0178 All hands on deck: CREWED for technology-enabled learning

Author

Carol Russell

Faculty of Engineering, UNSW
Kensington Campus, Sydney, NSW 2052, Australia

carol.russell@unsw.edu.au

Abstract

The University of New South Wales' (UNSW's) Faculty of Engineering is introducing a new process for designing and developing blended and fully online (distance) courses, as part of action research to support curriculum renewal. The process, referred to as CREWED (Curriculum Renewal and E-learning Workloads: Embedding in Disciplines), is being used to develop key courses that add flexibility to student progression pathways. By integrating the design of learning activities with the planning and organization of teaching and support work, CREWED addresses some of the known barriers to embedding innovative use of learning technologies within disciplines. CREWED incorporates key features of two course development models from the UK, one emphasising team building and the other emphasising pedagogical planning. It has been piloted in priority curriculum development projects, to ensure that the disciplinary organizational context is supportive. One pilot is a fully online distance version of a postgraduate course. The other is a blended version of an undergraduate course. Both are core (required) courses in accredited professional engineering degree programs and were previously available only in face-to-face mode. The UNSW pilots have confirmed the importance of articulating clear pedagogical models, and of planning ahead for the resources required to put these models into practice, as part of departmental capacity building, especially where teaching has primarily been treated as an individual classroom-based activity that competes with disciplinary research for academic staff time and resources.

Introduction

UNSW's Faculty of Engineering is developing a new process for designing and developing blended and fully online (distance) courses, to support curriculum renewal in the discipline. The course development process, CREWED (Curriculum Renewal and E-learning Workloads: Embedding in Disciplines), is being used to develop key courses that add flexibility to student progression pathways. The context is one where there are clear drivers for curriculum development, and where learning technologies can enable this development, by increasing flexibility and supporting new types of learning activity.

The faculty is aiming to expand distance and blended study options to provide more flexible pathways for students to achieve an accredited professional degree in engineering. Redesigning learning activities for new learning media and environments creates an opportunity for pedagogical review, as part of curriculum renewal. However, UNSW is a traditional campus-based university which, like other similar universities, still largely relies on traditional classroom teaching methods. CREWED aims to overcome some of the known contextual barriers to the adoption of new learning technologies in traditional campus universities,

This paper describes two pilot projects which form the initial stages of longer-term action research aiming to build knowledge of how learning technologies can enhance curriculum development within a discipline. Two courses have already been designed, developed, run and evaluated using a new team-based process. In both cases, there has been explicit attention to team process and managing the staff workload required for designing courses with technology-enabled learning activities.

The research is building on prior work in the UK, to develop a practical approach that will enable embedding of new learning technologies in mainstream campus teaching practices and systems. The pilots in UNSW identified some remaining barriers to implementing this team-based approach, and the outcomes suggest where further work is needed to address these.

The pilots aimed to:

- establish, evaluate and embed an efficient team-based process for developing innovative learning activities, incorporating use of learning technology within curriculum development for Engineering degree programs in the University of New South Wales (UNSW)
- build a knowledge base of the staff time, skills and resources needed for creating and running technology-enabled learning activities
- demonstrate how use of digital learning technologies can be embedded in academic departmental organization and in discipline-specific educational designs.

Analysis of the two pilot projects, and their outcomes, also contributes more broadly to understanding of how to build capacity for innovative use of learning technologies as an integral part of curriculum development within a higher education discipline context.

Background and rationale

Contextual challenges and opportunities in engineering education

Several Australian universities are seeking to strengthen the building of engineering graduate attributes through design project work, and to incorporate international initiatives such as the CDIO (Conceive-Design-Implement-Operate) framework within the discipline. There are also moves to introduce a 3+2 degree structure in university engineering programs. Both of these are drivers for curriculum renewal. Online learning resources and tools are already proving essential for managing large undergraduate classes in which team-based design projects are replacing some traditional lecture and lab activities.

UNSW's Faculty of Engineering is Australia's largest, with around 4200 equivalent full-time students. The faculty has identified some specific curriculum development goals, for which new learning technologies offer enabling features—in particular providing more flexibility of routes through to accredited 3 year, 4 year and 5 year degrees. However, there are barriers to the introduction of innovative teaching using educational technologies in UNSW.

In the faculty, teaching is a large-scale organised activity, run by academics who also have research responsibilities. About 90% of academic staff members are 'research active' according to the University's definition. Teaching work is measured in terms of student contact hours and course or program coordination responsibilities. There is no built-in allowance for developing new types of learning activity. Such work has to be treated as a special project, and there is little knowledge of how to plan and allocate staff time for it.

