Tales from the coalface: From tragedy to triumph in a blended learning approach to the teaching of 1st year biology

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Abstract: *In 2004 we made a significant move to blended course delivery in 1st year Biology at the University of Newcastle. Innovations included electronic delivery of course notes, laboratory instructions and other support material including interactive templates, instructional and background videos, step by step guides for data analysis and some online laboratories. Students also submitted reports electronically and used email along with peer review to provide guided feedback to each other. Online discussion boards were used to interact with students and to assist students outside of class time. We also used some automatically marked online assessment. Feedback on the implementation of a blended learning approach in Semester 1 during and after the completion of the semester showed that, although grades were strong, student and staff satisfaction levels were the lowest on record. Key issues identified were workload, quality and quantity of feedback and collusion. In the light of this feedback changes were made to the delivery in Semester 2 to reduce workload, improve feedback and minimise collusion. At the conclusion of Semester 2 overall course grades and the results of student surveys showed that grades and satisfaction were the highest on record. All this with a 40% reduction in part time teaching costs for Semester 2. We believe that our experience shows that the blended learning environment can produce an improved quality learning environment at reduced cost, although only when that environment is matched with skilled and motivated teaching staff.*

Introduction

A number of benefits of blended learning environments have been suggested including increased flexibility for students in terms of access and asynchronous teaching, improved delivery of support material, student engagement, automated formative and summative assessment, improved use of class time and importantly the possibility of reduced teaching costs (Alvarez 2005; Bonk, Olson, Wisher and Orvis 2005). 1st year biology at the University of Newcastle (Australia) services 400 students across nine laboratory classes in first semester and 250 students across seven laboratory classes in second semester. It has seen a gradual implementation of blended learning since the introduction of a course CD in Semester 1 2002. In Semester 2, 2002 the course moved to a *Blackboard* environment and gradually began to take up some of the additional interactive features offered by web based systems. At the beginning of 2004 a concerted effort to move to a blended learning environment was made.

The motivation for moving to a blended learning environment was precipitated by an independent review of plagiarism issues. In response the University implemented the *Turnitin* software package requiring assessment items to be in electronic format so that they can be compared via web based submission to an offshore database. Turnitin was a useful tool for encouraging academic integrity; however, it required a dramatic increase in computer literacy within the student (and staff) population that was not addressed directly in the course content. We viewed a blended learning environment as well suited to the teaching of computer literacy as learning occurred in context with the biology and the relevance of the material was immediately obvious. We (perhaps naively) thought this would aid the students in viewing computer skills as valuable research and communication tools rather than simply skills they were required to learn in order to pass the course.

Method

Our curriculum design for the Semester 1 course contained both structured and flexible elements. The structured elements included the delivery of course notes, laboratory instructions, assessment items and some of the support material. Flexible elements included extension material for laboratory exercises and additional support material. We employed a continuous monitoring and feedback

strategy throughout the course by direct discussions with students and an electronic discussion board that allowed anonymous posting. A formal Student Evaluation of Course (SEC) was held at the conclusion of the course using the Universities standardised course review tool and analysis of the distributions of final grades was also undertaken.

Curriculum design for the Semester 2 course also contained structured and flexible elements. These included a significant restructure of the assessment procedure to address concerns identified in the Semester 1 course. Unlike Semester 1 flexible elements were not used to provide extension material but were employed in fine tuning support material to identified student needs. Success of the approach was again continuously monitored by direct discussion with students and an anonymous electronic discussion board. SEC and grade distribution analysis was conducted as above.

