

# Blended learning: An approach to delivering science courses online

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*We describe a science course which is moving from being delivered mostly face-to-face to a blend of online, distance and asynchronous styles using a range of elearning technologies. In depth evaluations of the most recent presentation of this course have been conducted via focus group discussions and interviews. The responses demonstrate a spectrum of acceptance and reservation about this transition to a blended learning approach.*

## Introduction

A major problem with online instruction in contemporary universities is securing cooperation of academics. Oslington (2005) argues that although the benefits are widely recognised, participation is inhibited by 'the unverifiability of expertise in online learning, the firm-specific nature of investments in online learning and the team nature of online learning'. The preparedness of science faculty staff to engage in online and distance learning is further discouraged by the difficulty in presenting the skills and knowledge involved, particularly in the practical and fieldwork aspects of science courses. Virtual field trips, interactive multimedia computer-aided learning (CAL) packages and practical kits have been used in the past to overcome these perceived difficulties and we have used a range of approaches in trying to deliver geoscience courses online (James et al., 1995; James et al., 1996; James et al., 1997). The introductory undergraduate geoscience course described here has thus evolved from a completely face-to-face delivered course to one which can be partly taken off-campus. We have experimented with CAL modules, just-in-time teaching (Novak et al., 1999), online readings, discussion forums, question and answer sessions, mail-out practical kits, interactive field simulations using a combination of digital images and real earth materials, and virtual field trips, in an approach that can be described as blended learning. Blended learning (Thorne, 2003) is recognised as a way of meeting the challenges of tailoring learning and development to the needs of individuals by integrating the innovative and technological advances offered by online learning with the interaction and participation offered in the best of traditional learning. Fisher (2003, p.11) describes it as 'the selection of an optimum mix of instructional delivery strategies that will enable a learner or learner group to achieve desired learning outcomes'. Blended learning provides all the benefits of online learning including cost reductions, time efficiencies and location convenience for the learner as well as the essential one-on-one personal understanding and motivation that face-to-face instruction provides (Brown, 2003).

## Distance or face-to-face

The ready availability of computer technologies in the classroom and the community have greatly expanded the educational options available to both learners and instructors in a way that has blurred the distinction between traditional face-to-face and distance learning. Distance programs are attractive to working adults because they provide flexibility in time and place (Osguthorpe & Graham, 2003), but they suffer from limited human interaction. A weakness of traditional university courses is their lack of time flexibility, requiring learners to be present in class up to four times a

week and often on more than one day. This disadvantages part-time students, adults returning to study after or during periods of child rearing and traditional full-time students, many of whom now have to hold part-time jobs in order to survive. The pedagogy of the blended approach that we have adopted is based on the assumption that there are inherent benefits in face-to-face interaction as well as the understanding that there are inherent advantages to using online methods. Holt and Segrave (2003) recommend that planned learning experiences intended to develop excellence in professional practice demand design approaches that more broadly conceptualise contemporary learning environments. With this in mind we have adopted an approach that involves blending those components of the face-to-face and online methods that best suit the learning outcomes for this course. Our past experiences with the adoption of various technologies has led us to understand the importance of choosing the right blend. In this respect, it is important to consider the whole learning environment rather than patching together resources in different media (Fisher, 2003).

## **Course design**

Introductory Soil Science is a core course in the first year of the undergraduate environmental management programs at the University of South Australia. It is a typical undergraduate science course consisting of two discreet but related components: a theory component in which new knowledge and concepts are introduced in lectures; and a practical component where manipulation and classification skills are introduced in the laboratory and then practised in the field. The lecture component has gradually evolved from a fairly traditional teacher-centred didactic style to a much more interactive student-centred style. Like most undergraduate courses the lectures are illustrated by PowerPoint slides, an aspect of teaching that we have gradually adapted over several years (James, 1994).

