

JISC

Innovative Practice with e-Learning



# Case Studies

Promoting active learning

Active collaborative learning  
University of Strathclyde

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## Background

The University of Strathclyde in Glasgow has an undergraduate population of approximately 14,500. The Department of Mechanical Engineering at Strathclyde is one of the largest in the UK, with some 500 undergraduate and 80 postgraduate students, and adopts a strategy of continuous improvement in its approach to teaching and learning.

## The challenge

The first year intake (approximately 130 students) into the department is normally amongst the most highly qualified at entry across the university. Yet despite their proven academic ability, it became apparent in the mid 1990s that students were having difficulty in acquiring understanding of the core curricular content, making 'inexplicable blunders' in the application of essential concepts. Furthermore, attendance at lectures and overall retention figures were dropping, an indication of low levels of morale. It was estimated that the department was losing almost 20% of its intake over the first two years of the course. There was also a further concern – that the rise in applications for courses in the department during this period would limit the potential for interaction with students, especially in the crucial first year of their studies.

## Innovative solutions

As part of a wider project, New Approaches to Teaching and Learning in Engineering, or NATALIE, changes were introduced to the pedagogical approach used in the department. A product called Interwrite™ PRS (Personal Response System) from GTCO CalComp was adopted and four lecture rooms, seating up to 150 students, were equipped with PRS receivers and voting devices. In some of these rooms, curved rows of seats were installed to allow students to engage in group discussion while still facing the front of the theatre.

PRS is an electronic voting system. Students use handsets, which operate at a range of up to 60 ft. from the receivers, to

respond to multiple choice questions using infra-red technology similar to a TV remote. Receivers are linked to a computer or laptop and a data projector, and software installed on the computer immediately converts responses to histograms or bar charts, facilitating further discussion.

With the introduction of PRS, the content of lectures was re-structured to focus on the establishment of core concepts and the testing of students' understanding in line with a social constructivist perspective. Students were asked questions based on background conceptual knowledge, then required to explain and defend their responses in the face of questioning by others with different perspectives. The approach can be broken down into the following stages:

1. Introduction of a concept.
2. Response to questions (individuals test their understanding).
3. Polling of answers provides feedback (projected histogram shows group results).
4. Peer discussion (individuals asked to defend their answer).
5. Second vote (students respond again individually).
6. Further feedback (histogram shows subsequent group response).
7. Summary and explanation of 'correct' response by lecturer.
8. Optional class-wide discussion.

Discussing conceptual questions in class with their peers has proved to be a powerful motivating force, perhaps because the new structure allows students time for reflection, but also because debate, discussion and questioning have been shown to support more active learning. Students feel motivated to focus on knowledge gained during a lecture so that they can perform well in what they see as 'fun' assessment activities. In a suitably structured lesson, the continued reference to tasks involving the voting system help to maintain a consistently higher level

Surveys have shown that over 90% of students felt that concepts were learnt more effectively when they had the opportunity to discuss and question.

of student attention to the content of the lesson and promote thought about the issues raised.

The PRS system has now also been adopted by staff in the Physiology and Pharmacology and Mathematics departments, and the French Studies division of the Department of Modern Languages at Strathclyde.

## The technology

The system used at Strathclyde comes with software which is installed on the computer or laptop and enables student responses to the multiple choice questions to be instantly displayed. The Interwrite PRS software also has a 'Review Session' feature that allows the lecturer to see the results of a questioning session both on an aggregate basis and by individual student. In addition, data from student responses can be imported into a variety of other applications including Notepad, Microsoft® Excel and Word. InterWrite PRS software is an independent application that operates on Windows® or Mac OS®X platforms and can easily import graphics for PRS-generated questions.

The hardware proved to be simple, reliable and inexpensive (approximately £1000 per 100 students). Receivers operate on a line of sight and so do not interfere with radio frequency equipment or systems in adjacent rooms.

