APRES: electronically managed student feedback via peer review

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Abstract: Students maximise learning when they receive timely and detailed feedback on their performance from teachers as well as peers. Yet in many subjects taught at university level, feedback consists only of grades and written commentary from teachers, on a final version of submitted work. This form of feedback provides little incentive or opportunity for improvement and places considerable demands on staff in subjects with high enrolments. In 2004 we addressed these problems in our subject Experimental Animal Behaviour, by involving other students (peers) in the feedback process, and designing a web-based software platform APRES to manage the administratively complex task of exchanging submitted work and reviews between students in an anonymous context. We evaluated the success of our innovation by means of written student evaluations, changes in Quality of Teaching survey scores, and changes in the quality of submitted work. All three areas indicate that the project was highly successful. We believe that there is considerable promise for widespread application of this form of feedback and the software platform that enabled us to implement it.

Introduction

Learning is a cyclical process that involves successive phases of experimentation, feedback and assessment. For new information to be assimilated, it must be organised, structured and integrated into existing cognitive systems. Feedback is crucial to this process (Ramsden 1992; Pascarella and Terenzini 1998; Hounsell 2003). Giving students the freedom to experiment with knowledge also means that constructions may be mistaken, confused, or incomplete, so they need to be tested – typically against the experience and the understanding of others. For effective learning to occur, it is therefore essential that students are provided with opportunities to articulate and test their understanding and to receive informed and constructive feedback on their interpretation (Nightingale and O'Neil 1994; Wlodowski 1999; Westberg and Jason 2001). By learning from feedback as they progress, students ultimately assume responsibility for monitoring their own learning, and this equips them for ongoing, independent learning throughout their lives and careers (Boud 2000).

While the idea that students learn most effectively when their ideas are regularly exposed to the scrutiny of others is broadly accepted, in practice the type of feedback offered fails to maximise learning benefits. As a consequence, assessment practices in higher education institutions tend not to equip students well for effective learning (Boud 2000). There are mounting concerns that opportunities for feedback will shrink further in the wake of larger classes, more diverse students, declining resources and 'end-loaded' assessment regimes. In our teaching environment and many others, the most common source of feedback for students is commentary accompanying the grade attached to a final version of written submitted work. As a source of feedback, this approach has several limitations. First, only a single perspective is typically provided – the teacher's. This limits both the qualitative and quantitative diversity of feedback available to the student and places considerable demands on teaching staff, especially in subjects with high enrolments. Perhaps more significantly, the approach is largely ineffective as part of an intended iterative cycle of learning. Because there is generally no further opportunity for students to improve on the assignment, there is also little motivation to reflect on, and thus learn from this feedback. As a consequence, evaluation of student work is sometimes viewed as time-consuming and onerous labour of little apparent benefit for either instructors or students.

A solution to many of these problems is to create opportunities for the students to become involved in the process of evaluating the work of their peers (Askew 2000; Falchikov 2001).

Critiquing peer submissions gives students valuable experience and perspective on their own work. It forces students to revise their work and thus appreciate the nature of incremental improvement in writing and the value of generating successive drafts. It promotes a sense of community and collaboration, may help to decrease the incidence of plagiarism, and helps students to realise that learning is an ongoing process (Laurillard 1993; Westberg and Jason 2001). Thus, peer review offers clear pedagogical benefits to students, as well as a potential reduction in the assessment load of teachers.

Developing online peer review management software

We became interested in the idea of implementing peer review as a result of our experiences in teaching a third-year undergraduate subject 'Experimental Animal Behaviour', with an enrolment of about 60 students. In this subject, students learn abut the intellectual, organisational and logistical challenges associated with conducting research in animal behaviour. Students form teams of 4-5 students, supervised by a graduate student or member of academic staff, by selecting a research topic. The team then formulates a question, designs an experiment or sampling regime to test their idea, collects and analyses the necessary data, and finally prepares a scientific paper. The projects are organised entirely in the students' own time. As a consequence, they not only hone their scientific skills, but also gain greater appreciation for the value of time-management and collaboration. The formula has been singularly successful in generating original scientific discoveries, leading to the subsequent publication of numerous research publications in international journals.