Removing systemic barriers to effective use of learning technology in campus universities

Laurillard (2002, p227) maintains that collaborative development is crucial for developing effective use of learning technologies, because of the range of skills needed. She also observes that staff time and resources need planning at institutional and departmental level, but that academic staff time is rarely costed in relation to specific areas of their work. Academics in traditional universities spend a significant proportion of their time presenting through lectures and marking and spend relatively little time designing. For many academic staff, the introduction of new technology has been "a nightmare of overwork and lack of support" (Laurillard, 2002, p229).

Previous projects on embedding e-learning design in university teaching have developed a team design process (Gilly Salmon, Jones, & Armellini, 2008) or have focused on pedagogical planning tools for academics (Diego, et al., 2008; Laurillard, 2008), but have not integrated these with the planning of staff workloads within academic departments and disciplines.

Especially when under pressure, individuals adopt behavioural strategies that minimize enquiry, based on 'theory in use' learned through socialization rather than on explicit espoused theory based upon evidence (Argyris, 1999). Theories are also embodied in organisational systems such as academic workload models. It is mainly an individual academic responsibility to develop new learning resources and there is usually limited or no support available for developing new digital media (Uys, Buchan, & Ward., 2006). There is a lack of organised and articulated knowledge of how to plan and allocate university staff time to developing use of new technologies to best advantage within disciplinary departments.

The aim of this research is to generate new workload models for new educational designs and new technologies as part of a systemic approach

within academic departments, by including the planning of staff workloads as an integral part of a team-based design and development process. The underlying conceptual framework is that a discipline-based university department is a complex adaptive system (Russell, 2009). Figure 1 illustrates how, in disciplinary learning and teaching, systemic adaptation to contextual change involves interdependence among forms of teaching and learning activity, material resources used and organising processes. Attempts to change pedagogy without also addressing the other complementary changes will result in a homeostatic response that minimizes, or even cancels out completely, the impact of the change (Kezar & Eckel, 2002).

The development and piloting of a practical process that can take account of and document the interdependencies illustrated in Figure 1, in the context of UNSW Faculty of Engineering curriculum development priorities, also contributes to addressing a broader research question:

In the context of disciplinary curriculum development, how can the use of new learning technologies be integrated with development of new forms of learning activity and changes to departmental teaching processes, so that each of these helps rather than hinders the others?

Research methods

Action research

The research is a practical intervention in a complex university learning and teaching system, seeking to identify and adjust the key interdependencies illustrated in Figure 1. The aim is to help the disciplinary system to adapt, with the introduction of new learning technologies forming part of the adaptation. Several writers advocate action research approaches for such interventions in complex organizational systems, higher education curriculum development and online learning (Mitleton-Kelly, 2003; G. Salmon, 2001; Trevitt, 2005; Zuber-Skerritt, 1992). This paper reports on the early cycles of an ongoing action research project (Figure 2).

