INNOVATIONS IN CURRICULUM DESIGN: INVOLVING SUBJECT SPECIALISTS WHEN TEACHING STATISTICS TO NON-STATISTICS STUDENTS

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Statistics is important and relevant to many college subjects. Coincidently, it is common for students to dislike and under-perform in modules involving mathematics, numeracy or statistics. In order to address these issues the project brought together a statistician, a clinician and educational experts to redesign the way that statistics is taught to medical undergraduates, making it more relevant to them. It re-conceptualized the syllabus, focusing on developing different methods of delivery, including a web-based learning environment which allowed students to access materials at levels consistent with their current understanding. The new teaching materials, including videos, animations and the online resource, placed greater emphasis on applying statistics and interpreting data. This innovative approach enabled the project to make the teaching, learning and understanding of statistics more people-centred and relevant.

INTRODUCTION

There can be little doubt that statistics is important and relevant to many college subjects. Coincidently, it is increasingly common for students to dislike and under-perform in modules involving mathematics, numeracy or statistics. Medical students have varied backgrounds, and it is increasingly clear that teaching statistics in a traditional didactic way does not entirely meet their needs; comments from previous student evaluations included:

'Medical statistics – YAWN!!!- could be taught in a more interesting way'
'Medical statistics lectures were poorly presented and not explained well'
'Statistics session were not well presented, too rushed, no handouts.'

Many students fail to understand basic concepts, which impacts negatively on their use and interpretation of statistics. This is in contrast to the increasing awareness of the importance of statistics to current medical practice, dating back to the 1993 General Medical Council report *Tomorrow's Doctors* which recommended that medical education be required to promote 'the critical evaluation of evidence.' Nowadays medical students need to be able to interpret statistics so that they can use them to appropriately inform their medical practice, both during training and most importantly post-qualification when they will be treating patients. The education and training that medical students receive is fundamental to the formation of their attitudes and behaviours. Doctors increasingly need to use statistics to help them understand medical issues.

In designing, or indeed redesigning any course the new programme will be more effective if its designer determines from the start what it is that they really want the students to know and do (Garfield, 1995). In addition to this consideration it is important to be aware that different students learn in different ways. There are many acknowledged models of learning, for example information processing models which focus on the way that students sense, think, solve problems and remember information (Kolb, 1984), or personality models which focus on attention, emotion and values (Lawrence, 1993). The fact that there are differences in individual learning styles, however they may be categorized, needs to be appreciated when redesigning any course. Thus, within the limits of what may be possible with regards to time and resources, as many different approaches should be employed as is practicable.

Following the departure of a colleague, Jenny Freeman inherited the teaching of medical statistics to the undergraduate medical students in Sheffield. Upon taking over this teaching she became increasingly aware of problems in the teaching of this key component of the medical undergraduate curriculum. It was an unpopular and little understood part of the students' early medical education. She was keen to revamp the teaching to address both the concerns of students and her own concerns about what they needed to know and the way in which teaching was contextualized. Fortunately this desire to revamp the teaching coincided with the arrival of a clinical colleague, Kevin Smith, an academic training fellow, who was also keen to progress the

teaching of epidemiology and medical statistics. Together they started the project described below to redesign the way in which statistics was taught to students medical undergraduates, in order to make the subject more relevant to them.

PROJECT DESCRIPTION

The first step was their successful application for a *Learning and Teaching Development Grant* from the University of Sheffield. This grant scheme had been recently set up to 'promote excellence in learning and teaching by supporting innovation, development and enhancement within the student learning experience' (University of Sheffield, 2005). Successful applicants are offered support to explore and/or introduce a new idea or approach within their learning and teaching practice; or develop or further embed an earlier innovative project; or explore and develop their own practice through engagement in an action research project into learning and teaching. The award is particularly concerned with ensuring that through the project there is a positive impact upon the student learning experience and/or attainment. In addition to financial support to develop new materials, part of the support offered was access to two specialists in learning and media development. Thus David Staniforth, an educational development advisor, and Steve Collier, an educational media producer, became part of the team that collaborated closely to develop the new programme and teaching materials.

The original project was titled *Innovative teaching of statistics- the quest for improved understanding of evidence* and was concerned with redesigning the delivery of medical statistics teaching to the medical undergraduates at the University of Sheffield, in order to make it more relevant to their future learning and medical practice. The project offered an opportunity to develop new approaches and materials that would contextualize learning and strengthen the application of statistics to medicine, in line with the recommendations of Yilmaz (1996), who emphasized the importance of real-world examples when teaching statistics to non-specialists. Given the considerations outlined above, the team set out to redesign and reconceptualise the way in which students were taught medical statistics at Sheffield. In line with Garfield's recommendations they first concentrated on what it was that they felt students needed to know and be able to do following the teaching sessions. Students of statistics can generally be classified into two groups, those who 'consume' statistics and those who 'do' statistics. Whilst previous teaching at Sheffield had focused on 'doing' statistics, with little emphasis on its contextualization, it was felt that, in line with the recommendations of the GMC, the undergraduate medical students were unlikely to become 'doers' of statistics but they were almost certain to become 'consumers' or users of statistics. Thus, they would need to be able to interpret research findings and explain basic concepts such as risk to patients. As a consequence it was decided to concentrate the teaching on ensuring that students had an understanding of how to interpret the basic statistical concepts that they would encounter in the literature and in patient information leaflets. The amount of formulae that they encountered was minimized and little time was spent covering the mechanics of statistical tests.

