Re-engineering Assessment Practices in Scottish Higher Education

The goals of the REAP project

The Re-engineering Assessment Practices (REAP) project involved the implementation and evaluation of new models of assessment practice supported by technology in large cohort first year classes across three Scottish Higher Education institutions – the University of Strathclyde (lead), Glasgow Caledonian University Business School and the University of Glasgow. It has also examined how to embed new assessment practices within institutional strategies and within quality enhancement processes. REAP was one of six projects funded by the Scottish Funding Council under its e-learning transformation programme.

Assessment in REAP is broadly defined to include tutor, peer and self-assessment and feedback processes both formal and informal. In practice, professionals not only assess their own learning but they often also form the criteria against which to evaluate progress. In the REAP project, the goal has been to re-design assessment in first year modules to enhance the development of learner self-regulation and the skills required for lifelong learning.

REAP Course Redesigns

Across the three participating institutions over the period 2005-7, nineteen class redesigns were implemented and evaluated, primarily large enrolment first year classes with numbers per class ranging from 160-900 students. Overall about 6000 students participated. The redesigns spanned a considerable range of disciplines (sciences, engineering, arts, education and social sciences) and teaching and learning contexts. Each redesign addressed different local drivers for change, involved different technologies and involved a different balance of local and central support. The technologies utilised to support redesigns included podcasts, blogs, electronic voting systems, online tests, e-portfolios, discussion boards, simulations, intelligent homework systems and feedback software. The institutional contexts also differed with the project including an ancient university, a nineteen-sixties university and a new post-92 university. Also, in one institution the redesigns all took place in the same faculty (Glasgow Caledonian Business School) following a top-down management trajectory whereas in another they spanned all five faculties (the University of Strathclyde) and involved a more bottom-up process of change. This diversity was intended to ensure that any findings would have wide applicability across the HE sector.

Evaluation

A key assumption underpinning the REAP project is that if we wish to enable students to develop as self-regulating learners they must be given a more active role in assessment processes. Within REAP a set of assessment principles were defined (Nicol and Macfarlane-Dick, 2004) and developed (Nicol, 2006) and used to evaluate opportunities for enhanced learner responsibility in assessment processes brought about by the assessment redesigns. Also evaluated were:

- the workload burden on staff;
- learning gains (improved exam performance);
- the added value of technology applications in different contexts;
- improvements in relation to the departments own specific objectives from change.

The REAP team supported all the evaluations using a range of methodologies. These included focus groups (staff teams and students), questionnaires to students, analysis of exam results as well as changes in relation to REAP assessment

principles. An assessment and feedback experience questionnaire has also been developed and piloted.

Achievements: learning and workload gains

The evaluation data from the redesigned modules are still being analysed. However, the following represent some of the key findings to date:

- Some assessment redesigns involved the replacement of face-to-face activities with online tasks where students could practise specific skills at their own pace. Such redesigns were characterised by reductions in staff workload without any loss (and often gains) in learning quality. For example, in French, tutorials were reduced by 50% and replaced with online tasks: a saving of 200 hours in staff time was shown while the exam failure rate was still reduced from 24% to 4.6% compared with 2005/6. Mechanical Engineering used an online homework package to reduce homework assessment workload – this department saved 102 hours in staff time over the year without any drop in exam performance.

- In many cases, the redesigns did not involve a reduction in academic workload. Instead, there was a redistribution of effort with staff spending more time supporting learner-led interaction with content with less time being spent on lecturing or traditional assessment activities. For example, Psychology reduced lectures by 50% but used that time to support student interaction through online essay writing tasks with facilitated and monitored peer feedback. Students spent more 'time on task' and the mean exam mark improved from 51.1% in 2005/6 to 57.4% in 2006/7. In Educational and Professional Studies time spent by teachers on assessment activities was reduced while peer feedback processes were given increased support. Here a 10.4% gain in overall exam marks was evinced compared to 2005/6.

