AC 2007-985: BLENDED LEARNING: ENRICHING THE CLASS ACTIVITY WITH TECHNOLOGY

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Blended learning - enriching the class activity with technology

Abstract

Blended learning presents new opportunities. Opportunities to enhance the conventional lecture experience and also stimulate the students outside the lecture theatre. This paper provides some drivers for learning and indicates some of the influences likely to impact on the development of a blended learning curriculum. To situate the work an example of blended learning from an Engineering Science module is presented. Here the use of an Electronic Voting System, animations, use of a tablet pc and active use of a Managed Learning Environment is presented.

Introduction

Whilst traditional classroom-based activity present an opportunity to transmit information, a better view is one where the lecture is seen as a place for the lecturer to inspire, enthuse and participate in a so called *learning conversation*; a conversation that actively seeks out, and uses, the students' own conceptions to re-align what is *taught*, what is *asked* and hence better develop what is *understood*. Such principles are captured in strategies including Laurillard's Conversational Framework[(1)]. For many teachers this idea requires a significant change in how they view their role in the classroom and their relationship with their students. In a dialogic model of teaching and learning the teachers too are learning, adapting and responding to the students and not simply being a knowledge provider. Problems often arise with the dialogic view of teaching in that growing class sizes and the available 'bandwidth' for the lecturer and student to communicate quickly becomes saturated. Saturation of the bandwidth often results in teachers adopting a more didactic and less engaged teaching practice which may reduce the support for the individual learner.

Fortunately, given that technology in the 21st century is ubiquitous, it is in our homes, our cars and our pockets it is no surprise that it is filtering into the everyday classroom too. Information and communication technologies (ICT) present an additional connectivity; a connectivity that widens the bandwidth and allows greater participation between teacher and learner and also learner to learner. Such technologies, however, need to have a purpose and they need to be 'solving a problem' not being used because they exist. Quite simply, technology needs to support sound pedagogic practice and not displace it.

This paper demonstrates how the active and innovative use of ICT can support and enrich the class activity and also meet many of the recognised principles of good practice in undergraduate education.

Some underpinning principles

If technologies are to be exploited for learning then their affordances need to align with what is required. Teaching teams (faculty) should not ask what technologies should they use but rather undertake a needs analysis that includes and asks

- What actually are our needs and why might we wish to do things differently?
- What are we doing currently and what evidence do we have that it works and should be kept?

- What are our teaching philosophies?
- What good practice guidance do we align with? and
- How might the various technologies support them?

This, it is argued, provides a more educationally robust and persuasive argument for the use, or non-use, of technologies.

Numerous offerings exist with respect to suggested good practice. One of the more permanent and enduring appears to be the Seven Principles of Good Practice in Undergraduate Education(2). Other principles include the Nine Elements for Instructional Design(3)the four centeredness of the How People Learn framework(4) and also the Four A's of learning(5).

Particularly key to this paper is the significance of assessment as a driver for student activity and learning(6), the need for learning to be seen as an activity (learning is, after all, a verb!), the importance of time-on-task, setting high expectations, setting a teaching and learning framework that is dialogic, responsive and adaptive and establishing a learning space where learners are free (indeed encouraged) to share their conceptions and misconceptions.

Blended learning

Although many definitions exist for blended learning, they seem to converge around the idea of synthesising on-line, (e) learning with the more traditional forms of teaching and learning. i.e. drawing together the e with the classroom, the laboratory, the seminar and the tutorial setting. The synthesis being influenced by, but not limited to, items noted in Table 1.

Table 1. Potential influences on blended learning

The teacher o teaching philosophies o expertise o comfort zone o adaptability o willingness to learn o level of risk aversion o commitment to scholarly and reflective practice	The learner o expectations o previous experiences o expertise o comfort zones o preferences (learning styles) o demands (work, family commitments, proximity to study environment) o access to technology
The subject domain o learning outcomes o assessment strategies o knowledge base and its compatibility with new forms of teaching, learning and assessment	Barriers and enablers o internal and external o time and cost implications o professional body reviews o industrial advisory groups o skill sets o staff development regimes o thoughts on return on investment o the balance between educational effectiveness and resource efficiency o support and encouragement for scholarly and reflective practice

Different teaching teams undertaking an analysis of the above together with their own unique 'needs analysis' will show a range of blends are possible such that a continuum will exist; one end being technology weak and the other being technology rich. At the extremes these might be thought of as traditional classroom teaching vs. full e-learning. See figure 1. What is important is not where the blend is positioned on the continuum but rather that its position is justifiable. Hence it should be evidence-based and 'fit for purpose'.