We were interested in a peer review process for several reasons. We wanted to provide students with feedback on their work that was useful in the sense that it promoted a genuinely reflective cycle of learning. 'Quality of Teaching' survey scores (see 'Outcomes and Evaluation' below) had identified feedback as an area for improvement in our subject. These scores were initially perplexing, since the students had ongoing access to supervisors to discuss their project and obtain feedback on its progress. In addition, as an introduction to the scientific process we felt that one thing lacking in our subject was exposure to the process of peer review which lies at the heart of quality control of scientific publication. Although the majority of undergraduate students do not pursue scientific careers, the ability to critique constructively the work of others, and interpret and reflect on critical feedback are clearly generic skills that are valuable in many work environments. Indeed, learning cycles of experimentation, feedback and assessment are recognized as one of the fundamental 'Nine principles guiding teaching and learning in the University of Melbourne' (James and Baldwin 2002).

However, when we first considered the implementation of a peer review process within the subject, it rapidly became clear that the task of administering this process would be extremely complex and time-consuming. Technological support of the process seemed to be the obvious solution. We found, however, that while web-based submission and review was increasingly employed by the editors of scientific journals, there was no readily available software to manage peer review within an educational environment.

Our aims were therefore twofold. We wanted to improve learning outcomes for students in our subject by implementing peer review, and we also wanted to develop software that would allow teachers to manage this process simply and efficiently.

Description of the software platform

We developed software that allows students to submit a draft version of their main piece of assessment (a scientific report) and receive reviews on this report from two other students and a supervisor, all within an anonymous double-blind framework. The review form includes structured yes/no questions that query important aspects of each section of the scientific report (e.g., 'Was enough detail presented to allow the methods to be repeated?') as well as open dialog boxes in which

reviewers elaborate on their views. Students are encouraged to improve their report by incorporating this feedback into their final draft before they submit it for assessment. This process is formalised by requiring the students to submit a 'letter to the editor' with their final report, in which they explain how they have dealt with the reviewers' suggestions.

Our software was written in Java and is codenamed *APRES* (Anonymous Peer Review and Evaluation System). Students access the system online via a simple interface and password-based login. The main menu of the programme offers options for uploading of reports for review, an online review form, and access to reports for reviewing and returned reviews. The report may be in one of three common formats: .doc, .rtf or .pdf. Reports and reviews are identified by student number, with dummy id numbers assigned to supervisors. *APRES* assigns each submitted project report to other students using a simple set of criteria. These criteria are that the reviewer may not be a student from the same group, and that all reviewers must receive projects for review from two different groups. Once submitted online, anonymous reports for review automatically become available to the assigned reviewers. Reviewers may download and print reports, and complete the online review, which is then automatically mailed to the report author.

Submission of the draft report is a hurdle requirement, but this draft is not graded. All students both review projects and receive reviews and thus learn the art of providing and responding to constructive critical feedback. To ensure that students take the reviewing process seriously, the quality of reviews is assessed and students are graded in the degree to which they provided 'useful' or reflective comments to their peers. The 'letter to the editor' is also graded, and provides an illuminating record of the degree to which the student has engaged with the reviews.

Many students comment that completing a structured, comprehensive review of other work is an effective way of helping them to identify areas requiring attention in their own report. As Ramsden (1992) notes: 'Giving feedback on another student's work, or being required to determine and defend one's own, not only increases a student's sense of responsibility and control over the subject matter, it often reveals the extent of one's misunderstandings more vividly than any other method'.

Our procedure forces students to prepare successive drafts of their work and discover how they can improve their written work. Additionally, they gain an appreciation for the fact that reviewers can differ widely in opinion and competence (or can have surprisingly similar, independently derived opinions) and learn how to distinguish between helpful and unhelpful forms of feedback. The exercise is effective both as a taste of the scientific process, but also as the introduction of a key generic skill required in almost any career. Most importantly, it allows students every opportunity to submit a piece of work for assessment that genuinely reflects their capabilities and talents.

Training and tuition in peer review

For many students, this was their first experience with peer review, so we offered a 2-hour tutorial session in which we both described the peer-review process generally (in the context of the primary literature) and then gave more detailed descriptions of issues to consider when writing a review. This included advice on the process of reviewing (reading and annotating a manuscript, preparing and proof-reading the review, completing the review form); the importance of providing both praise for the positive aspects of a study as well as highlighting the weaknesses, examples of helpful and unhelpful reviews, and tips for time management of reviews.

