

## Blended Learning for Foundation Engineering Students

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Subject area: Electricity and Electronics

This case study has been developed from data gathered through observations of the teaching component, interviews with the tutor and a student focus group.

### Background

This report describes the use of a combination of online diagnostic assessments, video-captured worked examples and face-to-face problem workshops to support an electricity and electronics module. The module is taken by approximately 150 students as part of a foundation year of a four-year course leading to bachelor-level degrees in physics, geophysics and engineering. The reasons why the students are taking the foundation year are varied. Approximately 50% are overseas students who may have studied a syllabus that does not cover some of the prerequisite subjects of year one of the degree courses they wish to follow; they may not have experience of practical lab work; and they may be accustomed to a different educational philosophy. Others are mature students whose academic skills may be weak and who may have forgotten what they learnt at A-level but who may have good life-skills such as being able to focus and manage their time. A third group are students straight from school who have changed their minds about what they wish to study at 18; they are typically good students, with good academic skills and great A-level results but in the wrong subjects. The result is a very diverse cohort. Additionally, there is a larger than average number of students with learning difficulties or differences such as dyslexia, dyspraxia or some mental illness. The courses that the students wish to take have very stringent requirements for entry to their first year and so it is the aim of the foundation year to ensure that the students acquire the necessary study skills, are brought up to A-level grade B standard in maths and physics and make a successful transition to University study in other ways.

Every week problem sheets are provided for the students as PDFs via the course VLE. Students have one week to solve these problems, entering their solutions as responses to multiple choice questions through the VLE and also uploading a scanned copy of their working. The students are allowed two attempts at answering the problems, with feedback provided on incorrect answers. Those students who do not attempt the problems or who score less than 50% are required to attend a face-to-face problem workshop offering additional support (this workshop is open to others should they wish to attend). Online videos, which are basically little whiteboard lectures lasting five to ten minutes giving model answers to a couple of the problems, are provided each week. The tutor says the lectures "*go through my thought processes when I solve a problem, from start to finish, so they can hear me talking about what I'm thinking about at every single stage from A to Z on that problem.*"

## Reasons

The core reason behind adopting this approach is the diversity of students in the class, which means the tutor "*can't possibly teach them all in the same way all the time or in the same class.*" Previously, problems had been assigned each week and attendance at the problem workshop was compulsory. The most able and committed students would have completed the problems in advance and would become bored and disruptive in the workshop. Students who couldn't speak English very well, or had a weak mathematics and physics background couldn't finish the problems over the course of just this single two-hour slot. Due to the class size there needed to be four workshop sessions, each with two post-graduate teaching assistants with varying ability to help the students. The tutor "*wanted to find a way of getting the better students out of the classroom*" and to provide more help and a better working environment for those who really needed it. Thus the online problem sheets are provided as diagnostic assessments identifying those students who need more help. They also help the tutor identify which problems or topics students find most difficult and (with the help of the uploaded working) which misconceptions cause most errors. The uploaded working is useful in making sure that students aren't just copying the answers. The online videos provide help in a mode that gives students a chance to digest the material at their own speed and in an environment of their own choosing. This is especially good for students who struggle with either spoken English or mathematics.

The tutor tells the students that overall the blended approach "*really is an enhancement to give you more choice, more ability to manage your own time, more independence and for you to choose which way is better for your own learning approach.*"

## Lecturer's Perspective

The lecturer has found that the online assessments have given him the ability to monitor his students' progress, to judge whether they are engaging with the problem sheets and classes, and to identify common errors or misconceptions. More importantly they have enabled him to allow the able students to do the problem sheets at a time that suits them and focus the problem workshops on helping those students who have most difficulty. With the previous approach he was getting about 50% attendance at the workshops and no information about whether the other 50% were doing the problem sheets or not; now he knows that about 80-90% of the students are doing the problem sheets online and/or attending workshops.