- A key purpose behind the assessment redesigns was to support the development of learner responsibility in first year classes. Many approaches were used to encourage students to actively engage with, and take some ownership of, assessment criteria including discussions of criteria before engaging in learning tasks, peer identification of criteria and model answers. Opportunities for active self and peer assessment also took a variety of forms including online multiple choice tests, peer review processes, students self-assessing their skills and producing a development plan and students predicting their grade for a submitted assignment. For example, in Business Management, students generated their own multiple-choice questions, which were then delivered in class using electronic voting technology. This procedure encouraged active engagement with assessment criteria and helped students identify gaps in their own understanding.

- Students generally reported positive reactions to these modes of assessment and learning which give a focus for the development of lifelong learning skills. Also, most redesigns led to enhanced support and formative feedback on learning in first year classes. The literature on retention shows positive effects from such interventions.

During REAP we observed local patterns within the redesigns that we believe are potentially important to the achievement of learning enhancement and/or to efficiency gains. Again this data is preliminary with many redesigns incorporating more than one of these aspects:

- *solo-group processes*, characterised by alternating phases of solo work and group dialogue around learning tasks, often linked to the use of discussion boards or e-portfolio tools;
- *online skills practice*, characterised by feedback on demand through software simulations, intelligent homework systems or online objective tests, often associated with a reduction in teacher feedback or marking workload;
- *enhanced classroom feedback processes,* specifically linked to the use of questioning and electronic voting systems in face-to-face classes;
- *community support processes* where enhanced opportunities for online social interaction (e.g. a discussion board) often triggers shared learning and the development of learning communities;
- *peer scaffolding processes*, where discussion boards support teacher-monitored peer feedback with large numbers (e.g. over 500) often without teacher workload increases.

Dissemination

A wide range of outputs are available on the REAP website (www.reap.ac.uk) including:

- Case studies telling the stories of assessment redesigns for most classes/modules including matrices analysing each implementation against the assessment principles.
- Extensive evaluation data from each redesign.
- Links to institutional strategy resources.
- Guides and resources on use of electronic voting systems, e-portfolios and other software tools.
- Conference presentations (over 40), publications (8 papers) and reports deriving from the REAP project.
- A range of materials from the REAP Online International Conference on '*Assessment for Learner Responsibility*' held from 29-31st May 2007 have also been archived. This includes conference keynotes, a further 35 cases studies of technology-supported assessment course designs, the outputs of synchronous and asynchronous discussions of keynotes and case studies. 400 delegates from 32 countries participated in this conference.

Achievements: Strategic Developments at Institutional Level

The REAP project tested two different trajectories in relation to strategic developments at institutional level – top-down and bottom-up. At the Caledonian Business School (CBS) the REAP assessment principles were incorporated into the CBS Teaching, Learning and Assessment strategy and were subsequently used to review all undergraduate modules. In contrast, at the University of Strathclyde, the REAP developments were led from a local bottom-up level with a range of class redesigns in each of the five faculties. However, the success of these local developments has now led the Deputy Principal, Convenor of Academic Committee, to request a strategic review of Strathclyde's assessment policy including the role of technology. An institution-wide working group, chaired by the REAP Director, has now embedded the principles in assessment policy with examples of technology applications. Future work will use this policy as a tool for quality enhancement of future assessment and to support further redesigns across the University.

Lessons Learned

The following are some lessons that might help those wishing to replicate these developments in their own institution:

- The benefits deriving from ICT in education are not automatic and are more likely to be achieved by redesigning classes and courses with particular objectives in mind. Clear pedagogical objectives linked to a robust rationale should underpin development activities. In the REAP project, the objective was to increase learner-self regulation. This objective was defined in relation to a set of assessment principles drawn from the research literature. These principles guided the selection of local departmental projects for funding, were used as the basis for redesigns and formed part of the criteria underpinning the evaluation.

- As well as pedagogical objectives there are usually practical objectives such as demonstrating cost saving or efficiencies gains through course redesign. You are more likely to achieve these benefits from redesigns with technology if the redesigns are carried out with the desired benefits clearly in mind in advance of implementation (learning gains, cost savings) and when these objectives are iteratively addressed during ongoing formative evaluation.

- A coherent approach to evaluation should be adopted with considerable support provided to departments. Most academics do not have the skill or the time to carry out evaluations but if the institution is to build on successes then evidence must be forthcoming. Such evaluations should be formative in nature so as to encourage continual refinement from pilot to full implementation.

