. Students generally benefit from being led into contrasting ways of representing the task or problem of interest.

English is often a second, or even third, language. Students must understand the concepts as the material develops incrementally. They are encouraged to discuss the material being presented during the lecture. We permit an opportunity to speak in home languages, discussing statistical concepts and explaining their understanding to each other in groups. The students offer feedback to the class, which encourages a wider discussion and questioning. The diversity of knowledge, learning styles and backgrounds enriches the understanding of both the lecturer and student peers. Extra notes/resources are available via the course website (access is available on request). Understanding and learning of statistics can only be achieved by actually engaging and participating, so lectures require a great deal of input from all students sitting in the venue (including any people who might be observing).

INITIATIVES TO AID STUDENT LEARNING

Some initiatives that have been used to aid student learning include:

Individual multiple response technology (clickers) that gives the students, both individuals and as the group, and the teacher, some instant feedback to questions and topics explored. This technology ensures that individuals can remain anonymous and minimizes vulnerability, while responses are privately available after the lecture to promote understanding and comparison, before grading answers as correct or not.

Students are able to communicate with the lecturer via Facebook, Blackberry Messenger (BBM), Whatsapp and so on. Most students to not have smartphones, but still they do have WAP enabled phones, so in 2010 MXit (a cellphone messenger program) was introduced with close to 40% of the class communicating with the lecturer during the semester. Since cellphones do not allow for mathematical notation, the users must explain their problem in 160 English characters, similar to an SMS (Short message service). This discipline engages students, but decoding their messages and offering a response, requires some effort.

Statistical concepts are developed through imaginary newspaper articles with letters and responses from the public. Injection of names of students from the current class creates non-invasive fun, and data and methods for the context have an authentic feel. At the start of the next day's lecture the topic is developed with a follow-up article or email/Facebook message 'quoted' from the newspaper, giving more information.

Games, such as "Who wants to be a millionaire" with different groups of students answering questions, are very time consuming to set up. However they allow both revision of

topics and a sense of class belonging, especially when the questions get difficult near the million-mark total.

Setting questions in one's own language (e.g. isiXhosa) demands verbal and mathematical skills, from students for whom English as a 2nd or 3rd language. To promote understanding Multiple Choice Tests have been translated with some very interesting outcomes, most notably that some statistical terms require a whole sentence for a single English word. We are developing a thesaurus of statistical terms in isiXhosa and Zulu.

A survey of student views and personal information at the start of the course creates a database to be analyzed during the semester. We ask students to grade exam/test questions with identified mistakes. We supply three pieces of card – green, orange and red – which they can display at any time during a lecture to signal need for clarification before proceeding.

It is important for students to become accountable to themselves. In a new and alien place, time management is a source of difficulties. Ground rules of lecture etiquette are established from day one of lectures. Lectures start on time. Nobody is permitted to enter a lecture once it has started. A student who will be late must inform the lecturer before the lecture starts, using any one of a variety of electronic means. A signed register is taken daily and captured. A minimum of 80 per cent attendance is expected at lectures. The purpose of these rules is not compliance but an initiation of self-discipline.

Lectures must be a safe environment in which a student is able to ask and respond to questions without the fear of ridicule from anyone. Whoever may be speaking, the class needs to respect that person and listen. When asked to work on a problem, discussion with a neighbour is an option, but not twiddling of thumbs. The lecturer being the last person to leave the venue makes it possible for even the shyest students to stay behind and ask a question, or make a point, should they wish to do so.

These lecture guidelines (rules) are surprisingly easy to uphold, especially when lectures *do* start on time and when the first student(s) are refused entry into the lecture for being late!

The daily register is very useful (even for a lecture of 250 students): it encourages students to attend and identifies when a student is missing too many lectures in a row. Follow-up emails are then sent out to find out if a student is managing/coping with University life (they may be experiencing sickness, time-management problems, or stress, for example). At the same time it can be quite interesting to see which students start pairing up and taking similar days off in a week, or if Monday is a bad day for some, for example! These patterns can also be fed back to the students, which can create considerable discussion amongst the class and also has the added benefit of encouraging them to feel that they are not alone and that their lecturers take an interest. This helps to re-enforce the sense that the lecture is a safe environment that we are all sharing.

Part of the lecturers' job is also to offer support to students over and above purely academic matters. Students respond positively to the interest shown in them, often dropping by the office to chat even after they are no longer following a course in mathematics or statistics. This attitude of support, which is a hallmark of the Education Development Unit (EDU) approach, is reflected in the good results most of them achieve. Cohorts taught within this Unit often achieve substantially better results than the mainstream cohorts. We are not teaching for results but for the self-empowerment that necessarily changes lives and in so doing brings results.

Finally, we offer optional Saturday morning workshops, every other week, to give students a space to interact with the statistical material and work together in groups to develop their understanding and confidence. These 3-hour workshops are attended by approximately 80% of students, which shows how dedicated EDU students are to succeeding in their studies.

Outside the lectures students are offered tutorials with carefully graded questions that enable students to build up their understanding of each topic. We believe if students develop a sound understanding of mathematical theory it helps them to appreciate why particular important concepts arose and became formally defined and how these important concepts can then be applied to other areas of their degrees, such as Economics and Accounting. We devote considerable effort to assessing and monitoring student performance. Using tests, tutorials, on-line quizzes, weekly pc-lab sessions and the final examination as well as taking a daily class register of attendance. Through this formative assessment we am able to monitor their individual performance and

identify if and when a specific student is beginning to struggle at UCT in general. But these processes also allow the students to personally monitor their own progress.

SUMMARY

This paper has given an overview of ideas that are used to make the learning of statistics more engaging while also considering how students need to learn and master the higher education role. We have highlighted the challenges faced by EDU students such as the language used within university discourses, the expectations of students themselves and how the successful student role may be unfamiliar and therefore difficult to understand, adjust to, learn, practice and master.

The challenges going forward include exploring how students own languages can enhance the learning and understanding of statistics and whether a more blended approach to lectures will benefit EDU students.

REFERENCES

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