Case Study

Enhancing practical learning using pre practical quizzes

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This case study has been developed from data gathered through observations of the teaching component, interviews with the tutor, conversations with students and their evaluations of the activity

Background

This case study reports on the practice of using pre-practical quizzes (PPQs) to enhance learning in first year physiology (includes medical, veterinary, dental science and physiological science students). In many institutions increased numbers of students, pressure on staff and competing activities has led to a reduction in the number of practical assessments (i.e. lab reports) that students are required to produce which in turn has led to a reduction in the number of opportunities for practice and for formative feedback. There were several related aims for the quizzes, including increasing awareness of experimental design, methodology, data presentation and analysis, numeracy and problem solving, plus familiarity with the practical schedule. As the quizzes were completed in advance of the practical they served to link theory and practice.

Developed and trialled in 2006-7, the PPQs were launched at the University of Bristol for the Physiological Sciences first year Unit. Using Questionmark Perception, PPQs were constructed for nine laboratory practicals (LPs) as well as two quizzes that focussed on general laboratory skills, numeracy and experimental design. Each PPQ contains 12 questions and a text box that students can use to provide feedback to tutors. The quizzes employ a variety of question types, including single correct response, multiple responses, numerical entry, ranking, true/false, matching (drop down) and drag and drop. Some questions test knowledge of the practical schedule, to encourage students to read the schedule in advance; something that the instruction for each quiz recommends. Students are instructed to allow about 40 minutes to complete each quiz, although many undertake additional reading. Students receive an automated email confirming their score on completion of each quiz and those who fail to submit two or more quizzes during their first term are contacted by the head of year to remind them of the mandatory nature of the quizzes. Attempts and marks are automatically recorded on the system and can be accessed by tutors. At the end of the series of PPQs students are provided with an overall feedback document containing a frequency distribution histogram of marks for the year and can access a record of their own marks so that each student can reflect on their performance relative to that of their peers.

In practical terms, PPQs are available for one week, becoming unavailable an hour before each LP. Importantly, students have unlimited access to each PPQ over the course of the week, allowing students time to reflect and learn from the formative feedback and repeat the quizzes as often as they wish (Bull and Stephens, 1999). However, students are repeatedly made aware that the score from their first attempt is the one used to calculate their running average. Up to the 2010-11 session, PPQs were a mandatory component of course work, with an overall average of 40% required in order to 'satisfactorily' complete the Unit. Our data suggests that this strategy is effective with completion rates for six first and second year Units being consistently above 90% (n >900 students over 5 years). The median score per cohort has been approximately 70% (range 64 to 76%). In 2010-11 the physiological science unit included the PPQs within practical unit summative assessment and they now count for 20% of the Unit mark.

Reasons for introducing this teaching method
PPQs were introduced to encourage students to undertake preparatory work prior to their LPs. The PPQs also encourage students to make clear linkages between the lectures and the related laboratory work. The large class size (i.e. average cohort is 160; range 75 to 260) meant that it was essential that the quizzes were accessed on-line using a system that authenticated each user and recorded details of each attempt. As LPs are key elements of student learning in the unit, *the glue between theory and practice*, students are able to repeat the PPQs several times, thus learning from the feedback as they do so. The PPQs are also made available for revision purposes from Easter to the end of the academic session.

Lecturer perspective
The tutor is passionate about the value of experimental and practical work to the development of the knowledge, skills and attitudes that are characteristic of 'science'. The inspiration for the pre-practical quizzes came in 1998 following an overheard conversation between students before a laboratory practical which suggested they normally did little or no preparation for practical classes. The tutor is very clear about the benefit of preparation. The practical schedules are a bit like a whodunit in the sense that one must read to the end and reflect to recognize the significance of the steps along the way.

Only recently did the University of Bristol have a system that could host on-line pre-practical quizzes and it took the tutor several years to persuade colleagues that the benefits would outweigh the costs. The tutor is equally clear that the PPQs have been effective, students are more engaged, and had more knowledge of what they are doing and why. This has been evident in the questions that students ask; more commonly about the science and less about the process.

Students' perspective
Students suggested they found the PPQs an extremely useful tool in preparing for their LPs. They commented positively on the tutor's ability to put materials across in more formal lectures and how the quizzes helped to assimilate knowledge that could then be utilized in subsequent practical classes, "*They [quizzes] provide a good way of preparing us for the practicals and give us chance to think about the concepts that we need for the practicals".*

In some cases the quizzes encouraged students to undertake additional reading in preparation for the practical classes, which would probably not ordinarily have taken place. *"They [PPQs] were very relevant to the practical and required reading of the practical in order to obtain more information"* and *"[quizzes] did encourage me to read the schedule before the experiment when otherwise I wouldn't have, in all honesty".* Another popular feature was the provision of immediate and constructive feedback on completion of the PPQ as students reported their satisfaction with, *"being given the correct answers at the end"* and the *"mathematical workings provided".* Students appeared to find the experience very useful..., *"just the right amount of questions, did not take too much time – no boredom"* and *"good format and balance of knowledge and calculation problems".*

Issues
When designing the PPQs some colleagues were concerned about the time required to design questions but in many cases most time was spent ensuring that the on-line feedback was high quality and useable. When designing the quizzes student focus groups were used to ensure that the interface and layout of the PPQs were user-friendly. Compliance was a huge concern as it has been shown that educationally sound activities that are 'optional' or peripheral to the unit tend not to be completed by the majority of students. This has lead to the adoption of measures to motivate, *e.g.* contribution towards coursework marks, despite evidence that unsupervised, on-line quizzes can be defrauded (Kibble 2007).

Benefits

Students are better prepared for their practical classes and appear to make better linkages between theory and practice. Anecdotal evidence from teaching staff is that students need less support in practical classes and ask more questions related to the science than to the practical schedule itself. This interpretation has been supported by feedback from students. There has been no significant increase in marks in the end of year examinations although there is a significant positive correlation between the PPQ scores and the end of year marks (Pearson; $p<0.0001$, r 0.52, r^2 0.27), which is consistent with research findings (Dobson, 2008).

Reflections

This is a practice that could easily be adopted by other institutions to optimise learning from laboratory practicals (Langton et al, 2009). To date no colleague has challenged the interpretation that PPQs benefit students' engagement and learning although some remain wary of the investment of time required. The time has come to find ways to more effectively share resources like practicals and quizzes; something that initiatives such as Creative Commons[1] and reusable learning objects[2] may solve. Guests can access the PPQs throughout 2011 at via the University of Bristol website[3].

References

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[1] See http://creativecommons.org/

[2] See http://www.jisc.ac.uk/whatwedo/programmes/elearningpedagogy/sharingtheload.aspx

[3] See http://qmp.bris.ac.uk [select 'login as guest' and use username *1abc* and password *2xyz*].