Effectiveness of the blended learning approach

Semester 1

The semester 1 course consisted of 3 hours of lectures and 3 hours of laboratories per week. Lecturers used *PowerPoint* and these files were made available to students via *Blackboard*. Instructions for the laboratories were provided to the students as *Word* files via *Blackboard*, who were expected to read them in advance and bring a hard copy to the laboratory session. Assessment of the laboratory course was worth 40% of the final grade and comprised 5 written laboratory reports (24%) and 2 online quizzes (16%). The course contained 11 laboratory exercises and students were required to write 'practice' reports for the non-assessed exercises and peer review 2 'practice' reports of other students to qualify for submission of their next marked assessment task. It was up to students to organise their reviewers. 'Practice' reports were submitted electronically to *Blackboard* and *Turnitin* and emailed to fellow students for review. Reviews conducted by each student were also submitted to *Blackboard* so that their completion could be tracked and eligibility for their next assessment assessed. Support material for the writing of laboratory reports and reviews was supplied in the form of *Word* based templates. These templates provided both an academic guide to what was required and well as an aid in file formatting and structure for those with limited computer skills. Other support materials such as background video and step by step guides to data analysis were also provided via *Blackboard*. Laboratory reports that were submitted for marking were not peer reviewed and were submitted in hard copy as well as electronically to *Blackboard* and *Turnitin*.

Overall perceptions

Table 1. Average responses (1=strongly disagree → 5=strongly agree) for Student Evaluation of Course (SEC) for the offering of Semester 1 biology at the University of Newcastle before (2003 – 265 respondents) and after (2004 – 202 respondents) implementation of blended learning.

SEC Question	Sem 1 2003	Sem 1 2004
I have found this course interesting and stimulating	3.45	3.5
I have learned a lot from this course	3.45	3.55
The course has been presented in an interesting and stimulating way	**3.05**	**2.95**
The workload in this course is reasonable	**3.05**	**2.45**
Assessment in this course is fair	3.4	**2.95**
Assessment in this course sets a suitably high standard	3.6	3.45
Sufficient help and advice has been provided whenever I needed it	3.4	**3.1**
Sufficient resources are available to support the teaching of this course	3.4	3.35

It is clearly evident from Table 1 that the workload required of both students and staff was excessive. In previous years, students prepared hand written reports during the laboratory session which were marked during laboratory time. While we reduced the number of assessed reports by 50%, we failed to predict the increased effort students would put into their report writing when given the opportunity. Students focussed on report length as a measure of quality despite the assurances of staff and were unable to pragmatically allocate effort to marks available.

> It takes at least a few days to get a decent report done, then there's the other coursework we're required to do. I think if you ask any biology student, you'll find that BIOL1010 labs have been a black hole (in a nice way) as far as time is concerned.

The magnitude of submitted work increased the marking workload of the demonstrating staff and they fell behind with a consequent breakdown in feedback to students - 'it's really not fair that some people get feedback and others don't, how are those of us without any feedback expected to improve'. This is reflected in the SEC results for fair assessment and availability of feedback (Table 1). This inconsistent feedback led to a rise in complaints and requests for re-marking that further increased the workload of supervising staff.

Student grades at the completion of the course were strong. The course recorded its lowest ever fail rate of 8% (fail rate is usually 12-18%). The low fail rate was thought to have a number of contributing factors: The cohort was looked at as being unusually strong, the high work rate forced students to invest time into their biology studies. Given that 64 students (15%) withdrew from the course the low fail rate may also be explained by 'burn off' of the students that usually made up the tail of the cohort.

The use of a blended learning environment was successful in re-enforcing the importance and relevance of generic skills with students by placing them in context of the science 'as far as the computer work goes, we understand that to be good biologists, we need to constuct acurate reports and graph our data'. The blended learning environment was effective for those students with some pre-existing computer skills but created a Catch 22 situation for students with no prior computer skills. While there were only a few students in this situation, the blended learning environment created anxiety for them and meant that they had increased difficulty in keeping pace. This phenomenon occurred almost exclusively with mature age students and was viewed as a barrier to them progressing in the course irrespective of their understanding of the biology 'I HATE THE LABS!!!!!!!!!!!!!!!!!!!! the actual work is ok but i hate all the computer stuff……It needs to change PLEASE it is putting me off bio'.