- Where possible, implementations should involve course teams rather than isolated individuals. This will promote sustainability and is more likely to lead to a coherent student experience and efficiency gains.

- Consideration should also be given to the possible benefits deriving from linking local redesign implementations to strategic developments. In two of the participating institutions, the REAP assessment principles were incorporated into the institutions' teaching, learning and assessment strategies. The aim was to build on local developments.

- Findings should be widely disseminated within the institution and externally. Internal dissemination helps create a culture of continuous development whereas external dissemination ensures that implementations are compared against current national and international developments. Also, importantly external dissemination and recognition often has a positive backwash effect on the participating institutions.

Conclusion

The REAP project has demonstrated new ways of engaging students as active agents in learning. It has provided 'proof of concept' that technology can support learning and workload gains in large classes when assessment design and e-tools are tightly coupled. Examples of transformation have been shown across a diverse range of courses and disciplinary contexts and across more than one institution. These findings suggest that these processes of transformation are a plausible prospect more generally in the HE sector.

For further information see, www.reap.ac.uk
David Nicol, July 2007.

Advice on Managing Transformational Change: Course Redesign using ICT

The Scottish Funding Council's e-Learning Transformation Programme aimed to identify ways of using information and communication technologies (ICT) as a catalyst to transform and improve the quality of teaching and learning in higher and further education. The Scottish Funding Council recognised that making effective use of ICT to support teaching and learning is a major challenge. Firstly, there is little systematic evidence that technology application leads to learning quality improvements or to cost savings. Secondly, the rapid pace of technological change means that investments in ICT can be risky if they do not serve strategic goals. Nonetheless, institutions cannot ignore developments in ICT. Technology permeates all aspects of daily life, including business and leisure pursuits, and students are now coming to university with the expectation that they will learn using technology. This paper provides some pointers to how to harness ICT in support of teaching and learning. The assumed context for the analysis is a scenario where a higher education institution has secured external funding, or is intending to use internal funding, to stimulate further use of technology in support of teaching and learning within courses or modules. This paper draws on findings from the Re-engineering Assessment Practices (REAP) project (www.reap.ac.uk).

Pedagogical Purpose

A key first step in the application of technology to teaching and learning is to identify a clear pedagogical purpose and rationale for each application of ICT. This will help ensure that the application of ICT leads to the enhancement of teaching and learning and not just to an increase in staff time or costs of delivery. The pedagogical rationale should also be aligned with the strategy for teaching and learning within the institution. In the REAP project, the rationale was to redesign assessment practices so that they supported the development of learner self-regulation in first year classes (e.g. through enhanced opportunities for self and peer assessment). A set of assessment principles was defined based on published research: these served both as a framework to redefine the student role in assessment and to evaluate the potential afforded by technology in different disciplines.

A clear understanding of the potential benefits deriving from ICT applications

It is also important that the expected benefits of the technology implementation are defined in advance and are measurable. The Scottish Funding Council identified learning quality improvements and/or cost savings as key goals for the transformation programme. While these goals are measurable (e.g. through exam performance and an analysis of staff time spent on teaching and learning) this is not straightforward. First, providing proof of benefit requires that robust baseline data is collected before new approaches are implemented. Secondly, collecting some data (e.g. measurements of staff time) is complex and requires significant commitment by project participants. Thirdly, some benefits might occur over a longer term (over a few years) rather than during the lifetime of the project. Having a clear pedagogical rationale can add value here: it allows some 'process' measures of effectiveness to be identified that can enrich the evaluation: for example, in REAP it was possible to evaluate enhanced opportunities for self-regulation by analysing increased use of self and peer assessment processes.

Selection of projects

How projects are selected for internal support is a key consideration. It is important that early implementations provide proof of concept of benefits if the intention is to motivate further participation in course redesign within the institution. In REAP, the assessment principles served as criteria for the selection of projects for funding as

well as contributing to the evaluation. Departments were asked to provide a redesign plan identifying their own specific objectives for change and to show how their approach aligns with the overall assessment goals of the project (i.e. to develop learner self-regulation).