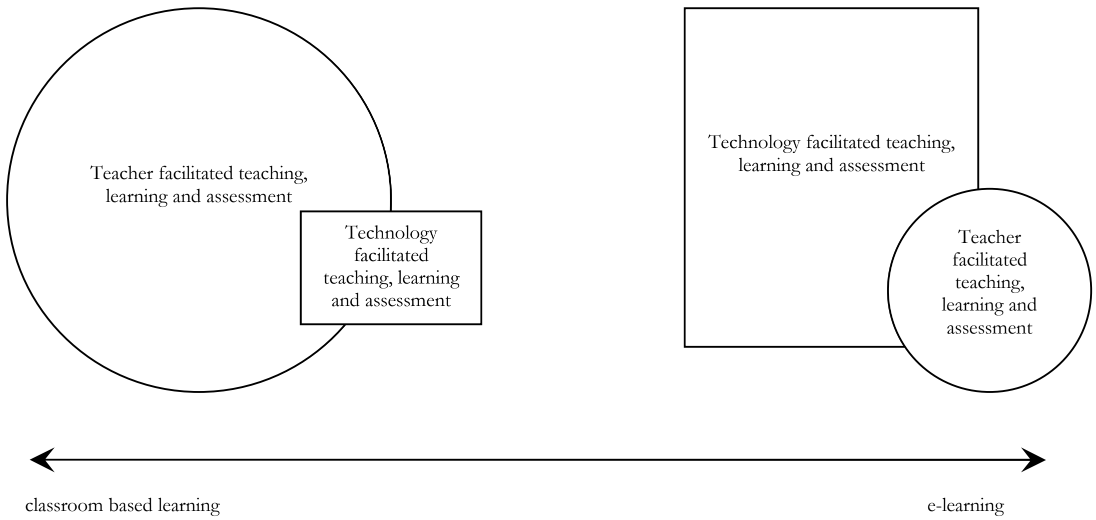

Figure 1. A continuum view of blended learning

The module and the blend

The module under review is a second year BSc Engineering Science module which comprises heat transfer, thermodynamics and fluid mechanics. Entrance qualification to this degree programme is more relaxed in that UK A levels in Mathematics and Physics are not expected (A levels in Mathematics and Physics are expected for our traditional B.Eng degree programmes). A consequence of the entry qualifications is a spread of ability, both mathematically and in the subject domain.

There is seemingly a perception from students that traditional engineering science type modules present another opportunity to receive more Mathematics. Clearly that is not the view held by teachers and in this particular case, because of the entry qualifications, drawing on mathematics to present examples or clarify ideas is not particularly helpful.

The solution adopted here was a blend that incorporated significant elements of the traditional activity but supported by in-class and out of class use of technology. The blend was around 60% technology and 40 % traditional.

The greater emphasis on technology was not to replace class work but rather to better support it and also explicitly encourage out-of-class, consolidatory and preparatory, learning.

What was important here was motivated by the necessity to keep the students engaged in the subject and also get them to demonstrate what they know and also what they don't; thereby supporting the learning conversation. Another example of this is presented elsewhere[7].

Some specific examples
To help see what the students topic conceptions they were offered the use of an **electronic voting system** (EVS). It is acknowledged that whilst inroads in the use of EVS is being made in the UK, it appears that we are trailing the usage patterns from those in the USA. Hence this would have been a novel experience for students and would have privileged them over many of their peers. Interestingly not all of the students chose to attend one of the introductory sessions and so did not take ownership of a handset. That said the resulting activity was not dependant in them all having a handset - it would simply have provided more data. Using the EVS handset, at the start of each class the students were expected to respond to a short formative test. Typically each test comprised around 10 questions and sought to consolidate not only what they had retained from the previous week but also to see what they had gained from the out-of-class tasks. Strategies to check for answer guessing was included in the tests and in this instance used separate yet related questions. An example set of separate, yet related questions, which seek the students understanding of pressure gradient within a fluid is given below.