The project aims and objectives were set in terms of both educational aspirations and the production of new materials. The outcomes of the project were to:

- ensure that students were equipped with skills in interpreting data that would enhance their future performance as doctors;
- improve student awareness of the growing importance of medical statistics in medical practice;
- improve students' ability to use data to inform their medical practice, thus arriving at greater understanding of the underlying statistical principles;
- increase the amount of learner-centeredness in appreciating the role of statistics;
- develop materials that allowed students flexible access, and more opportunities to interact with materials at their own pace;
- provide materials giving support and feedback to students at various levels, and allowing students to interact with materials until a deeper level of understanding was achieved. Extra or 'extension' work would be a feature for those who needed it.

Although there had been previous revamps to the module, with an increasingly diverse and large student body – currently 260 students - statistics was still failing to touch many students. Ways of addressing this were sought, so that the revamped approach would provide real alternative ways of learning, both for students who had previously studied maths/statistics at 'A' level and for those who had not. A number of criteria were identified that the literature suggested could be helpful to learners, such as the use of medical examples, the use of a variety of visual forms and the provision of an online learning resource for students to access materials repeatedly. Importantly, materials were created that presented the same information in a number of ways, maximizing the opportunities for students with different learning styles and approaches.

The lecture session was kept as the main form of input and the approach of using a statistician to present the statistics and a clinician to contextualize them, was introduced as this appeared to hold promise particularly with respect to the contextualization of learning. As previous student feedback suggested that in addition to the large lecture, the students liked small group tutorials, each lecture was followed up by small group tutorial sessions with 8 students to a tutor. During these the concepts introduced in the lectures were reinforced by means of problem solving exercises based on the medical literature. After significant discussion, some new additions were made to the teaching:

- Each lecture would open with a short dramatised video-clip. Each clip depicted a scenario based in a general practitioner's surgery, setting up a realistic problem requiring the use of applied statistical methods to resolve. These scenarios featured a trainee GP, designed to be someone the students might be able to relate to. A second video clip at the end of each lecture showed how the fictitious characters resolved the issues and how statistics played a vital role in diagnosis. Each 'learning episode' was carefully considered in order that the topic of the week was addressed, by applying the relevant statistical approach to the process of making medical judgements. The video scenarios were informed through a number of consultations both with clinicians working in general practice and medical statisticians, in order that they accurately reflected both medical and statistical perspectives.

- Animations were created to illustrate certain concepts that benefited from the dynamic explanations offered by animation, and that were known to be found difficult by students. These also had the additional benefit of providing breaks in the time spent lecturing and a change of pace, so as to improve student concentration and attention.

- An online resource was designed to serve as an easy reference guide for consolidation of learning and revision (Figure 1). Students were able to access the lectures, further materials (including other web-based statistical resources), and check out any of the statistical issues raised in the teaching, either through a statistical or medical approach. This resource also provided more advanced use of statistics for students who wanted to delve deeper, and provided a glossary of terms for easy reference.

SUMMARY

Entry criteria to the MbCHB course have recently been changed to favour entrants from non-traditional backgrounds. Additionally, numbers have risen. The challenge has therefore been to motivate these students into deeper study of statistics in medicine, at a time when practice is becoming increasingly evidence-based and the requirement on students when they become practitioners will be to demonstrate that they can reach correct diagnoses using both clinical and statistical data. Using a variety of approaches and materials we have sought to maximize the opportunities for students with different learning styles and approaches.