The CREWED process

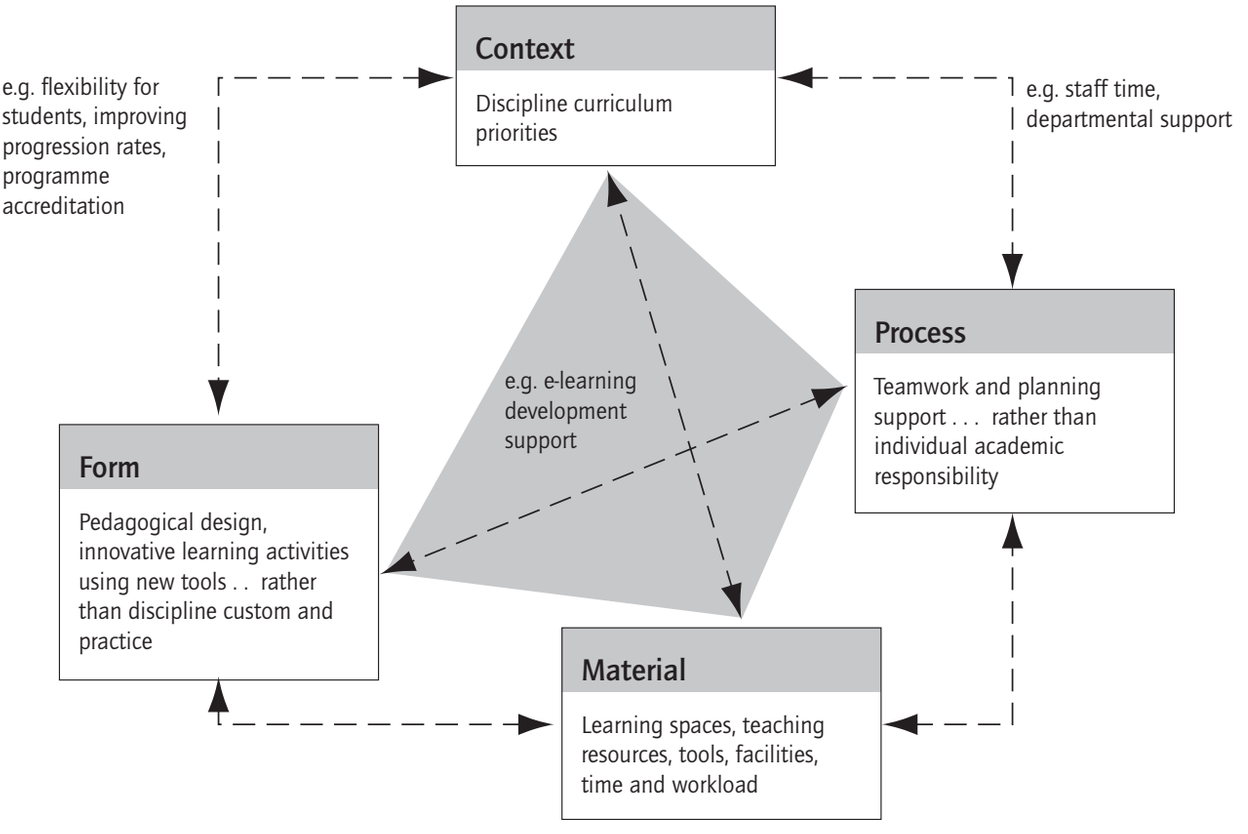
Figure 3 shows a flowchart of the course development process as piloted, called CREWED (Curriculum Renewal and E-learning workload: Embedding in Disciplines). The CREWED process is based on the Carpe Diem model (Gilly Salmon, et al., 2008) for building team-based capability in e-learning design. The main benefit of this process is that it offers a clear result to busy academics for a short and contained investment of their time. Another UK project, the London Pedagogy Planner (Laurillard, 2008) provided ideas on how learning designs can be made explicit as part of a planning process. To this was added explicit planning and evaluation of the workloads for developing and running the course, in relation to the pedagogical models being used. There was also evaluation of the effectiveness of the design, as implemented, for student learning.

The two courses chosen for piloting the team-based design and development process represent different aspects of the Faculty's curriculum development priorities:

- a distance version of a core introductory course in all postgraduate mining programs, piloted in Semester 2 of 2008, previously offered only as an intensive campus-based course in Semester 1 each year
- a blended version of a core 1st year course for undergraduate chemical engineering programs, offered in blended mode in the 2008–9 summer term, previously offered only as a standard classroom Semester 2 each year.

The pilots therefore engaged with all parts of the disciplinary learning

Figure 1: Disciplinary learning and teaching framed as a complex adaptive system



system illustrated in Figure 1, including and especially curriculum development priorities.

