Using Technology to Encourage Regular Study and Engagement with Feedback by Students in a First-Year Undergraduate Biosciences Module

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OVERVIEW

The work reported in this study addresses several fundamental concerns: *How do we impress upon first-year students the importance of a regular habit of study? How do we promote student engagement with feedback?* and *How do we promote a dialogue about feedback involving student-to-student and student-to-teacher conversations?*

We have developed an assessment design that attempts, at least in part, to confront these concerns. Frequent summative computer-based assessments (CBA) help to dictate a steady pace of student effort across the period during which a first-year biosciences module is constituted. These CBA are subsequently released in formative versions online so that students can revisit them as revision aids. An electronic voting system (EVS) is used in classes subsequent to each summative CBA to promote engagement with feedback and whole-class discussion around troublesome topic areas.

The case study therefore touches upon two themes raised by the REAP conference: *Assessment and the first year experience* and *Great designs for assessment*.

INFORMATION ABOUT THE CLASS, MODULE OR PROGRAMME

This case study focuses on assessment design within a first-year module (*Molecular Cell Biology*; MCB) that is a core component of several biosciences Foundation (FdSc) and Undergraduate (BSc) Degree programmes at Birkbeck, University of London, UK. Although applied within a biosciences context, the basic assessment design for MCB is generic and, with appropriate modifications, could easily be applicable to other disciplines, other modes of study and other types of institution in the UK and elsewhere.

Students at Birkbeck undertake part-time programmes of study, attending classes in the evening. Almost all Birkbeck students are aged over 21 and most are in full-time employment. In MCB the typical age range is 19 to 50+, with a median age of ca. 28. For FdSc, the programme is 2.5 y; for BSc, 4 years. The academic year consists of 3 terms of 11 weeks duration each, over the periods October-December (Autumn), January-March (Spring), and April-July (Summer). Programmes consist of credit-bearing modules, with the BSc, for example, requiring accumulation of 360 credits. Modules of 15-credits represent the lowest denomination and these are normally convened for one academic term. For most modules, a substantial proportion of the assessment is delayed until a formal examinations period in the Summer Term, although coursework (continuous assessment) normally contributes 30 to 50% of the marks overall.

Biosciences modules are comprised mainly of face-to-face class sessions, but a blended approach is used, with online support provided through a virtual learning environment (VLE). The MCB module (30 credits) runs over an elapsed time of 20 weeks (from first meeting in January until final assessment in May), with 14 class meetings over this period. Fig. 1 in the next section illustrates the plan of the module in more detail.

Average enrolment on MCB over the past 5 years has been ca. 60 students (range 49 to 81). The module is taught entirely by one of the authors (RCR); the assessment design is a co-production by both.

DESCRIPTION OF THE CASE

Students enrolled in *Molecular Cell Biology* (MCB) attend one session per week of up to 3 h duration for 11 consecutive weeks in the Spring Term and three such sessions in the Summer Term. Timetabled sessions are either lecture + discussion-based, practical/skill-based (i.e. actual or virtual lab sessions), or are used for summative computer-based (CBA). Herein, we emphasise *two of the main features of the overall assessment design* for this module:

1) a series of summative/formative CBA,
2) use of an electronic voting system (EVS) for feedback and formative assessment in the classroom.

Another key element, a "practical" assessment involving use of a computer simulation alongside a paper-based test (and the written assessments supporting this) is not discussed here; a preliminary report on this aspect of the module was given in Rayne and Baggott (2004).

Figure 1 depicts the structure of the module, emphasising the timing of the CBA and of subsequent in-class formative assessments (as further described below). It should be noted that these CBA contribute 60% (5%, 10%, 10%, and 35%, respectively) of the overall module grade.

Students' progress in acquiring knowledge and understanding of basic facts and conceptual underpinnings of key molecular-cellular processes[1], is checked by summative CBA on Weeks 3, 6 and 11 (Fig. 1). These are brief (13-15 items), bespoke CBA, produced using the Adobe Authorware-based product, TRIADS[2]. The majority of test items have been designed to emphasise *comprehension* and *application* rather than *recall* (c.f. the ReCAP cognitive taxonomy of Imrie, 1995).

