

## Student-centred activity-based learning and teaching using technology

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Subject Area: Electrical and electronic engineering, circuits and systems

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 study concerns the introduction of a range of student centred activities in several modules. The activities include problem-oriented lectures and lab work, continuous online formative- and self-assessment and optional tutorials in place of traditional long lecture/tutorial-sessions. Also, the tutor has had videos made of lectures delivered in previous years that are available to students should they miss a lecture or need to catch-up for some other reason. The modules are all in electrical and electronic engineering: one on circuits and systems (taken by 70 students about half of whom are first year electrical and electronic engineering students and the other half are second year clinical sciences students), one on analogue electronics (taken by second year electrical and electronic engineering students) and one on mechatronics (taken by about 160 first year students from a range of engineering, technical and clinical programmes). In addition to the range of courses studied, the students typically come from a diverse range of backgrounds, with over half being from overseas, and they have a range of entry qualifications.

The details of the approach vary from module to module.

The mechatronics module is the first that the students take, and in this the tutor starts by setting up a problem for the students, for example by showing them a model tank and asking them what they would need to know in order to build something similar. He then spends three weeks filling in the gaps in their knowledge through one-hour lectures, information on the course VLE, suggested reading and tutorials. There is then a mid-term exam, after which the course moves to the design lab where the students build a robot for themselves. The robot should be capable of moving forward and of reversing and changing direction if it senses it has bumped into something. The students are given a control circuit, which the lecturer explains, but must design the mechanical elements themselves. At the end of the module students are assessed on how well the robot works when demonstrated, they receive feedback and can explain what they would do differently if given the chance.

The circuits and systems module is taken in semester 2 and aims to build on what the students have learnt in the semester 1 modules. Each week the students have a one-hour lecture, after which they are assessed. The assessments are online, and the students can practice in their own time, but only the scheduled assessments count towards their grade. There is then an optional one-hour tutorial targeted at those students who don't do so well in their weekly assessment: "so you learn the theory, you do some assessment and find out whether you understood it or not, if you've done it well that's fine, if you don't do it well you come to the tutorial". The module also has a mid-term exam, labs which are assessed online in an open book exam to which the students may bring their lab books, and the tutor introduces the pSpice circuit simulator.

The analogue electronics module taken in the second year includes lectures and tutorials. The tutorial problems are marked by teaching assistants so that the students get rapid feedback. For each lecture

there is an online quiz that the students have to submit within a week. They get feedback on their quiz results and may re-submit once if they believe they can improve on their marks. There is also a midterm exam and lab classes.

### **Reasons for introducing this teaching method**

The lecturer's reasons for teaching the modules in this way were to engage the students' attention, to break-up what would otherwise be a continuous three-hour teaching block and to deal with the diversity of student abilities and backgrounds. Of the mechatronics course he says it is difficult to teach 160 students studying a variety of degree programmes, "the main objective is just to attract their interest in the course, so they'll be interested in learning about various aspects of mechatronics". The students have a limited attention span and don't always see why they are taking the course, so it is necessary to provide them with motivation and to try to make the course fun for them. In general, the University seems to prefer timetabling courses as three-hour slots in one lecture room. Such long sessions of lectures and tutorials would be inappropriate for these students and it is the lecturer's experience that this leads to problems with attendance and progression. He also says he has to deal with students with a range of learning styles, language skills and abilities: "I find students need to be engaged in different ways. Some learn better by listening, some learn better by doing, since I have a mixed bag I can't assume they all learn in the same style, so I think the more variety, more ways of engaging them the better is the learning experience." He wants to build confidence in the weaker students while not boring the more able, hence the breaking down of the learning task into small chunks with continuous assessment and feedback which the students can use to decide whether they need to attend the tutorials for further explanation. These weekly and mid-term assessments also have the effect of "keeping the students on their toes" and of making sure that they work continually throughout the course rather than trying to cram everything for an end of year exam—a consideration that is especially important for the first-year students.

### **Lecturer perspective**

The lecturer feels that this approach helps students through improved feedback and motivation. In previous years he has observed an improvement in attendance and seen an improvement in students passing the subject at their first attempt (from 35% to 67% in year two and from 60% to 74% in year one). Feedback from students suggests that they favour the use of a variety of assessment methods rather than a reliance solely on end of module exams. He finds, however, that it is difficult to get long-term feedback from first-year students in studying on non-electrical degree programmes, so while he is pretty sure the approach is achieving what he wants for the second year students he is less sure about the first year students. Personally he finds difficulties in booking appropriate room slots for one-hour lectures and tutorials, especially for the class of 160 students and especially when there is a need to set up a PC suite for assessments which count towards the students' overall course mark. He also finds that while the software package used for online assessment (QuestionMark Perception) helps by providing a variety of question and interactivity types, setting up the questions and feedback is time consuming. Overall, while he has some concern about over-assessment, he believes that because of the e-assessment the students are more engaged with the course.

### **Students' perspective<sup>1</sup>**

With such a variety of students it is not surprising that there was a range of opinions about the approach taken in these modules. However, the range of opinions from the circuits and systems and the analogue electronics was broadly similar.

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<sup>1</sup> Student opinion was gathered by means of a questionnaire and group interview from students taking the Circuit and Systems module and the Analogue Electronics module.

A number of the students seemed to find these courses hard: the issues they identified often concern not being able to understand the subject. There was agreement seen in the questionnaire responses that the assessments and tutorials help the students learn and also that students would help each other when stuck or to improve their marks in the self-assessments: "we always team up and try to get the best solution". There was also agreement from those taking the analogue electronics module that the approach helped them work at their own pace. When asked in the group interview the students agreed that the approach was "student-centred" in that it provided a variety of approaches from which each individual student was able to find something that suited them. The counter side to this is that for every student who liked a particular aspect there was another who disliked it.

The benefits identified by the students, apart from the generic "helped me learn X", largely centred around fostering or enforcing good study skills: "it gives us enough time to revise as we go", "having a test every week, and learning for it every week just keeps us at the top of the subject, so we know what's going on". There was, however, also concern raised by some students about the number of tests, that is, having an assessment which counted towards their final mark every week.

The students also by-and-large approved of breaking up the three-hour lecture slots into three distinct one-hour activities: "the lessons are not very long and boring [...] there is always interaction between you and the lecturer." There were some complaints about the scheduling which resulted from not being able to block-book the sessions in a single place at a single time. Furthermore, some students, especially from the circuits and systems module, felt that they required more contact time with the lecturer, rather than assessment and tutorial-problem sessions.

## Issues

This approach centres on providing a range of activities in order to meet the needs of a wide variety of students. Since each activity brings its own problem, whether it be with room bookings or writing online assessments, the approach generates a wide range of implementation issues. There is some concern about over-assessment or over-frequent assessment which, while it helps students keep up with the module in question, may distract them from others. There is some concern, from first-year students especially, that contact time with the lecturer has been replaced with time spent doing computer-based activities.

## Benefits

With the range of approaches available most students find something they like, whether it's lectures, problem-based tutorials, online videos or something else. The approach has been successful in encouraging peer-instruction, with students forming groups to help each other improve their marks. There have been positive results in improving retention and progression.

## Reflections

This is an ambitious approach to solving the difficult problem of having students from a wide range of backgrounds with a wide range of abilities and there have, of course, been mixed reactions to the approach taken. The lecturer has succeeded in encouraging good study practices such as regular study, group work and independent research to solve problems, in ensuring that the study schedule is appropriate to the students' attention-span and has had some success in improving motivation.

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