Analysis of individual components

Practice reports had a mixed and contradictory reception with students. On the one hand students appreciated the chance to practice what was required for submission 'theycan work on their report writing skills and improve them gradually without having one report worth heaps and blowing all your marks at once' and on the other they thought that it was unfair that they were required to do work that did not directly contribute to their assessment grade 'i dont like the fact we do lab reports and assignments which are not worth anything but which we have to complete in order for assessable reports to be marked. i dont think its fair.'. One important thing the practice reports did facilitate, however, was the identification of students with potential difficulties with plagiarism and academic integrity. Remedial action could then be taken to rectify these issues prior to the commencement of real assessment. It also ironed out practical issues associated with *Turnitin* submission.

Peer review was carried out via email. Students were directed to email their practice reports to 2 other students and review the work of 2 other students under the guidance of review templates. The first review used a rubric type template that also acted as a check list for their own report. Later reviews were in the format of a formal letter that was designed to teach students the art of providing constructive feedback. The letter template outlined a sandwich approach where the reviewer was first required to identify the strengths of the paper, followed by identifying something that could be improved on and then finishing with a recap of the strengths of the paper. Peer review was seen by students as at best a waste of time and at worst a source of anxiety/ misinformation. Students did not feel they had the confidence or knowledge to give adequate feedback to other students and felt uncomfortable doing so 'Really, what is the point of getting students to assess work when they are on the same educational level?' As the timing of peer review was somewhat asynchronous, a number of students also thought that they were exploited in terms of aiding less diligent students with their

reports while receiving inferior feedback themselves. There were also suggestions that the practice encouraged collusion 'I believe that it only encourages students to copy each other's work'.

Part of the continuous assessment of the laboratory program was conducted via two online electronically marked quizzes. The first quiz duration was 30 minutes and while students were able to access the quiz any time in a five day period they were only allowed a single attempt. From a workload perspective the quiz was successful and ran relatively smoothly. From a student perspective there were two main problems with the online quizzes: The first was the perception that students from some classes had an unfair advantage due to the identity of their demonstrators. This possibly stemmed from the difficulty some students had in understanding questions testing higher levels of Bloom's taxonomy requiring them to apply the basic principles underpinning the laboratory to novel situations. This led many of them to assume that other classes had received additional material to themselves with a consequent advantage

> i think there should be no more quizzes and if there are, they should put a lot more thought and effort into both the questions and making sure all the labs are getting the same info, not some demonstrators putting in a lot more effort than others.

The second issue was reported problems with collusion, where a student would sit the quiz at the beginning of the time period and pass the questions on to fellow students who would sit the quiz at a later date. Other students sat adjacent to each other during the quiz and assisted each other with the answers. Staff had no direct observations of collusion but the reports sounded plausible and warranted steps being taken. The arrangements for the second online quiz were altered to attempt to deal with the allegations of collusion raised in association with the first quiz. The quiz was again of 30 minutes duration, however, this time the quiz needed to be attempted within a 1 hour period (their usual lecture time). We randomised the order of questions and allowed only a single question to be presented at a time to reduce the usefulness of collusion. This proved successful at reducing collusion, however, drew criticism from students who thought the time allowed for the exam was insufficient.

The discussion board was well patronised by students with more than 750 posts during the semester. The large number of anonymous posts made it difficult to gauge the exact number of participants, although tracking of the number of times messages were read indicates that it was probably about 25% of the course. Many posts followed a theme similar to a chat zone and were comprised of simply agreeing with previous posts. After key events such as quizzes the discussion board was a source of hysteria where students vented their anxieties

> 'i studied really hard for the lab quiz and on everything we had learnt. how then, can i get 19 out of 50 and risk failing this course?!! This better be scaled' and 'i am working damn hard for my degree, their teaching methods suck in this course'.