One key lesson learned through REAP was that it was better if funding allocated to departments was in two parts and was contingent on specific deliverables. Half the funding was provided at the beginning for the production of a course redesign plan and the second half was given on production of a final case study report of the implementation including an evaluation of the benefits. This strategy meant that the REAP project team had to provide considerable support at the planning stage in supporting the redesign process. However, the payoff was that the redesign plans were more likely to produce the desired outputs. Where possible, implementations should also involve course teams rather than isolated individuals. This is more likely to result in sustainability, a coherent student experience and to efficiency gains.

Types of Support Required

The following are the different kinds of support required in redesigning courses with ICT:

- Project Management: managing a programme where there are multiple course redesigns requires robust project management processes, to evaluate proposals for funding, to manage contractual arrangements, to chase up reports, to organise staff development events, to ensure evaluation data are collected at the right time and where required to produce reports and liaise with funding bodies. Academic staff may not have the skill or the will to carry out such administrative activities. REAP showed that a central project manager did facilitate the smooth operation of such programme activities. Some departments also found it productive to allocate a local project manager to organise meetings of staff, to produce reports, to liaise with the central programme team and to manage other activities.
- Pedagogical support: experience in REAP shows that carrying out a complete redesign of teaching and learning using technology is a complex process. While support in producing redesign plans at the outset has a large payoff (see previous section) departments might also require advice when building on the findings of formative evaluations. A clear pedagogic framework is at the heart of the best module or course redesigns using technology. There is a great deal of research in this area but it is unlikely that academic staff will be familiar with this literature.
- Technological support: the need for technological support can vary at departmental level as some departments have technical assistance. Nonetheless central support can pay dividends in supporting project objectives by training and supporting staff in use of new technologies and by developing guidelines on software applications. Failure to address technological issues can seriously damage motivation and discourage participation in course redesign.
- Evaluation: a coherent approach to evaluation should be adopted with support provided to departments. Most departments do not have the skill or the time to carry out extensive evaluations but if the institution is to build on its successes then there is a need for robust evidence of benefits. Such evaluations should be formative in nature so as to encourage continuous refinement from pilot to full implementation.
- Project Funding: while funding is usually required to legitimise change in modules and courses, the level of funding required need not be high. In the REAP project the sum required to pilot module innovations was around £7-

12k depending on need. Contrary to common belief such monies were rarely used to release staff time as those teaching courses generally had to be involved in their redesign. Experience indicates that funding was generally used to employ a local project manager, to buy equipment or software licenses, to provide local technical support or specialised training or to develop content.

Sustainability and Embedding

While the operational context is critical to the choice of tactics to ensure embedding and sustainability, a number of factors can increase their likelihood. These include

- A widely discussed and shared institutional strategy for teaching and learning (and e-learning)
- Linking local implementations to a strategic driver and to recognised needs within the institution (e.g. reduce the assessment burden, enhance group working, provide greater support in the first year)
- Involving all members of a course team in the redesign.
- Involving a range of disciplines in redesigns to demonstrate broad applicability of findings
- Support for staff to help them make educationally sound choices about the use of technology in redesigns.
- Evidence based evaluation where proof of concept can be demonstrated
- Common evaluation criteria across all redesigns – this ensures that the reasons for successes and failures of individual designs can be identified
- Having a roll-out strategy that builds on the successes of initial implementations.
- Sharing success stories across the institution including the provision of opportunities for personal dissemination by those teaching redesigned courses.
- Explicit senior management support including project reporting at a senior level.
- Providing user centred services that make it easy for staff to adopt new approaches (e.g. in REAP, providing a one-stop shop where advice on all the issues associated with the use of electronic voting technologies could be acquired).
- Central institutional support for new software applications and for their integration with other systems may be required longer term, depending on the institution.

In the REAP project, one institution used a revision of its assessment strategy to guide local course redesigns (a top-down approach) and then evaluated the redesigns in relation to the strategy. In another, the success of the local implementations led to a review of the assessment strategy (bottom-up), with this review guiding further implementations. While the initial trajectory for change differed across these institutions, synergy at both organisational levels helps strengthen and promote long term embedding and sustainability.