The way in which the course has been taught has evolved as new technologies and new (theoretical) conceptions of learning have been developed. The purpose has always been to provide an effective learning environment with the emphasis being on acquisition of knowledge and skills about soils. At the same time the course is expected to begin to develop in students a set of generic skills (referred to as Graduate Qualities by the University of South Australia). These are the first two of three of what Goodyear (2002) describes as 'conceptions of the nature and purposes of higher education': academic; generic competence; and reflexive. It is not possible to describe all aspects of the learning environment here. In what follows we describe some of the online activities that have been 'blended' with the more traditional methods, the reason(s) that we chose to use them and a brief description of the results of their evaluation.

We feel that it is important to have a clear, coherent model of learning around which to design the curriculum and the learning system rather than to use the tools and technologies because they are available or trendy. Thus before the various face-to-face and online components were chosen we carefully considered how they would contribute to the model of learning that we felt would result in improving learning outcomes. The nature of the course, its place in the program, its relation to the University's goals, as well as more pragmatic considerations such as timing of the class, the time demands of both full-time and part-time students, class size, learning styles, etc. were considered. Biggs (1996) suggests that in designing the learning environment, close attention should be paid to what the learner is doing. Learning depends on both the physical and mental activity of the learner and while we cannot control these things directly we can create an environment that influences what the learner does. In what he calls 'constructive alignment', Biggs stresses the importance of aligning the curriculum, the teaching methods, the assessment procedures, the educational environment we create and the learning objectives we want our students to achieve.

## **Learning model – guided construction**

There is a strong body of evidence suggesting that learners use their current knowledge to construct new knowledge and that what they know and believe at the moment affects how they interpret new information. Sometimes learners' current knowledge supports new learning,

sometimes it hampers learning. Effective instruction begins with what learners bring to the setting. The guided construction model of learning is widely accepted as the one that best fits our understanding of how learning occurs (Fensham, Gunstone & White, 1994; Tynjala, 1999; Bransford, Brown & Cocking, 2000). In this model, learners have an active role in constructing their own knowledge. It differs from the 'Discovery Learning Model' in that there is an important place for external guidance, from the instructor, from online resources or from collaboration with other learners. Referring to this model, Goodyear (2002) suggests that learning outcomes are more likely to be improved if we use a model that emphasises that learning is active, cumulative, individual, self-regulated, and goal-oriented. These were used as a form of checklist in the development of the learning environment that was created for this course.

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## **Aspects of the learning environment and its evaluation**

### **Course delivery and the learning model**

The University of South Australia has established an online presence in the area of teaching and learning known as UniSAnet. The UniSAnet facility, accessed via the world wide web is the masthead for all online dimensions of the University's teaching and learning program. A standard set of authoring and communication tools have been adopted across the University and form the basis for putting further materials online.

### **Course evaluation**

The pedagogy of the blended approach that we have adopted is based on the assumption that there are inherent benefits in face-to-face interaction as well as the understanding that there are advantages to using online methods. The purpose of this project was to determine whether students perceived the benefits in the same way as we did. Specifically we wanted to find out from students: which of the online resources they used and how they used them; and whether they felt that they helped learning.

The principal methods of evaluation were the application of standard University of South Australia CEI (Course Evaluation Instrument), SET (student evaluation of teaching) surveys and a series of focus group interviews. The CEI and SET evaluations are conducted online and are open for students to use from the middle of the second last week of teaching until after the exam period. Sixty-five of seventy-nine students in the course responded.

Focus groups of six to eight students were convened during normal practical sessions in the final week of teaching. One of us (PJ) guided the discussion using a series of questions designed to elaborate on the class responses to the CEI and SET questions that related to the online components of the course. Each session was tape recorded and recorded by a note taker. Adapting a method suggested by Kreuger (1994), the first part consisted of introductions and a brief overview of the background and purposes of the focus group. Students were encouraged to respond independently and to discuss their responses with each other before replying to the questions. About 20 of the 79 students in the course participated in the focus groups.