Q1. The pressure gradient (dp/dz) in a fluid …
a) is always zero
b) is always negative
c) is always positive
d) can be either positive or negative depending on the fluid properties
e) is equal to the gauge pressure

Q2. The pressure gradient (dp/dz) in a tank of water, 2m deep, is approximately
a) -9790 Pa/m
b) 9790 Pa/m
c) -19580 Pa/m
d) 19580 Pa/m

Q3. The pressure gradient (dp/dz) in a fluid can be calculated from
a) $-\rho g$
b) ρg
c) $P_{gauge} - P_{atmospheric}$
d) $-\rho gH$
e) ρgH

Q1 establishes the students' expectation for the type of answer they should get. Far too often students undertake calculations and yet have little sense for the correctness of the resultant answer.

Q2 requires the actual calculation of pressure gradient. The given depth is not completely a *red herring*, since it could be used to calculate the pressure gradient in a less direct way, but is presented to tease out the regular confusion between pressure and pressure gradient.
Q3 completes the set and is presented to see if the students know how they should calculate the pressure gradient.

Joining these questions together implies that a student can only demonstrate true understanding if they get all three questions correct. Any less suggests they have been lucky with answer guessing or they do not see the ramifications of their set of submitted answers. In the example given a correct series of guesses would arise from a 1 in 100 (1%) chance.

The output from the EVS tests was then used to provide the teacher with instant information on what is known and what is not. This resulted in an evidence-led, in-class, dialogue on the *answer choices*. Additionally each weeks test was created as a PDF file which and was subsequently annotated using a tablet pc. This provided further feedback as to why the selections were correct and also why others were not. This annotated PDF was then loaded to the **Managed Learning Environment** (MLE) for student use and exploration.

Feedback from this experience was not only positive from an *enjoyable perspective*, see for example Table 2, but it also demonstrated that the activity presented new opportunities to challenge the students and engage them in their studies and learning. See for example Table 3.

Table 2) Student response to feedback statement 1

I enjoyed the PRS tests	n	%
Strongly agree	13	30.2
Agree	19	44.2
Neither Agree nor disagree	8	18.6
Disagree	3	7.0
Strongly disagree	0	0.0
Total	43	100

Table 3) Student response to feedback statement 2

The use of the in-class tests make me think about the subject more than I would normally	n	%
Strongly agree	17	34.7
Agree	28	57.1
Neither Agree nor disagree	1	2.0
Disagree	2	4.1
Strongly disagree	1	2.0
Total	49	100

Other statements including how *safe* they felt, how *confident* they felt and how *they used* the feedback were also positive.

During the teaching sessions Microsoft PowerPoint was not the tool of choice but rather pre-written gapped notes supported and supplemented by notes made on a **tablet pc**. The use of a tablet pc in a lecture presents to the students a highly animated experience which allows teachers to develop ideas and also record students' thoughts and questions. In some sense it is similar to a white board except the pages on the tablet pc do not need wiping clean to allow for the next idea to be presented. Indeed pages can readily be re-shown or added to as ideas evolve and develop. Further, as was the case here, they can also be saved as a resource for loading to the MLE.

Teaching heat transfer and fluid mechanics is not without challenges but was brought to life by the use of technology that facilitated the showing of flow **animations**. Rather than simply talk around the animations, a useful experience in its own right, selected animations were loaded to the MLE a week prior to the lecture, where the students were required to describe what they saw and also indicate why the resulting flow pattern was likely. An example of which is shown in figure 2.

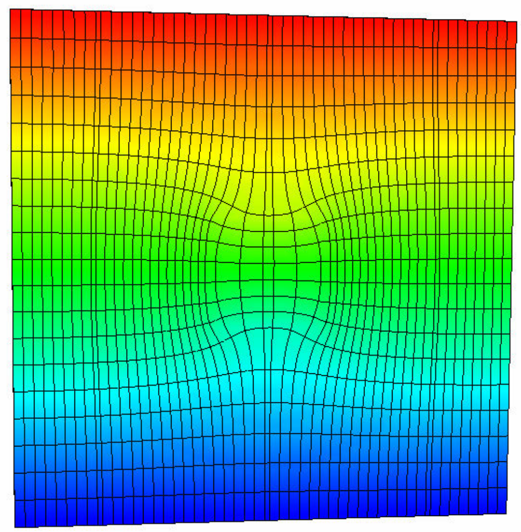

Figure 2. A single frame from an animation showing two dimensional conductive heat transfer. The central core has a thermal conductivity four times greater than its surroundings.