For more information, see www.reap.ac.uk
David Nicol, July 2007

Abrupt Transformation at GCU

The Caledonian Business School (CBS) at Glasgow Caledonian University (GCU) introduced a variety of learning technologies during the REAP project, and makes a case study with three noteworthy features:

- The scale of change: multiple new technologies introduced in the same one-year time frame.
- The context of change: significant progress made against a backdrop of extensive re-structuring within CBS.
- The approach to change: The integration of a "top down" approach with a perceived need by lecturers to improve student feedback. This means that the institutional level was important in introducing change, as well as the course team level.

Thus relative to its partners and to most e-learning change reported in the literature, GCU is a "big bang" approach to change, and one that is less reliant on self-volunteering enthusiasts. This makes it an interesting test-case for the feasibility of fast change in the sector.

Institutional preparation

Although the introduction of new technology with the REAP project was on a large scale and sudden, there was a considerable organisational lead-up to it. GCU had already adopted a VLE, which CBS had piloted in 2000 as an early adopter; CBS had created a dedicated academic post from 2001 to promote e-learning within the School, with the post-holder liaising closely with relevant support staff from across the University; and Gilly Salmon, a well-known expert in e-learning, was appointed as a CBS visiting professor from 2002.

Large change

Most e-learning implementations, in REAP as in Twigg's programme, have been local in the sense that one course was redesigned while the other courses in that department, and the other courses the students were taking, remained much as before. During 2006-7, multiple changes were introduced simultaneously in the CBS which is the largest school in the University.

- EVS (electronic voting systems) were introduced into three of the core first year modules, where they were used in large lectures.
- Weekly Multiple Choice Question (MCQ) tests administered on the VLE were introduced into two modules (one first, one second year).
- Staff feedback on student essays (central to business school teaching) was made using software that offers a (digitally stored) comment bank in two third year modules.
- Summative online exams for a large cohort of students were introduced for one module
- PebblePad was introduced to support Personal Development Planning for students in three modules.

Evaluations

Evaluations analysed so far indicate that the majority of staff and students believe that learning gains have been achieved. 77% responded that EVS "was beneficial to their learning". A typical quote about the weekly MCQ quiz is "... the weekly tests ...

made me learn more than with other assessment methods". The comment bank software for supporting essay marking led to students getting feedback more quickly, and (according to the students) getting it electronically increased the likelihood of it being used and useful. Similarly PebblePad drew favourable comments suggesting the students felt it was prompting more reflective learning.

Current plans are to continue the use of all four technologies.

Organisational and course-team levels
In many reported cases, new technological initiatives are led by enthusiasts from below, whether they are enthusiasts for a particular technology or for improving some aspect of their teaching. This of course has weaknesses: many initiatives die as soon as the original enthusiast moves on, and change is dependent upon staff volunteering themselves. It means that in most cases, effective change depends mainly on the course-teams who control the design of courses. In the GCU case too one factor was a group of staff interested in improving the students' learning experiences through technology introduction, but another major factor was management interest and action, which is particularly important in cases of large change with considerable resource implications. Thus the organisational level was crucial here.

Adverse circumstances
The timing of the project was not ideal as CBS was undergoing a major re-structuring with new subject groupings being created and staff re-located, and some staff losses. Not only does restructuring take away attention from teaching innovation, it often reduces interest in it because any changes made are likely to be immediately lost to the individual making them if they are reassigned to other courses, and lost to the courses since the replacement person may not have the same interest or capability for making the change. A remarkable feature of this case is that large scale change was nevertheless possible, seems to have been successful, and is on course to persist and expand.

Other features / conclusions
This relatively "big bang" approach was made possible because the REAP project allowed:

- the injection of funds that bought equipment
- technical support from the project partners (in setting up equipment, and attending many lectures to support it), some evaluation data collection, and some staff training and pedagogical advice.

There are some indications that this support from other institutions was seen as raising confidence in the worth of the changes embarked upon. This demonstrated a cross-institutional collaboration not normally part of how the sector operates.