## Making it happen

Other similar systems exist but may have different features and capabilities. It is important to check that the chosen system will support the number of potential users in large group settings. Mobile PRS units will make the system more widely available, but its use will have effects on the timetable: two hour rather than one hour sessions will be needed to enable group discussions to take place. As a result, not all curricular content can be covered in class.

## Key points for successful innovation

- With this system, multiple choice questions and peer-to-peer discussion can bring to life the less

accessible aspects of a curriculum, but this may introduce changes in pedagogical approach and course structure.

- Lecture spaces will ideally need to be reconfigured to encourage discussion. Questioning and debate engage each individual in thinking through an answer and are vital to success.
- Workshops for practitioners are recommended to support the writing of effective questions and meaningful feedback.

## Final word

**The use of PRS at Strathclyde has been fully evaluated by the Department of Psychology at the University of Glasgow. This revealed that students interact with lecture content and with each other in a number of different ways when using polling devices and that the variation in techniques stimulates learning still further. Results from diagnostic tests provide further evidence of raised standards in the department. The retention problem has been greatly reduced; exit interviews with those leaving show that lack of motivation is no longer cited as a cause.**

## For further research

Interwrite™ PRS™ website –  
[www.gtccolcomp.com/interwriteprs.htm](http://www.gtccolcomp.com/interwriteprs.htm)

Draper, S.W. & Brown, M.I. (2004) 'Increasing interactivity in lectures using an electronic voting system', Journal of Computer Assisted Learning Vol.20 pp.81-94, –  
[www.psy.gla.ac.uk/~steve/ilig/papers/draperbrowncover.html](http://www.psy.gla.ac.uk/~steve/ilig/papers/draperbrowncover.html)

Nicol, D.J & Boyle, J.T: 'Peer Instruction versus Class-wide Discussion in large classes: a comparison of two interaction methods in the wired classroom, Studies in Higher Education', Vol.28, No. 4, October 2003

Boyle, J.T & Nicol, D.J: 'Using classroom communication systems to support interaction and discussion in large class settings'. ALT-J, Vol.11, No.3, December 2003

"It helps you to learn to stand up for yourself and argue your point of view... To be able to sit there and say that you are wrong is difficult for anybody, but in there it is easier because there are 50% that were wrong as well."

Student quote, Evaluation Data, Nicol and Boyle, 2003

Focus on the technology – Electronic voting device				
<b>Learning and teaching potential</b>				
Enable learning through collaboration, questioning and discussion.				
Can increase lecturer-to-student interaction in large group contexts.				
Can increase students' motivation to learn.				
<b>Risks</b>				
Impact on timetabled course delivery.				
<b>Support implications</b>				
Training for staff adopting new pedagogies.				
<b>Accessibility</b>				
Benefits: Dyslexic learners can benefit from discussion-based learning.				
Constraints: Deaf or hearing impaired learners can struggle to follow group discussions. Visually impaired learners may need the voting results described orally.				
Motor	Mobility	Hearing	Vision	Cognitive
Possible Challenge	✓	✗	Possible Challenge	✓
<b>Costs</b>				
Low-to-medium, but adaptation of lecture theatre seating will increase costs.				
<b>Added value</b>				
High in large group teaching contexts.				
<b>Additional uses</b>				
Formative assessment, if results are recorded individually as well as by group.				



Key to the accessibility section: Ticks and crosses indicate where use of the device as described in this case study will support or disadvantage a learner with a disability. 'Possible challenge' is used where it is advisable for practitioners to check the degree of accessibility for individual learners. Definitions of the categories of disability are given below.

<b>Motor</b>	Difficulties in moving, controlling or coordinating movement of the body.
<b>Mobility</b>	Restriction in movement from place to place.
<b>Hearing</b>	Hearing impairment or deafness.
<b>Vision</b>	Visual impairment or blindness.
<b>Cognitive</b>	Difficulties in processing information as a result of a range of conditions, including dyslexia.

This case study is based on case studies of innovative e-learning practice collected for JISC by the Open University – [www.jisc.ac.uk/eli\\_oucasestudies.html](http://www.jisc.ac.uk/eli_oucasestudies.html)