From a workload perspective it was hard to judge if the discussion board increased or decreased effort. While students could advise each other about problems it was often necessary to step in and correct misinformation. Some of the problems would have been more easily dealt with in person during a consultation period however, it was clear that a number of students considered online feedback preferable to personal contact.

The provision of *PowerPoint* lecture notes via *Blackboard* was appreciated by students. This quickly became an expectation and complaints were made if the lecture notes were not provided sufficiently ahead of time. Lecture attendance also fell to approximately 50% despite the advice from lecturing staff that the lecture notes were not written with distance education in mind. This suggests that there is considerable demand for flexible delivery within the student cohort, or that many students simply don't find oral presentation of the lecture material helpful. Electronic provision of laboratory instructions dramatically increased the flexibility of the program and allowed alteration

of the laboratory to make the most of available materials. This procedure also created some difficulties for students in that some forgot to bring their notes with them to class and students that liked to plan ahead were prevented from doing so by the unavailability of some laboratory instructions until close to the laboratory session. While the students did not have to face the initial cost of purchasing a laboratory manual, for some students the total cost of printing the instructions themselves may have been higher overall.

Laboratory report templates were introduced in order to accelerate the process of learning laboratory report writing. The templates were *Word* documents that were preformatted into the correct style with instructions as to what should be written in each section. As the course progressed the focus of the laboratory reports and hence report templates shifted from style and organisation to exploring the analysis and evaluation of the experimental data and the creation of coherent researched explanations for observations. Laboratory report templates were well received by students and staff as an effective teaching and learning tool 'i think the report templates are a great idea because they give us an idea of how to go about setting out the report for each section and what to include.'

Electronic submission operated relatively smoothly. Students were required to submit their reports to both *Blackboard* and *Turnitin* and both had their good and not so good points. *Turnitin* was easier to submit to but there was no easy way to tell which students had not submitted their report. *Turnitin* was simple to use for plagiarism detection (note that *Turnitin* only detects matching text and it is up to the staff member to determine if this constitutes plagiarism) and is a valuable tool in the development of academic integrity. *Blackboard* created some difficulties for students. Sometimes successful upload was erroneously reported to students but staff could rapidly determine which students did not submit reports. The University is currently implementing a building block for *Blackboard* that will seamlessly integrate *Turnitin*. This it is hoped this will alleviate some of these issues and make the submission simpler for students.

Take home messages

Improvements were required in the course to make it less stressful to both staff and students. These changes were: Fewer assessment items, more timely and consistent feedback, workload reduction, practice assessment was required but needed to be integrated into assessment, no peer review and start slowly to avoid creating a Catch 22 for students with low initial levels of computer awareness.

Semester two

In light of the feedback from semester 1 the assessment for the semester 2 course was structured quite differently. The number of written laboratory reports was reduced to 2 (1 on each major theme of the course), and the number of automatically marked laboratory quizzes was raised to 4 although each contributed a smaller amount to the total assessment. Students were able to submit draft reports for staff feedback prior to submission to ensure that feedback was timely. Students also participated in the preparation of the online quizzes by submitting questions to a discussion board in Blackboard from which initially 50% and later 100% of the quiz questions were drawn. The use of custom made instructional and background video files delivered via *Blackboard* were also trialled for practical tasks such as dissections. In addition to changes in the assessment and support material changes were also made to the management of demonstrating staff. We increased the staff to student ratio from 1:18 to 1:25, but simultaneously increased support for demonstrating staff through briefing sessions.

Overall perceptions

Table 2. Average responses (1=strongly disagree → 5=strongly agree) for Student Evaluation of Course (SEC) for 1st year biology at the University of Newcastle showing the effect of changes in the design of the blended learning delivery (202 respondents Sem1, 124 respondents Sem2).