There were also some advantages inherent in this "big" approach, due to the way colleagues were all involved together, and shared experiences. For instance, a staff session was run near the end of the first semester in which lecturers using EVS each shared new tips and techniques they had developed. This is not possible in the typical change approach in other institutions that relies on scattered enthusiasts and early adopters, rather than colleagues in the same school. However there were also emergent enthusiasts within the larger group of new users, and a novel pedagogical use (i.e. having students design EVS questions for use in their presentation to the class) was devised, just as happens in enthusiast-driven change. Another advantage

of the "big" approach was inadvertently demonstrated too: the larger group seems robust against a dependence on individuals to maintain the changed approach.

Almost all the changes to teaching occurred in 2006-7. The data has not yet been analysed in detail. A major case study is in preparation.

For further information see, www.reap.ac.uk
Steve Draper & Linda Creanor, July 2007.

Assessment as a driver for institutional transformation

Current challenges in higher education

Of the many developments taking place in higher education today, three stand out as being especially challenging (i) higher teaching workloads brought about by increasing class sizes and resource constraints (ii) the shift from teacher-driven models of learning to more student-centred models and (iii) the rapid pace of technological change.

A key question is how to manage these developments in a way that maximises benefit, not only to the student but also to the institution. Each of these developments - increasing workload, the changing role of the student in learning, and technological innovation - could be addressed separately. However, a more productive approach is to identify some key process within higher education that, if harnessed, could act as a lever to manage all three areas simultaneously. What would be the characteristics of such a process? Firstly, it should have a wide-ranging influence on educational, business and/or organisational activities. Secondly, it should directly affect the way teachers and students interact and hence the balance of responsibility for learning. Thirdly, the application of new technologies should produce positive benefits.

Assessment is arguably one such process: it is core to institutional functioning, it is the fulcrum that mediates teaching and learning relationships, and it could benefit from appropriate technology application.

Assessment as a driver for change

Everyone in HE is involved in assessment and it is the major bottleneck in relation to large class sizes. Whereas it is possible to achieve economies of scale in lecturing (through larger lecture halls) as far as traditional assessment practices are concerned workload (marking and feedback) is directly proportional to student numbers. Assessment is also the crucial interface between the student and the teacher or institution. One effective way of shifting the balance of power and responsibility, and of moving towards a more student-centred learning culture, is to redefine the role of the student in assessment processes. In addition, the application of new technology can help address workload issues and support shifts in student responsibility.

The Re-engineering Assessment Practices (REAP) project, funded by the Scottish Funding Council under its e-Learning Transformation Programme, has explicitly used assessment as the core driver for transformational change and as a way of addressing workload, the changing student role and the need to utilise new technology to best effect.

The REAP Project

The driving force for REAP has been the re-thinking of both the definition of assessment and the teacher-student relationship in assessment. Instead of viewing assessment as something the teacher does, assessment in REAP is conceptualised as a collaborative process where students share responsibility with peers, staff and the institution. A key assumption underpinning REAP is that students are already monitoring, self-assessing and regulating their own learning and that the purpose of HE is to build and strengthen this capacity. REAP takes a broad view of assessment, spanning formal and informal processes including self, peer and teacher feedback. A key goal of REAP has been to harness new technologies so as to support the kinds of assessment redesigns this new thinking requires, and to generate learning quality gains and efficiencies in contexts where there are large student cohorts.

Findings from the REAP project
The REAP project involved the re-design of 19 large enrolment first year classes supported by technology across three Scottish Higher Education Institutions. The student numbers per class ranged from 160-900 students with over 6000 students participating.

REAP has shown that when students are re-conceptualised as partners in assessment, and when technology is harnessed in the assessment design, significant learning and workload gains are possible even with large first year classes. How is this evidenced? When working in groups in online environments around structured but open-ended learning tasks, students have been shown to become more self-reliant seeking feedback and support from each other rather than just from the teacher. They invariably challenge each other and this promotes higher levels of individual learning while at the same time they also scaffold each other's understanding and development. By extending feedback, to include peer and self-generated feedback, the redesigns have shown that it is possible to reduce teacher workload without any loss (and sometimes an enhancement) in learning quality.

The Role of Technology
Technology has a dual role. It helps facilitates self-assessment and supportive social and peer processes, by providing students with familiar tools and flexible ways of interacting with each other and with learning resources. Technology also supports teachers by providing them with the ability to monitor group interactions as they happen online, and to intervene to clear up misunderstandings when required, but without providing unnecessary feedback or dominating discussions. This is a more economical use of the teachers' time and it helps avoid over-teaching, but it does require the careful design of learning tasks.