Outcomes and evaluation

We evaluated the success of our innovation in three different ways. First, we compared student scores in surveys carried out before and after the implementation of our software. Student opinion on the quality of teaching in their subjects at the University of Melbourne is measured through a Quality Of Teaching (QoT) Survey that is completed by each student each semester for each subject they

undertake. This survey questions students about their experience of teaching and learning in each subject in which they are enrolled. The QoT survey specifically addresses the issue of feedback provision with the following statement: 'I received helpful feedback on how I was going in this subject'. Students are invited to indicate the degree to which they agree with this statement by providing a score ranging from 1 (strongly disagree) to 5 (strongly agree). Our mean score for this question before we implemented our peer-review system was 2.8 (n=54). This score rose dramatically after its implementation (mean=4.2, n=56), and has subsequently been maintained. We obtained more detailed information on specific subject components from in-house student surveys. Of 49 respondents, 98% either agreed (n=15) or strongly agreed (n=33) with the statement 'The reviews helped me improve my report'. It is worth noting that the students had more variable responses to the question 'My supervisor provided helpful guidance' (with 92% either agreeing: n=22; or strongly agreeing: n=23) and the question 'The tutorial on reviews was useful', with 84% either agreeing (n=26) or strongly agreeing (n=15).

Second, written evaluations from students indicated that they were enthusiastic about the approach. Many nominated the peer review system as a highlight of the subject ('The review system is excellent; no other subject I have done gives this opportunity' … 'I learned a lot, reviewing was great!' … 'Web-based reviews were extremely helpful' … 'reviews were fantastic') and commented favourably on the format of the subject ('this subject was really rewarding and different to anything I have done at uni so far'). The positive reactions to the review process are consistent with those expressed by Richard Light (2001), who found that students identified subjects that had the most profound impact as ones in which they were required to write papers that would be read by their fellow students.

Third, we tested whether the process we implemented actually resulted in a net change in mean student performances. We assumed that if our approach had succeeded in improving the overall quality of submitted work, this should be reflected in higher grades awarded to final reports. The mean grade obtained for projects in the year before the implementation of our programme was 76.5 ± 0.7 s.e. (n=57). The mean grade obtained for projects in the year we implemented the program was 79.1 ± 0.7 (n=54; t=-2.56, p=0.012). Thus, early indications are that the opportunity for peer-assisted improvement of work has indeed led to a significant improvement in the quality of project reports that are submitted.

Problems and prospects

Some students fail to provide a timely review. The main problem with this non-compliance is that it disadvantages the author of the report. To date all students have complied because we have stipulated that failure to do otherwise leads to an automatic failure in the subject. Nevertheless, it is likely that in the future, some students may be unable to provide a review because of circumstances beyond their control. At present, the only solution to this problem is for the subject coordinator to complete the missing reviews. We are uncertain of whether there is a better solution.

Not surprisingly, there was variation in the quality of reviews provided by students, which ultimately reflects student aptitude and interest. We have attempted to limit this variation in several ways. First, the reviews themselves are assessable items worth 20% of the overall mark for the subject, thus providing some incentive for the students to provide a considered assessment. Second, the reviews are structured, forcing the students to address a range of issues. Third, each author receives three reviews, one of which is prepared by the supervisor (who will have had at least some prior experience with this activity). Nevertheless, we recognise that there is potential for dissatisfaction among high-achieving students that receive superficial or low-quality reviews. Although one might argue (perhaps facetiously) that this provides them with an introduction to the reality of publishing, it is reassuring that thus far, our survey results suggest that this problem has not arisen.

We believe that the separation of feedback from grading that is a consequence of our approach is beneficial for both teachers and students. It has improved our ability as teachers to focus effectively on these two qualitatively different tasks, and therefore we tend to perform them more fairly and consistently. It has also reduced the students' tendency to try to decode grades as feedback. Studies discussed by Black and Wiliam (1998) show that comments accompanied by grades often lead to reduced learning in comparison to comments without grades, and that indeed grades may act as a barrier to student understanding.

While we developed the system for trial in this subject, we believe that an online-administered system of peer review has considerable potential for application to other subjects that include written assignments as past of the assessment process. It is simple to manage, requires no specific programming skills, and could be adapted to suit a variety of assessment styles (reports, essays, etc.) and class sizes. *APRES* offers a number of convenient features for the subject administrator, including an overview of all reports and their submission status. Submissions are time-stamped and catalogued, and outstanding reviews are easily identified and reviewers can be readily contacted if necessary. Copies of all submitted reports and reviews are archived, and this provides subject coordinators with another useful resource for subject development.

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