IMPROVING THE IMMEDIACY AND QUALITY OF FEEDBACK FOR PHYSICS STUDENTS

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Abstract
What is good feedback? What do students want when they are asking for more feedback on their work? Is it simply they want to know if they were right or wrong? In this paper we investigate the effectiveness of feedback given to individual students using lecturer-generated audio-files emailed to each student for exams and assignments. We evaluate this using student focus groups and by reflecting on our own practice. We also discuss the effectiveness of immediate feedback using student-marked tests and assignments.

Introduction
The aim of feedback is to address students' misunderstandings and ultimately improve their learning outcomes for the course (and ultimately career). Following Nicol and Macfarlane-Dick (2006) we can define feedback as 'anything that might strengthen the students` capacity to self-regulate their performance'. In this era of mass education most feedback in undergraduate education is summative and expressed only as a rank or percentage. The student perception of feedback however is that it is a key element of good teaching (Ramsden, 1992) and that staff should never assess without giving comment on how they could improve. In physics, this feedback can often be expressed as whether students have the question right or wrong and whether they are taking the correct approach in trying to solve the question.

One quality aspect of feedback is immediacy – relating back to students' perception of the assessment task in a timely manner. In a test or exam students usually leave the assessment with a perception of how they fared in the task and it is a natural response to discuss and seek a collective view with other students. In the first section of this paper (Section A) we reflect on our experience of implementing student marked tests and assignments in first year service physics.

In marking assignments and exams we often experience the desire to write extended comments to students about issues above and beyond the question at hand. By recording and emailing these comments to students we can improve on feedback given to students – where the improvement is measured by the depth and specific nature (by student, by question) of the feedback. This will be discussed in Section B – Improving quality of feedback.

Section A. Improving Immediacy of Feedback
Improvements necessary in the immediacy of feedback were evident from course (subject) experience surveys conducted in 2005 for courses in which students considered 'the returning of 'marked assignments on time' as critical. Evidence from our service courses indicated that the average time between performing an experiment and receiving a mark was greater than four weeks. We addressed these issues using two initiatives – firstly assignments that were individualised and secondly: within our laboratories we changed to a laboratory journal and laboratory test arrangement. Details of these initiatives are described below.

Method A1: Individualised Assignments
In first year we give three assignments within a mechanics course, each covering 8 or 9 hours of lectures. We can generate computer assignments using the 'mail merge' feature of Microsoft Word/Excel to use the same physical scenario but change parameter values in a random fashion within each assignment.

This system is simple to establish with values taken from Excel into a Word 2003 Document. The existing mail setup at our University (Novell Groupwise) allows emailing of individual Word documents if one column within the Excel Spreadsheet contains the email address for each student (each row in the spreadsheet contains the values for that student's assignment). Practically there are problems dealing with the number of significant figures used by Word (defaults to 10) and use of the Excel CONCATENATE() function was required to place two spaces at the beginning and end of each value once it had been rounded to the correct number of significant figures. Only one student within the course was unwilling to access their email to download the assignment and this could be remedied by simply printing and giving it to them in class. An example of a student assignment question with the values imported from Excel (in bold) is shown in Table 1.

Table 1: Sample Question from Individual Student Assignment: variable parameters boxed.

Find the horizontal and vertical components of vector **A** which is **8**.00 units in length at an angle of **110**° to the positive x-axis in the x-y plane. Express your answer in ijk notation.
Solution: A = **6.89** $\hat{i}$ + **-1.21** $\hat{j}$ + 0.00 $\hat{k}$ - do not need z component

A1. Marking Student Assignments in class

On the due date of the assignment we ran an in-class assignment marking session where a solution sheet is given to each student containing rough working or descriptive solution and exact answer to that students set of questions. The assignment solution is then discussed (Students who did not choose to attend the assignment marking session were required to submit their assignments to a staffed assignment box before the end of class. This ensured the integrity of the assessment.). The students could walk away from a session knowing roughly the mark they had achieved and could also check their final answers against those provided. It also allowed the lecturer to explain to students what they were looking for in a particular question if a difficulty arose in the answer. Surprisingly very few students actually wrote marks on their own papers (>5 out of ~100 students) but most students walked out confident of what mark they had achieved and (more importantly) what they had done incorrectly and how to solve that particular problem. Students were informed of their final grade using a Blackboard™ *Gradebook.*

A1. Benefits of self-marked assignments

One positive outcome of this method is that it enables students to discuss problems with fellow students without giving away the specific answer. To counter plagiarism, each student is given an individual assignment solution. This also reduced the need to correct every line or working (as this was covered by the solution). Where plagiarism is suspected, because each student had a unique set of values for each problem, if a student did directly copy from another, the source is identifiable.

Method A2: Using self-marked tests

We have trialled self-marking of laboratory tests in a number of classes over the past year. This has typically involved students undertaking an hour's test, followed by the marking process in the subsequent hour. During the marking stage, students are expected to mark their work and to make comments.

The demonstrator outlines the key points in the questions and how the answers may be arrived at. There may be more than one way to answer the question and these alternative routes are often also discussed. The class is shown a rubric to help them assess their work.

This method of marking is often quite novel for many students and they are often uncertain of what is required of them and how to mark their work. We therefore spend some time with the students prior to the first such test to give them exemplars of the questions and how the answers may be judged. This also informs the students on how they should structure their final examination answers.

Unlike the assignment, all students are expected mark their tests and arrive at a mark which they write on the coversheet to the test. The demonstrators subsequently mark each test and compare their score against the student's self assessed mark.