At the beginning of each focus group it was explained that we were interested in the use of online resources that were accessible through the course home page. We reminded the students that there were several components to the course online material: the course outline; PowerPoint slides for each lecture; online readings; questions based around the online readings; an online discussion page and the AssignIT online assignment submission tool. During each focus group interview, each of these components was explored separately and the students were asked about how they used them. Discussion in the groups inevitably raised other issues and although these were recorded and will be used during ongoing course refinement they are not reported here.

## Course outline

Preparation and distribution of a course outline to all students is a requirement of all courses. Course outlines are prepared by inserting course specific information into a template that also contains information about relevant policies and regulations. In the past, like most courses, we have distributed it as a paper copy to each student at the beginning of the study period. Recently, we have changed to only providing an online copy on the course home page. We felt that by making it only available online we would not disadvantage students and that it would be more readily available to the students when they needed it. This was supported by the overall positive response of the focus groups.

The students were asked when they referred to the course outline handbook during the study period? How often they referred to it and which parts of it were useful? They were prompted to recall responses by mention of the fact that the outline contained a timetable for the lectures and laboratory sessions, assignment due dates, assessment weightings, course objectives and graduate qualities table.

All student focus groups and students were generally supportive of the presence of an online version of the course outline handbook. Quotes such as 'The course outline was referred to every week to keep up to date, see what assessment tasks are worth and when they are due, as well as the timetable of upcoming lectures and what is required' were typical and the overall response was positive. They also commented on the manageable size of the outline which was purposely kept brief (4–5 double-sided pages), the fact that it could be used as a quick reference tool and that it was much easier to read than larger outlines provided for other courses. Some students used the outline to mark out their diary and also commented that it was good to know it could always be easily accessed for future reference. They also found the list of basic readings useful. In terms of frequency of use, students generally used it more in the first half of the study period although they did refer to it from time to time in the second half, while others students used the outline throughout the semester and indicated that they would refer back to it regularly. One student stated:

I printed it [the outline] out and kept it in the front of the folder for easy reference!

Another student:

set up a planner [that was given out by the student association] to easily tell what was due every week.

Students also highlighted that the due dates were an absolute must to enable prioritisation with other courses, particularly in terms of assignments and assessments and their due submission dates. They were able to gauge how much to do for assignments – as the outline showed assessment weightings.

The due dates being published enabled us to plan and prepare so as not to be too stressed if all first-year assignments were due at similar times.

The seven graduate qualities of the University of South Australia are a recognised (AUQA, 2004) exemplar of good practice in undergraduate curriculum planning. In brief, application of the graduate qualities anticipate that students will graduate with skills required to become: 1) effective problem solvers and 2) excellent communicators, as well as 3) knowledgeable individuals who can, 4) work collaboratively & autonomously, and become employees with 5) an international perspective and 6) a commitment to ethical action and 7) life long learning. Graduate qualities are mapped against course profiles in all courses and students (as well as staff) are encouraged to reflect on the generic attributes and benefits which flow from their consideration.

On being asked about their understanding and feelings about the graduate qualities, students were generally lacking in interest, ambivalent or negative, until prompted to discuss their possible value and benefits. Almost all students had heard of the graduate qualities, but many felt that they should not necessarily be inserted into course outlines. There was a limited understanding of the

requirement for students to recognise graduate qualities, and a feeling that they seemed to be more relevant to staff than students.

As this was something new to first years, we read them, but did not think about it too much.

Conversely, some students recognised the graduate qualities as part of the program objectives, while others remembered that some assignments actually indicated what graduate qualities they cover. Overall, there was a perception that the assessment weightings changed towards different graduate qualities as students progressed through the course. And a number of the students commented that the qualities could likely be later used as part of a resume or to identify skills gained.

## **PowerPoint lecture slides**

All lectures were illustrated using the Microsoft PowerPoint software, with presentation of PowerPoint slides comprising text, graphics, illustrations, field photographs and tables. As well as the face-to-face delivery of these lectures, the full PowerPoint files were uploaded onto the course home page prior to delivery and many students took advantage of this to print out summary pages of the slides for note taking during the lectures. Students were asked if they found the PowerPoint slides useful, how the slides helped with their learning and how they used the slides prior to, during and after lectures. They were also asked if the files were posted early enough and how the slides could have been made more useful?