The Benefits of Redesign: some examples
In one first year Psychology class, a single teacher was able to organise rich and regular peer feedback to 560 students on a series of online essay writing tasks. This resulted in an increase in mean exam marks (from 51.1% to 57.4%) with some students producing work at second and third year standard. In another Engineering first-year class with 250 students, teachers were able to cut homework marking in half (a saving of 102 hours) by encouraging students to engage in self-assessment using an online homework system without any drop in exam performance. The time saved was used to increase personal tutor-student contact. These examples were effective because the sources of feedback were extended beyond the teacher through planned and carefully structured learning tasks.

In addition, in each design the application of technology was integrated, and aligned to the learning goals and purposefully used to create efficient uses of staff time. In the Psychology example, communications technology made it possible for a single tutor to monitor the progress of 86 online peer groups. In the Engineering example, all homework assessment was automated. These examples show the added value of the technology.

Conclusion
Overall, the gains from REAP are the result of the synergies deriving from the redesign of courses using a new assessment philosophy supported by innovative uses of new technologies. REAP has shown that it is possible to address workload, changing student roles and technological change in productive ways.

For more information see, www.reap.ac.uk
David Nicol, July 2007

Interactive lectures and Electronic voting systems

What is EVS?

An Electronic Voting System (EVS) presents a multiple choice question (MCQ) to an audience and up to 10 alternative response options are displayed. The handsets (like domestic TV remote controls) are distributed to each audience member as they arrive, and allow everyone to contribute their opinion anonymously. An example of this can be seen on a TV show such as 'Who wants to be a millionaire'. After the specified time (e.g. 60 seconds) elapses, the aggregated results are displayed as a bar chart. Thus everybody sees the consensus or spread of opinion, knows how their own answer relates to that, and contributes while remaining anonymous. It is thus like a show of hands, but with privacy for individuals, more accurate and automatic counting, and more convenient for multiple-choice rather than yes/no questions.

Why should institutional management be interested?

- EVS can be applied in almost all disciplines
- EVS applies to lectures (central to low cost mass teaching) and introduces interactivity.
- Introducing EVS is low risk: student attitude measures have been markedly positive in almost all cases both from the start and after years of use
- EVS is used to implement "Interactive Engagement" (Hake), and a specific variety of this "Peer instruction" (Mazur), which is almost the only application of technology that has been demonstrated to raise exam results consistently by a substantial amount
- EVS contributes significantly to both individual learning and community building in a class
- A wide variety of types of pedagogic application may be (and have been) implemented with the same equipment