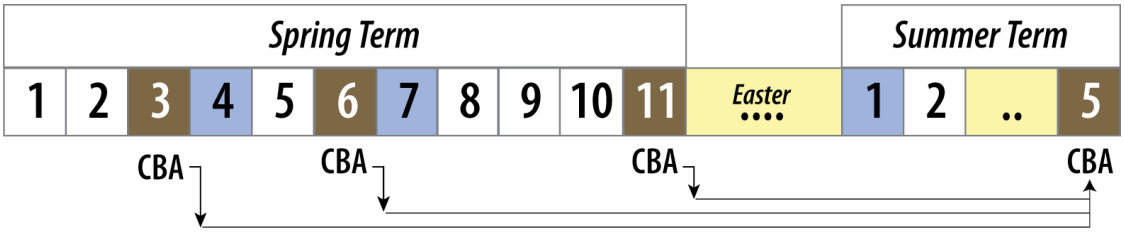

Figure 1: A timeline emphasising the contribution of a series of CBA to the assessment design in MCB. Timetabled CBA sessions are held on Weeks 3, 6, and 11 of Spring Term (mocha highlighting). After each of these summative sessions, formative versions of the tests are made available via the VLE. These tests are preparatory for a final, summative CBA on Week 5 of Summer Term. This design is explained and examined in much more detail in Rayne & Baggott (2006 and 2007). EVS is used in classes subsequent to each CBA (blue highlighting) as an aid to focused feedback on troublesome topics.

1 DNA replication, transcription, translation and chromosomal transmission of genetic information.
2 Centre for Interactive Assessment Development, University of Derby. http://www.derby.ac.uk/ciad/

Feedback on these CBA is provided in two ways. Class sessions on Spring Weeks 4 and 7 and Summer Week 1 (note the light blue highlighting in the Fig. 1 timeline) each include a segment in which an electronic voting system (EVS) is used to review selected items from the respective CBA and to initiate class-wide discussion on troublesome topics. Secondly, each CBA becomes a feedback vehicle after it has been taken for a grade in its timetabled session. For example, after the Week 3 summative CBA, the same test is made available online (linked via the VLE) in two forms. One version is not timed and supplies feedback on submission of each test item; a second version—a "self-test"—supplies no feedback, but provides a score at the end of a timed session. The same pattern holds for the Week 6 and Week 11 CBA. These tests then provide a "feed-forward" (as depicted in Fig. 1) into the final, summative CBA which takes place in Week 5 of Summer Term.

RATIONALE IN TERMS OF EDUCATIONAL IDEAS

Many (most?) teachers would assert that establishing an effective study routine is critical for a student's success in higher education, but "traditional" assessment regimes often fail to encourage students to regularly engage and reflect. For Birkbeck students, the "study routine problem" is especially acute given that they study part-time, attending in the evening; furthermore, as adults, usually in full-time employment, their time for study is limited largely to evenings and weekends. Moreover, the first-year of higher education (HE) often represents a "culture shock" to *any* student (not just those at Birkbeck!) given the expectation in HE that students should exhibit a greater degree of self-regulation and autonomy than perhaps had been required at earlier stages of education.

With these factors in mind, in 2001 we launched a new 1st year module, *Molecular Cell Biology* (MCB), designed around an assessment system that aimed to *dictate a steady pace of study*, particularly during the formal teaching period that takes place over the 11 weeks of our Spring Term, and at the same time would provide opportunities for focussed revision over the ca. 20 weeks during which the class is constituted (i.e. from the start until the final exam). We also hoped that the assessment design would *supply the teacher with timely and useful information about students' learning* and therefore would *contribute the design of the instruction*—i.e. so that adjustments could be made before it was "too late"!

How did we arrive at this assessment design? We were convinced by the many arguments in the literature about the power of assessment and its judicious deployment to productively drive student learning (see Gibbs and Simpson, 2004, for an excellent review). In addition, we realised that *computer-based* assessment would be especially appropriate in our situation, given that remote, 24 x7 access to revision materials would be critical for reaching our busy, geographically dispersed, part-time students. So, a regime incorporating frequent CBA seemed ideal as a "pacing" mechanism; moreover, it would offer the possibility of re-use in a formative context.

For this CBA pacing mechanism to work, we took the view that the tests should initially be *summative* (rather than attracting no marks) and *offered at timetabled sessions on specific dates* (rather than on a "when ready" basis). Only with this strong incentive to "keep up" would students feel the (intended) urgency of regular, focused engagement with the module. It has to be said that we have not done the experiment to determine whether our assumption is true! However, comments made by students over the years have only supported these contentions. Further supporting our claim are reports in the literature (e.g. Peat and Franklin, 2003; Pitt and Gunn, 2004) indicating "patchy" use of CBA by students, especially when the materials were offered exclusively as formative instruments available on a voluntary basis.

An incentive to use the formative tests for revision is provided by the fact that approximately 1/3 of the items on the end-of-module CBA (contributing 35% of the module grade) are very similar to items that appeared on the 3 previous tests; another approximately 1/3 cover topics covered on the earlier tests, but these new items approach their respective topics differently (for example, through a different question style). (The

remaining 1/3 of items, as implied, cover topics that were not addressed in the earlier tests.) Using the formative versions of the tests as revision aids therefore becomes a very worthwhile strategy, as borne out by analyses in which we have correlated strong performance on the final summative CBA with the extent of students' usage of the formative tests. The inclusion on the final CBA of previously used (or similar) items has another benefit: it allows us to monitor students' improvement (or not!) from earlier tests to the final CBA by comparing scores on the corresponding items. Such analysis has given us numerous insights into "troublesome" topics that have helped us to improve the instructional approaches used in MCB.