There was unanimous agreement that the use of PowerPoint slides during lectures was very useful and an overwhelmingly positive attitude to this style of lecture presentation. The use of PowerPoint slides was described as much better than overheads (as used by other contemporary lecturers), with an explanation that:

too much information can be put on overheads and hence (they) are not as easy to understand.

PowerPoint slides which included diagrams and photographs allowed students to remember content visually. Other positive aspects to the presentation of PowerPoint slides included their use of key words which were easy to retain (in memory), that they were 'useful' and 'made lectures easy to understand'. The groups also commented positively on the fact that they could be looked back on after lectures and that they could be used as reference tools for other assignments as well as for general revision and to study for exams. More than one student indicated that they could concentrate more on the lecture and what the lecturer was saying rather than taking copious notes.

It was obvious that the use of PowerPoint slides during lectures is becoming more common in undergraduate classes and that students are concomitantly becoming more sophisticated in accepting or rejecting this style of lecture. Amount of text, font size, style, colour, integration of figures were all commented on as being important to gauge and qualify the success of this technique. The frequent use of the whiteboard to give 'more detailed explanations and figures' was also highlighted.

Although this was not an issue in the soils classes, some teaching staff have too much information on each slide (too heavily weighted with words) – this tends to lose students in the lecture environment. Size of the print is important, if it is too small, students again lose interest

The ability of a PowerPoint presentation to impart vast quantities of data and information was also well understood by the students. The careful use of the slides and the mixing of didactic (electronic) presentation with more leisurely whiteboard illustration and frequent interaction, was commented upon favourably by a number of students.

The style of the lectures got students involved and set up a comfortable environment for encouraging questions. The lecturer explained terminology and defined it in lay terms [the slides allowed] easy access to the resources.

Printing of PowerPoint slides by students for use before, during and after lectures was quite variable. Some students printed out each slide on a single page using print format to include space for note taking, while others used the three-per-page or six-per-page print options. One student did not print out slides as she found it better to concentrate on the screen without distraction of paper copy, while another would 'print out (the notes) every week and notate (them) during the lecture'.

There was also some discussion about whether the availability of online PowerPoint files might encourage students to miss lectures or to take less notice of the lecturer and the presentation style and content during lectures. Most students considered that it was up to the student to come to lectures, and in fact there was no noticeable drop off of student attendance during the course. Students commented that attending the lecture was important as the lecturer helped to explain the content of the PowerPoint slides, and also that there were often extra hints and information presented during lectures to assist with assignments and tests or exams.

If you didn't attend the lectures and just used slides, you did tend to miss out on some of the explanation/detail.

In terms of when the PowerPoint lecture material was or should be posted on the course website, students commented that in the case of this course, they were 'mostly before the lecture, though a couple were late'. Generally students felt that having the lecture materials on the website prior to lectures made the slides into a more valuable learning resource. However, during this discussion, one student was:

unsure if all lectures could be put on web at the beginning of the year because one of the assignments was focused on the student doing their own research, hence if the lectures were already on the web, the students would not have learnt any researching skills.

To the question about how the PowerPoint slides could be made more useful, there was no response, indicating a general degree of satisfaction with this style of lecture presentation, in this case.

## **Online readings and guiding questions**

Online readings were posted each week which the students were asked to read and use to prepare answers to a series of set questions. These readings and questions were to form the focus of one of the one hour 'lecture' presentation sessions each week, during which time interactive discussion would be encouraged. This style of reading and Q/A sessions was designed to replace the use of a textbook for the course. The readings and questions were posted immediately after the Friday morning lecture. Students were required to submit their answers to a special email box by the following Tuesday. The elaboration of the answers was the topic for the Wednesday lecture. The submission of answers prior to the lecture enables us to identify and correct general misunderstandings and elaborate on concepts that needed more explanation. The nature of the guided questions helped the students focus on the main concepts.