SEC Question	Sem 1 2004	Sem 2 2004
I have found this course interesting and stimulating	3.5	3.65
I have learned a lot from this course	3.55	3.7
The course has been presented in an interesting and stimulating way	**2.95**	**3.45**
The workload in this course is reasonable	**2.45**	**3.6**
Assessment in this course is fair	**2.95**	**3.4**
Assessment in this course sets a suitably high standard	3.45	3.8
Sufficient help and advice has been provided whenever I needed it	**3.1**	**3.65**
Sufficient resources are available to support the teaching of this course	3.35	3.65

The semester 2 course was seen as a vast improvement for both staff and students. Table 2 shows the workload and fairness of assessment were no longer significant issues with this student cohort. Responses to the questions on academic standards and feedback were among the highest on record providing evidence that the reduction in demonstrating staff did not reduce support to students. Similar to the semester 1 course the fail rate was low at 8%, although this may have been confounded by the perceived 'burn off' of the lower tail of the cohort that occurred in semester 1. A particularly satisfying point though was the shift in the distribution of grades from passes into credits and distinctions showing that a majority of the student cohort performed better under the new course approach.

Analysis of individual components

Our finding was that the staff: student ratio was not as important as the quality of staff employed and fewer staff meant that they could be better supported in their roles. A key ingredient to the success of this process is the minimisation of marking time for staff and a refocusing of staff time to direct contact with students. Implementation of these changes reduced the cost of part time teaching by 40%, a major expenditure in delivering the 1st year laboratory program.

Draft submission was voluntary for the first laboratory report. To our surprise only approximately 50% of students took this opportunity to receive direct feedback on their report from supervising staff. Those students that did seek feedback showed great improvement (20%) while those that did not performed poorly. The student response was disheartening to the teaching staff (some students felt they did not require feedback despite poor performance) so a decision was made to save the students from themselves and make draft submission compulsory for the second report. This was an intense activity for staff that required a high level of maturity and skill. The activity was seen as being highly successful and the most effective method yet experienced by these staff for teaching writing skills.

Getting students to develop questions for the online quizzes under the direction of staff changed the assessment from summative to formative. This helped to engage students and eliminated perceptions that the quizzes were 'unfair'. It also enabled each class to have a unique set of questions and harnessed collusion as a study rather than exam technique. Students were required to submit an adequate question to qualify for sitting the quiz. Surprisingly grades from the quizzes were no higher than previous quizzes, although students did seem to get more out of them and gained additional insight into examination technique.

In line with the idea that some skills are best learnt by mimicry, we developed a video of a rat dissection to assist in the hands on dissection conducted during the course. The video showed the complete dissection and used subtitles rather than audio to provide instruction and useful tips. The lack of sound made the file size smaller and meant that students could view the video in crowded computer rooms without the need for ear phones. The video was played at the beginning of the laboratory session with the demonstrator in charge providing additional commentary and answering

student questions. Demonstrators found that the quality of dissections was much higher than previous years and the students were a lot more confident with the material. It also meant that students who were reticent to ask questions did not go as far astray as in previous years as the video was a more intuitive instruction source than written notes. The video also allowed for a more comprehensive educational experience for conscientious objectors and gave students a more realistic expectation of what was going to be required of them during the laboratory exercise.

Conclusions

Our experience is that the use of a blended learning environment can be very effective at engaging students and improving their educational experience at reduced cost. The transition from a traditional learning environment to a blended one is not a direct transposition however, and a great deal of thought, understanding and experience needs to be employed for the benefits to be realised. Our key finding is that the number of assessment tasks needs to be reduced and an avenue of entry provided for students with low initial computer awareness. Students get much more out of a few assessment tasks that are followed through and supported with appropriate feedback than many reports that are simply completed to make up the marks. Blended learning also offers a number of possibilities that have not been previously available including participation in formative assessment and asynchronous preparation for practical exercises. The impact of asynchronous use of resources by students needs to be addressed, however, especially in terms of the relevance and role of lectures and the troubleshooting of student problems.

References

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