A2. Benefits of self-marked tests

The primary benefit of this approach is the student-peer dialogue around problems and their solutions. Assessment is something that can be negotiable and the value of different approaches can be qualitatively then quantitatively discussed. Students are encouraged to self-assess and write the mark that in their judgement they deserve. Because the marking scheme is detailed, students have a clear idea of where they need to improve to achieve a higher grade. The diminished benefit perceived by students could well be related to the quality of the marking scheme rather than the process of self-marking. It is possible for a marking scheme to award understanding of a course concept.

Finally this method of feedback not only provides students with the discussion and answers to the problems, but equally it impresses on students the need for adequate communication of their work. They get an insight into how well they have expressed their ideas, and what a demonstrator is looking for when marking a piece of work.

A2. Reflection on self-marking

In these tests, students have regard for the mark they may attain and in such circumstances we have chosen to use self-marking as opposed to peer marking. The latter method is more useful in class situations where little or no marks are awarded and where formative discussion of the answers between students is of greater importance. Peer marking is

more appropriate where a fairly light-hearted approach may be taken and comparison with other student's ideas is not strongly competitive.

Groups of students have been asked for their opinion of such methods of marking and most have given favourable responses. These comments by students have been useful in refining the method of running the class in the marking time.

This scheme has helped to reduce the burden of marking for staff, since although the scripts are still checked over by the demonstrator, the task is made easier by the marking that has already been done by the students. Following the trials this year, this scheme will be adopted across all Physics service courses within our University where class tests and assignments are given.

Section B. Improving quality of feedback

Laboratory work and reporting is a key aspect of physics education and marking of such reports has always been an onerous task. Feedback on reports may be given as written comments, but this usually requires considerable effort on behalf on the marker to provide adequate explanation. It is often the case that talking with a student provides far greater clarity of explanation in the same time frame. In this study second year Physics major laboratory reports were marked and voice feedback given. The student reports are typically 8-10 pages long and involve detailed method, analysis, discussion and conclusions.

B1. Method: Voice Feedback

As well as more in-depth feedback of student's work, it was hoped that voice feedback might also allow for a more rapid turnaround time. In the past, once a laboratory experiment had been completed, students were given a week to complete the report and it might have taken a further week or more for the marked report to be returned to the student. Video was also considered as a medium to provide feedback. This might take the form of an individual digital video clip of comments made by a demonstrator of a hardcopy of the students work. Alternatively a screen capture package might be used in which a video is made of the computer screen, mouse movements and audio comments on the electronic version of a student's work. We chose the audio medium, due to its narrower bandwidth requirements, its easier production methods and because the listening platforms are now so ubiquitous.

The program used for recording is Audacity which saves the files in an MP3 format. The files were emailed to the students using a link from a list of email addresses in an html page generated from a student list.

B1. Feedback from Student Focus-Groups

A small sample from students who had received voice feedback was interviewed in two focus groups (N=9 and N=3). All students bar one appreciated the voice feedback and generally had no problem with communications in being able to listen to the comments. Most reproduced the audio from the loudspeakers on their home computers, and a few downloaded the feedback to their MP3 player.

One or two students had difficulty with what was being said, rather than the audio quality. Visual clues are often used by students when 'listening'' to a lecturer. (Almost no attempt was made to edit the comments to ensure that the time spent on each student was manageable.)

Many students felt that video might be even better, although this was not restricted to their own work. They felt a worked solution where they could view their work and listen to a written solution by a demonstrator would be valuable. This was especially relevant where students did not have a copy of their work at hand when listening to the comments.

B1. Reflection on Voice Feedback

For staff, the learning curve in using the software was quite minimal. More effort was required in devising the simplest and most effective means of passing on the audio comments to students.

Consideration also had to be given to how best to talk to a report or test, so that the feedback was intelligible to students but without requiring substantial time for production. Almost all the audio was recorded only once with no editing. Generally the quality of the sound and of the delivery of the message was not high, but they were quite adequate to the task.

The additional time taken up in producing the voice files was not onerous, and indeed not dissimilar to that required to produce less fulsome written comments. Usually individual comments lasted about 1½ minutes. Longer files suffer

the same problem as audio capture of lectures, namely the difficulty of navigation through a long, essentially serial medium.

Some time was also spent by staff in emailing the comments to individual students, but it is hoped to devise a more efficient method to reduce this time bottleneck. The voice feedback did definitely allow improved delivery of the message, not just because of the ease of speech, but also to the intonation of voice that could be added. An encouraging nuance of voice may be given, something which is difficult to put into words quickly and effectively.
There is real, although limited, scope for voice feedback. Some felt the communication was too one-way and likened it to a phone call where they could not respond or ask for clarification.

More positively, students appreciated the efforts to improve educational practice, and in the case of an examination, being provided feedback they would otherwise have not received (usually only exam marks are released). This raised the possibility of using the voice feedback to provide comment on final examinations which are not normally seen. This may not be practically feasible if the exams are team-marked and it proves difficult to collect feedback from multiple markers. There is also the privacy issue of non-academics sending essentially un-moderated feedback which can be traced back to an individual marker.

Conclusion

Self-marking of tests and assignments by students allows self-assessment and encourages a dialogue around assessment that is immediate and engaging. Individualised student assignments also provided immediacy of feedback but were not as successful in engaging the students in participating in a self-marking process. Recorded audio feedback received a mixed response from students with many comments around the inadequacy of audio without visual cues. Despite this it may be possible to provide feedback for final examinations which is not otherwise provided.

Students have also been generally pleased with the audio feedback they have been given and are not overly concerned with the quality of the sound. In practice this has involved little additional burden for staff over that normally expended in marking individual reports/exams.

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