During the focus group evaluations, the students were asked whether the online readings were useful and if so in what ways? They were also asked whether the readings helped with their learning or if they would rather have had a textbook, instead of, or as well as, the readings?

Responses to the use of the readings were variable and marginally negative. Overall, the use of the reader as a means to widen the knowledge base of the course was less successful than anticipated, but probably better than the setting of a textbook. Some students admitted to studying all of the readings in depth, but they were in the minority. Typical responses to the question about whether the readings were useful ranged from the observation that one student thought she could 'get away with not using the readings', while another 'found out they were not compulsory hence

didn't seem a priority'. Other students mentioned technical excuses for not engaging with the readings commenting that they were hard to read from a computer screen and not easily downloaded.

On the question of whether they would rather have had a textbook instead of, or as well as, the readings, most students were even more negative about the value of textbooks. Some said that they were not necessary. Others commented that with a reader they knew exactly what was needed whereas a textbook has a lot of information that is not required. The fact that textbooks can be costly (\$70–100 per textbook) was a frequent adverse comment. Specifically, it was mentioned that it was not worth buying the recommended textbook for the use of only four chapters.

The ease of getting readings off the website was praised, compared to other courses in which recommended readings from texts and other sources are not always available in the library and usually have to be photocopied to be taken away. On the negative side, the fact that the readings were not posted on the website until the Friday of the week they were required introduced a time factor which dictated for some students whether or not they were accessed. Discussion suggested that if all readings could be put on the website at the beginning of the course, they might be used when students had time, rather than as wanted by the lecturer. Only one student indicated that she would still buy the textbook as she found it difficult to read off the screen. Another requested a printed reader that could be annotated.

### **Questions associated with the readings**

A number of specific questions were set and presented along with the readings on the course website. The students were asked about their perceptions of the value of these questions in relation to the readings and whether they found these helpful and if so in what ways? Most students found the questions related to the readings to be useful and helpful. Students had difficulty with a few of the questions, but these questions were revisited during the lecture allowing full explanations to be reviewed.

Students also mentioned that they used the questions for revision, that is, before a quiz and (will) also use them before the exam.

After the lecture, you could read over the questions to see if you were on the right track ...

Other students commented that because the questions were not assessed, not everybody answered them and it was not clear from the discussion what proportion of the students actually did attempt to answer them. It was agreed by all groups that the questions were not tried when students had other commitments on their time.

I looked at the questions and did think about them, but didn't actually complete them.

In the focus groups, the students were asked whether they found the lecture that concentrated on answering and discussing the questions helped their learning. The discussion that ensued was more about the unsatisfactory time of the lecture than the actual content. Some students mentioned the positive aspects of the Q/A sessions rather than having another lecture, in that they allowed reinforcement of material already presented.

Wednesday lectures gave further explanations of the previous week's class and how to apply this information. Going over the material again, reinforced the learning ...

However, there was much criticism of this alternate lecture component, largely due to its timetabling as an isolated session at 5pm on a Wednesday afternoon.

I finished lectures at 11am and then would have to stay at the Mawson Lakes Campus until 5pm, then catch a bus to get home – this made it too difficult to attend.

## Online discussion

The students were encouraged to post questions about anything that was not clear to them on the online course discussion page. There was no assessment for this component and the quantity or quality of contributions was not monitored or facilitated. During the focus group discussions the students were asked whether they used the discussion page at all, and if so in what ways? They were also asked if they found the page helpful and if so in what ways.

Focus group responses were about evenly balanced between those who found the discussion board to be excellent and those who either did not use it or used it infrequently. As the discussion page was set up largely for students to respond to each others' questions, some students commented favourably that the questions could be answered by other students or by the instructor. Others, however, were not sure about the authority of a student who provided an answer.

Several students indicated that they opened the discussion page regularly, but did not submit any specific questions. They were happy to read and learn from what others had written, but did not necessarily participate themselves.