Although our records show that students *do* use the feedback versions of the CBA, and many do so within a short time following the corresponding summative test, substantial numbers delay their engagement with the formative tests until much later: i.e., shortly before the final CBA. While the brief discussion above indicates that to use the formative tests for exam revision is indeed sensible, *we wanted to ensure that students engaged with feedback as soon after each test as was practicable*. Moreover, we hoped to *optimise the benefit of this feedback to the students* and to *provide further information to the instructor* about the students' learning. Ultimately, we wanted to find a way to leverage the outcomes of the CBA and their effects on "setting the pace" in *contributing to the development of self-regulated learning* (cf. Nicol and Macfarlane-Dick, 2006) in our students.

As a first step toward realising these goals, we have begun to develop the use of an electronic voting system[3] (EVS) in MCB classes. With EVS being new to MCB this year (2007), the initial focus has been on targeting it to brief sessions in the classes immediately following each CBA. EVS questions were designed to mimic the test items shown to be most troublesome (by the mean item scores) for the class overall; responses to the EVS questions then were used as focal points for class-wide discussion of the topic(s) in question. This approach therefore not only provides feedback to individual students (as also happens with the formative CBA), but promotes a dialogue around this feedback, both with *peers* and with the *instructor*—conditions congruent with principles espoused by Nicol and Milligan (2006) in regard to good feedback practice.

EVALUATION

Although the MCB module and the CBA elements of its assessment design have been in place since 2001, this module was developed and evaluated extensively under the auspices of an FDTL4 project, *OnLine Assessment and Feedback* (OLAAF), that ran from 2003-2006. OLAAF developed a close association with another FDTL4 project, *Formative Assessment in Science Teaching* (FAST), and a study of MCB was undertaken as a FAST development project. Because various evaluations of MCB have been or soon will be reported (e.g. on the OLAAF and FAST legacy web sites, both presently in construction), only condensed accounts of these evaluations are given here.

An evaluation of MCB in 2004 and 2005 made use of the Assessment Experience Questionnaire (AEQ; Gibbs & Simpson, 2003) and the Study Process Questionnaire (SPQ; Biggs et al., 2001). In short, the results from the SPQ and AEQ indicated that MCB students were motivated to use a deep approach in their study and that the assessment regime encouraged and supported the "steady study pace" that we hoped students would adopt. A detailed account of this work is given in our FAST/OLAAF case study (Rayne and Baggott, 2007). Some representative passages from the "free-text" sections of questionnaires completed by MCB students during this evaluation are below:

> *"…in some courses it is easy to let learning and note-taking slip, but in MCB you are kind of forced to keep up with your learning if you are to get good marks in the assessments…"*

3 An excellent resource on EVS: http://www.psy.gla.ac.uk/%7Esteve/ilig/. Last accessed, March 2007.

"…has taught me…how much I have learnt….They [CBA] made me realise my weaknesses and strengths on topics…I like TRIADS assessments to bits."

"…frequent tests kept me motivated and allowed me to assess my understanding of topics without having to put all my hopes in a final exam…"

"I wasn't sure at first about the computerised nature of the assessment, but I have since embraced it. The ability to go back to the TRIADS test has greatly improved my capacity for learning. And the continuous assessment has enabled me to learn in "bite-size" chunks, rather than a daunting 'big exam' at the end."

An interesting effect of the frequent CBA approach in MCB has been the added benefit of the formative tests for students whose first language is not English (Baggott & Rayne, 2001). Around 15-40% of students from any given cohort on our bioscience programmes are non-native English speakers. These students actively use the tests to help them improve their English language–it is quite common to find MCB students in the computer labs perusing the formative tests with a copy of a "Language X"–English dictionary in hand! These students routinely report that the ability to revise directly from these feedback-containing tests is very beneficial to their learning.

The newest technical element in our design—introduced in Spring 2007— is the use of EVS to provide feedback opportunities through formative assessment in MCB classes. No formal evaluation has yet been carried out on the efficacy of EVS or on student attitudes to its use; this year was considered a pilot and the extent of use was limited (not to mention that, at the time of writing, the module is still running and the last EVS session has yet to be held!). However, there was no doubt from the enthusiastic responses at the sessions that the majority of students enjoyed the limited use of EVS this year and plans are afoot to further embed this technology and the instructional approaches it affords into MCB for 2008 and beyond.

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