To maximise the learning sample student responses, posted to a dedicated **electronic data gatherer**, were taken back to class for dissection and discussion amongst the students. Example student observations include

> *The flow of energy decelerated in the centre of the material, whereas at the sides the flow stayed the same*
>
> *The conduction is slowed down through the unknown object, as it may have a higher thermal resistance. The flow is from hot to cold, no heat transfer is done sideways as the horizontal temperature gradients are constant.*
>
> *The heat transfer always goes from hot to cold within a flow. The constant temperature lines are curved in the centre of the animation this suggests that there is an object inside the material. The flow within the conduction is 2D.*

All the remaining student observations on the heat transfer were tidied, made anonymous, and loaded to the MLE.

In terms of the student view many positive feedback statement were obtained and typically included -

> *I believe that the animations are really helpful in class and give others the opportunity to see what happening if they don't understand.*

Although only a sample of activities have been described here, it is hoped that they demonstrate how technology and more importantly blended learning can be used. In this case the technology wrapped around, and hence supported, the classroom activity. This, and a willingness to adapt to the emerging student knowledge, is essentially an example of Just-in-Time-Teaching[8].

It is apparent that central to the above was the MLE which, in addition to supporting the other activities, was more akin to an activity centre rather than a dumping ground for module notes. The MLE was not a deposit box but rather the semblance of a vibrant learning community sharing ideas and helping each other on the discussion forum, engaging them in on-line quizzes and facilitating the downloading of activities. It allowed the students to have some choice over where and when they studied; a valuable commodity for today's students with so many demands placed on their time.

Conclusion

Learning should be thought of a dialogic activity with activities and evidence to support a learning conversation. Far too often the traditional classroom activities and the increasing class sizes restrict this view of learning such that the student learning experience is not optimal. Technology, and its systematic and carefully considered integration with the class activity allows teachers to create a blended learning environment that will help resolve some of these issues.

In developing blended learning recognised pedagogical principles should not be forgotten nor should personal teaching philosophies be compromised. Indeed these should help shape and help create the richness of the blend and the technologies used to solve identifiable problems.

In this example the technology was used to help create a learning conversation and engage the students inside and outside of class. Here, many of the activities and support for learning would simply not have been possible without moving more towards blended learning and the integration of technology. The students were particularly complimentary about their experience and prized the variety of technologies used, the interactivity and also the benefits it afforded their learning.

A consequence of this work has been the ability to continually engage the students, collect and use evidence to better support the class contact time and realise resource efficiency gains. All benefits that are likely to feature highly on most teachers wish lists.

Appendix. Student feedback
The voice of the student is vital in reviewing how the activities received. The following presents a few sample statements received from the students.

A. Some student quotes on the use of in-class tests (Note the handsets and hence the experience is often referred to as *clickers* by students)

I found that the clickers became an important part of the lectures, providing opportunity to express our true understanding of the work that had been covered

Good way of realising how much you have understood the topic, gets you used to answering questions on the topic and how to go about it.

Made a change to the usual teaching plan, made the subject more understandable

Brings a bit of excitement to each lesson, the in class test feedback is also a good idea giving you a small competitive approach to the work

Makes me think about the module and makes the lectures more productive.

B. Some student quotes on this approach to the teaching and learning.

I find your teaching method extremely helpful. Not only do I enjoy your lessons I learn a great deal. If all lecturers were as devoted and passionate about their subject as you, I think a vast number of students would benefit.

Excellent teacher, one of the best so far. A different and effective way of teaching. Like the way you embrace technology rather than shy away from it.

The teaching is good, makes the student really think for himself, rather than just be spoon fed!!

A good direction of teaching, bringing in different types of media into the class making it interesting to learn the work and attend the classes.

Very good, enjoyed lectures and made the subject very interesting, like the good range of methods used to asses and teach. Also liked the amount of class interaction achieved.

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