Students can look at this page and get valuable information even if they don't have a question.

## AssignIT

AssignIT is a UniSA net propriety package for the online submission of student assignments. To submit an assignment, students log on, upload their document and provide any additional information required. The marker is then alerted via email and can then collect the assignment, mark and return it via AssignIT. AssignIT automatically tracks the assignment, recording this information in the University's corporate information systems and alerts students when their assignment has been returned. A copy of the assignment is stored centrally for three semesters. With AssignIT, staff can choose whether to:

- collect assignments online, download, print and return them with feedback manually;
- collect assignments online, return them manually and provide feedback electronically; or
- collect assignments online, return them online and provide feedback online (the option chosen by these authors). Comments can be added to assignments using the 'track changes' or the 'insert comment' facility of MS Word

Staff can also choose to mark assignments on-screen or print them first. The students were obliged to submit and receive all assignments online using AssignIT. In the focus groups, students were asked whether they had any problems with this compulsory online submission. They were also asked to indicate if the method of giving feedback using 'comments' and 'track changes' was satisfactory and what they liked about this process or, conversely, if they would have preferred to submit their assignments in a more traditional manner.

With regard to the first question about the compulsory submission of assignments online, there was overwhelming agreement that this was an excellent method of transferring assignments and they were not sure why other courses were not using this process. They commented that it was a simple, practical and seamless process and particularly liked the security of the fact that the assignments were automatically dated and a receipt sent.

This overcame an unfortunately common perception that students could previously not be sure that handed-in assignments actually arrived with the lecturer:

I felt safe that the assignment was actually received.

Likewise, one student commented that:

marks can be returned in a private manner (not for every one to access as happens with a display of marks on a spreadsheet on a notice board).

Another commonly put view was the flexibility of this process:

Good for students who do not live close to campus – can submit and have assignment returned without needing to visit the campus ...

Minor technical deficiencies were mentioned, however, in that there was a need for some basic instructions in the file saving and transfer process:

didn't accept rich text format – I wasn't told that I needed to save document in word.

Another student didn't realise she could get her work back.

With regard to the feedback using 'insert comments' and 'track changes' students appeared to prefer this to normal methods of handwritten comments on paper assignments. They were happy that the feedback was in red text, so they could track their progress, and that they could easily read those comments – previously the handwriting of some staff had been too difficult to read.. One student mentioned that he could use the 'comments for the lecturer' box to explain the situation if assignment was late.

In some courses only grades are given back without feedback and therefore you did not know what and where you went wrong, whereas AssignIT provided useful feedback. You saw on your report exactly what you needed to correct.

No-one expressed a desire to return to the old paper-based method of handing in assignments.

## Conclusion

The paper has described the evaluation by focus groups of the online components that have been blended with the more traditional face-to-face delivery methods in an introductory undergraduate soil science course. In summary the evaluation showed that the students:

- were positive about the use of PowerPoint slides to illustrate lectures and used the slides posted on the course home page in a variety of ways that aided their learning;
- appreciated the use of the whiteboard explanations and other student-centred classroom activities as a supplement to the PowerPoint slides;
- saw the benefit of attending class, rather than relying only on the online materials;
- were positive about the availability online of the course outline and liked being able to submit assignments online;
- were much less positive about the online readings and the associated guiding questions;
- saw the benefit of the accompanying lecture but needed more guidance about the purpose of this aspect and the way it was intended to be used to support learning.

The balance between online and face-to-face components will vary from course to course depending on their instructional goals, student characteristics, instructor background and access to appropriate online resources. Despite the fact that each of these was carefully considered when designing this course, some of the responses of the students during the evaluation of the online components were surprising and did not indicate overwhelming acceptance.

From this we conclude that an additional important step towards acceptance by the learner is a careful and sufficiently detailed explanation of the pedagogy that is guiding the delivery mode. This involves explaining the purpose and reason(s) for incorporating each aspect and at the same time helping the learners to understand how it relates to their own metacognitive style.

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