The project brought together a statistician, a physician and learning and development media experts to produce a new learning package for medical students. It explored ways of enhancing the teaching and learning of statistics to enable students to better apply their statistical knowledge. It re-conceptualized the syllabus by focusing on developing different methods of delivery, including using a web-based learning environment, and allowed students to access materials at levels consistent with their current understanding. Development of new and remodelled teaching materials and approaches placed greater emphasis on the application of
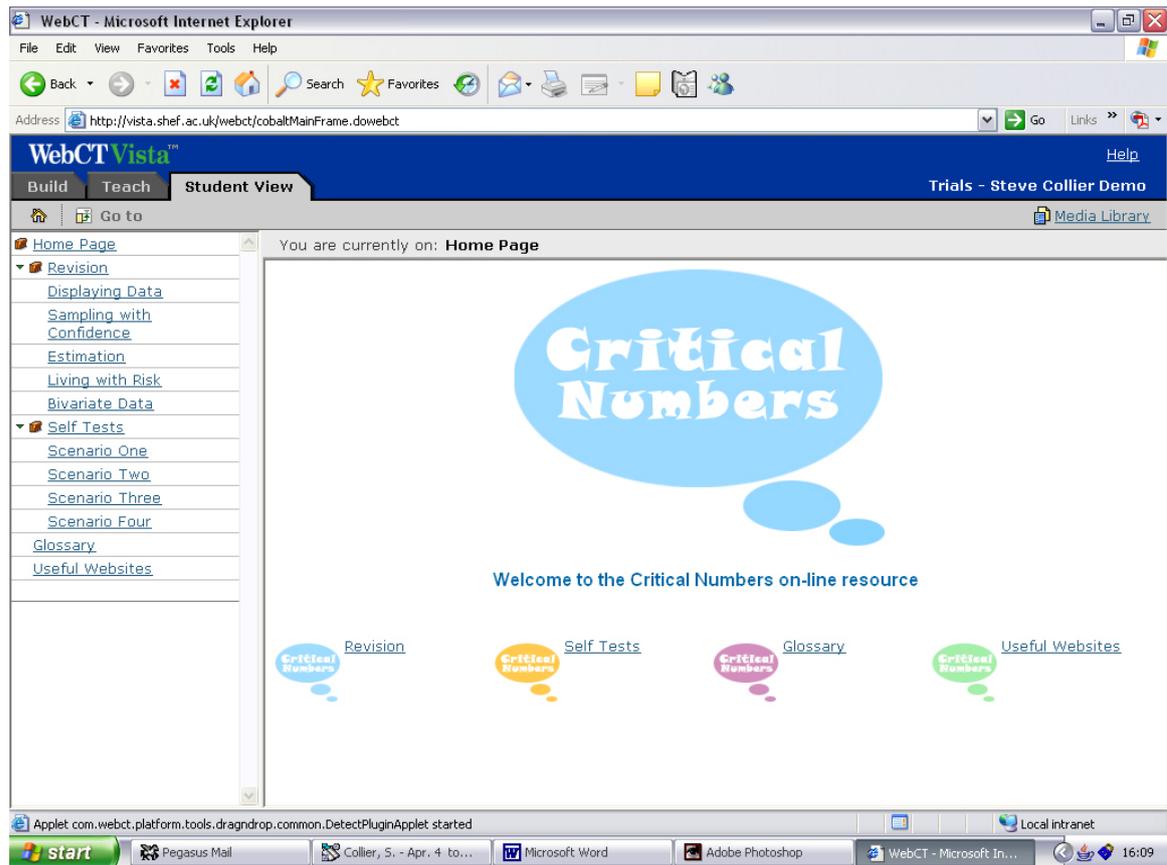
Figure 1: Front page for the online learning resource

statistics and interpretation of data rather than the mechanics of particular statistical techniques. As part of the teaching, videos and animations were developed to show how statistics are used during consultations and when making medical decisions and in addition the new teaching package was delivered by both a statistician and clinician. In order to emphasize the importance of statistics to medicine these two explained together the statistical concepts and their relevance to medical practice. And finally an interactive online resource was created for students to access outside of the taught sessions. Through this innovative approach, using a clinician, a statistician and learning technology, the project addressed some of the difficulties identified above, making the teaching, learning and understanding of statistics more people-centred and relevant.

Our ideas of what was needed have evolved as we have worked together. Whilst the original desire to improve students' understanding and attitudes has not changed, the manner in which this has been achieved has changed, through a process of dialogue and consultation within the core team. This process of dialogue has lead to some challenging exchanges between members of the team, particularly as members of the group critically evaluated the core content of what was to be produced and agreed upon a final curriculum. The contributions made by each member have been significant, different and valued and this diversity has added to the richness of the collaboration. Whilst meeting as a team is not always easy to arrange, and pressures on time can raise issues of prioritization, the ethos of the team has continued to develop and has led to a strong working relationship that has enhanced the final project. We recognise that the work that we have done on this project has relied upon the fact that we have all collaborated well together. This project would not have been as successful had this not been the case and in recommending a collaborative approach to others we would emphasize that this approach will only work if all participants are prepared to work closely together and value the other members of the team.

At this stage it would be easy to stop, but we remain keen to improve knowledge for all and will continue to strive to find new ways of improving our teaching, particularly for those who continue to fail to understand. We are committed to improving learning, both the student

experience of learning and the knowledge that they take away, and it was our goal that following our teaching the students – who will become doctors - should have more positive attitudes towards statistics, their possible meanings and their impact on the process of consultation. Ultimately we are seeking to make a difference to the skills that students will need when they become medical practitioners dealing with patients. The implications of this learning, therefore, are likely to extend far beyond their time as an undergraduate. This important issue coincides with current wider interest in professional standards. The education and training that medical students receive is fundamental to the formation of their attitudes and behaviours. Doctors increasingly need to use statistics to help them understand medical issues. We are seeking to counter phobias relating to statistics that may exist among the student group and, by presenting materials in different ways, we aim to give more students more opportunities to learn important content and principles. It is the pursuit of these professional standards that drives our efforts.

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