It has turned out that about 25% of the students don't achieve the marks required in the problem sheets and so attend the workshops. These are the most challenging 25% to teach. As a result, the number of workshops per week has been reduced from four to one and, whereas previously the workshops were led by post-graduate teaching assistants, now, with the same funding, an experienced college lecturer has been brought in.

The introduction of the online component was not without difficulties. Production of the video materials proved to be very time-consuming, taking in total about half a day to get each one right. There were also problems caused by the limitations of the VLE software (Blackboard), for instance it doesn't recognise 0.003V, 3mV and  $3 \times 10^{-3}V$  as being the same. These limitations were the reason for having the answers to the problems entered by selection from multiple-choice questions, which again took time to set up. Because of the time spent on videos and MCQs the lecturer was unable to spend as much time as he wanted on providing automatic feedback for when a student got a question wrong.

Overall, the lecturer believes that this approach could be transferred to any engineering course, although the amount of work involved should not be underestimated.

## Students' Perspective

Forty-one questionnaires were returned, which is a low return rate, of which about 25% percent reported attendance at the workshops or use of the video tutorials most weeks or every week. Overall, those students who returned questionnaires considered the course to be well organised and easy to follow; in particular they overwhelmingly agreed that the lectures were presented with clarity and the course notes were reliable. The problems were pitched at the right level, with only 3 students agreeing they were “*over my head, assume I know too much*”; 38 of the 41 students agreed or strongly agreed that the online questions helped increase their depth of understanding. In the interview, student comments included that in the videos “*he actually solves the problem, rather than presents the solution*” and in general “*you can feel the time that’s invested.*” The benefits identified by the students align well with those hoped for by the lecturer. The flexibility of working in their own time and space and at their own pace was appreciated: “*you can basically choose when you’re in the mood and when you have the mental power to actually solve the problems*” and “*at home you’ve got your textbooks instead of having to lug them down to the campus.*” Students also reported working at home while discussing the problems with their peers via Facebook and Skype. They foresaw that the videos and the diagnostic questions would be valuable at revision time. Promotion of independent learning skills and focussing the workshops on those who needed them were also identified as benefits by the students. Students had some issues with the lack of feedback for some of the multiple choice questions, and had had some technical “*niggles*” especially at first. The biggest potential issue was that the online component could lead to the course being impersonal, however the blended approach mitigated this concern: “*if you want face time you should be able to get it, which you do with this.*”

## Issues

- Creating the online component to as high a quality as required proved to be very time consuming. As one student said “*it’s not a timesaver at all, you can see that he puts so much effort into it.*” This led to there not being as much automatic feedback provided as the lecturer had hoped.
- There were some limitations in the software used and some technical niggles.
- The lecturer is disappointed that the introduction of the online component and optional workshops did not result in a noticeable improvement in the pass rate for the course.

## Benefits

- The problem sheets are successfully used by students and the lecturer to identify where students need extra help.
- Students appreciate the ability to work at a time, place and pace that suits them. It allows them to work in comfort, in contact with their peers, with access to their own resources, and frees them from the necessity of coming into University to attend a morning workshop merely to satisfy a course requirement.
- The reduction in the number of workshop sessions that need to be run has allowed a more qualified tutor to be present at those workshops than would otherwise be possible.

## Reflections

This blended approach has increased the quality of the teaching provision for those students who need it most and removed the burden of attending unnecessary classes for the more able students. As far as the students are concerned it's an optional enhancement. On the other hand, as far as the lecturer is concerned, and as far as the actual course is concerned, it's quite transformative; it has allowed problem sheets and problem-solving classes to run in a very different way. The online problems, online support and workshops were seen by students as key, complementary components in what they considered to be a very well-organised course. It is always difficult to observe an impact on pass rates from an intervention such as this; there are so many confounding variables that comparisons are hard to make and one never knows what effort students made to cope with a less satisfactory teaching approach. Furthermore, this approach seems to offer a more suitable introduction to University-level study and outcomes such as better study skills may be as useful as increased marks in one exam.

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