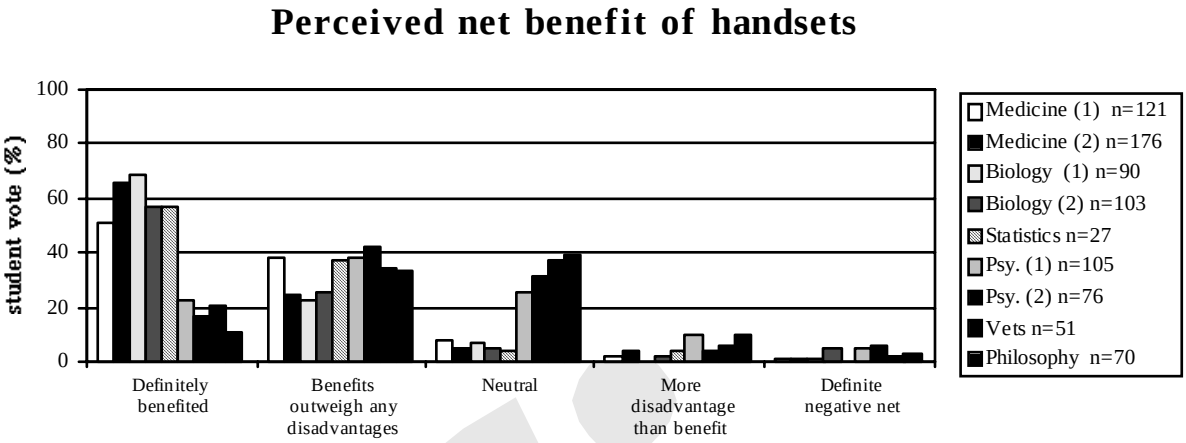
Some pedagogical applications

1. Assessment: class tests can be administered and interactive feedback given and discussed all in one session. Although limited to an MCQ format, a turn round of less than 60 minutes combined with interactive feedback where students ask for clarification as needed makes this far superior not only in cost but in quality for students to any other assessment method.
2. Formative feedback on learning within a lecture.
3. Formative feedback to the teacher on the teaching i.e. "course feedback".
4. Peer assessment.
5. Community mutual awareness building.
6. Collecting data from experiments using human responses: e.g. in psychology, politics, physiology, medicine, economics etc., thus demonstrating a phenomenon that is being taught.
7. To initiate a discussion (e.g. using "brain teaser" questions, as in Mazur's "peer instruction"). "Contingent teaching": a lecturer/tutor can be responsive and alter class designs according to the diagnositc feedback he/she gets during the learning process. This requires teachers to be adaptive and confident
8. Having students design EVS questions (and answers, and explanations) and use them in a presentation to the class.

Subjects that have used EVS at Glasgow University in the last six years

Accounting and Finance, Biology, Computing Science, Dentistry, Engineering (both electrical and mechanical), English literature, French, Management, Medicine, Philosophy, Physics, Psychology, Statistics.

Student attitudes to EVS



Responses to: "What was, for you, the balance of benefit vs. disadvantage from the use of the handsets in your lectures?" with the response options from "definitely benefited" through neutral to "definite negative net value" in assorted classes. The "n" shown is the subset of the class present and responding at the time the evaluation question was put

Behavioural evidence

- Exam results: Hake did a six-thousand student survey of mechanics data for introductory physics courses, all using a standardised test. Classes using the method of Interactive Engagement achieved on average twice the learning gain than those that did not.
  Poulis et al., and Crouch & Mazur have both published in journals on their statistically significant increases in exam marks. The former show a near doubling in the pass rate; the latter showed, like Hake, an average 2-fold and at best a 3 fold improvement in learning gain.
- Attendance: In one case (statistics) attendance increased from about 20 to about 80 (out of 200): a fourfold increase.
- Retention: At Strathclyde University, first year dropouts in mechanical engineering were nearly eliminated.

Practicalities

- Required equipment: a handset per student, receivers, software (often free from the manufacturers), a laptop or other PC, one or more data projectors.
- The equipment can be entirely mobile, thus avoiding room booking constraints, although requiring a bit more setup effort per session
- There are three ways of managing the handsets: requiring students to buy them, having them associated with a specific lecture theatre (managed by a technician) with students picking up a designated handset from its own pigeonhole, or handing them out as students enter. All take time on the first occasion, but go fairly smoothly if used as part of the routine of a class.
- To promote new adoption, it is important to have a single point of contact where the lecturer can obtain advice and assistance on all aspects (hardware, software, setup, pedagogic advice, room bookings); and furthermore, to attend their first usages to assist as much as possible including operating the software for them. Typically lecturers become self-sufficient in time, but at first they need their full attention on the changes to the teaching they are making, not on the equipment.

- Designing questions: many lecturers have little trouble adding useful questions to their lectures, but the learning benefits often increase as the lecturers get better at redesigning sessions around questions.
- In the long run, other things may be altered to fit better. At Strathclyde, over the past 10 years, lectures using EVS have moved to a 2 hour, rather than separate 1 hour slots; and the seating was reorganised into groups of 4 to further facilitate peer discussion.

Conclusion

Overall, EVS can be applied to teaching almost any subject, and a modest but measurable improvement can be expected from the outset. In cases where major improvements to the pedagogy can be and have been made, large improvements have been achieved with effects on exam results, attendance, and retention. Central support for new and prospective adopters can make a big difference, but may need to cut across traditional organisational boundaries between support for software, computer hardware, audiovisual equipment such as data projectors, room bookings, pedagogical advice, and assistance in the lecture theatre itself.

For more information see, www.reap.ac.uk
Steve Draper, July 2007