Implementing CREWED

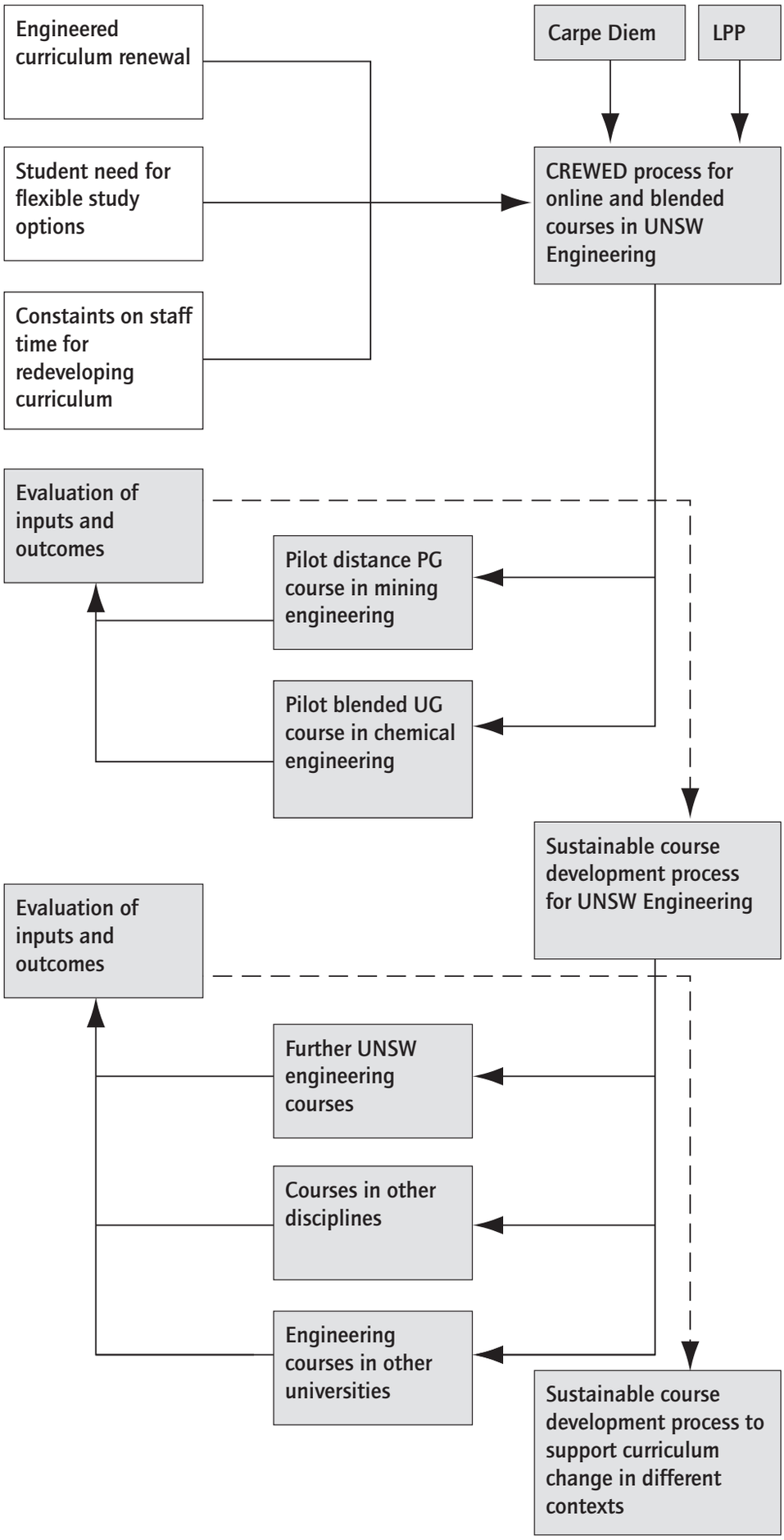
Figure 3 shows the intended version of the process. In both pilots it proved impossible to arrange for the academic staff involved to be available for two consecutive days. So instead of a single intensive 2-day session we (the course development teams) attended a 1-day workshop and follow-up half-day workshops, with development tasks scheduled between workshops, to maintain momentum. Like the original Carpe Diem model, everyone who would have a role in designing, delivering and supporting the student learning activities took part. Each course development team included:

- a facilitator;
- 2–3 core academic course team members;
- an educational technologist;
- an educational developer;
- the outreach librarian for the Faculty (to provide 3rd party resources, copyright clearance and information literacy support).

The support staff worked hands-on with the academics on design and development activities. The academics were asked to ensure that all the basic course learning resources were available in digital form to use in the first workshop. Both pilots also involved students as 'reality checkers' to work through some of the online activities developed, and give feedback. For the distance course this was done between workshops, and for the blended course the students came in at the end of a workshop and tried out the activities with the team present.

Another emergent change in the process from the Carpe Diem model was in how the course design was captured and visualised. In the first pilot

Figure 2: Action research cycles



workshop, for the Mining course, we started to use a storyboarding process to capture the design, and found that this did not work well as a method for making the pedagogy specific, nor for planning student and staff workloads.

The LPP project developed open source software for representing and planning implementation of the learning activities in a course or subject module. Although the software defaults to Laurillard's conversational learning model, it has the potential for use with other pedagogical models. (Diego, et al., 2008; Laurillard, 2008). As the facilitator, I drew on this idea to suggest using a spreadsheet representation of the course timeline, including all aspects of student and staff activity, and resources and tools used, on one sheet with estimates of course totals of student and staff workloads for running the activities clearly visible.

The spreadsheet representation brings together and visualizes the whole course design and each team member's role in supporting the learning activities. It also maps how each learning activity contributes to the course learning outcomes and their assessment, and to disciplinary graduate attributes. In the first pilot we were also able to map the course timeline onto the five-step model of levels of engagement in online learning (G. Salmon, 2000).

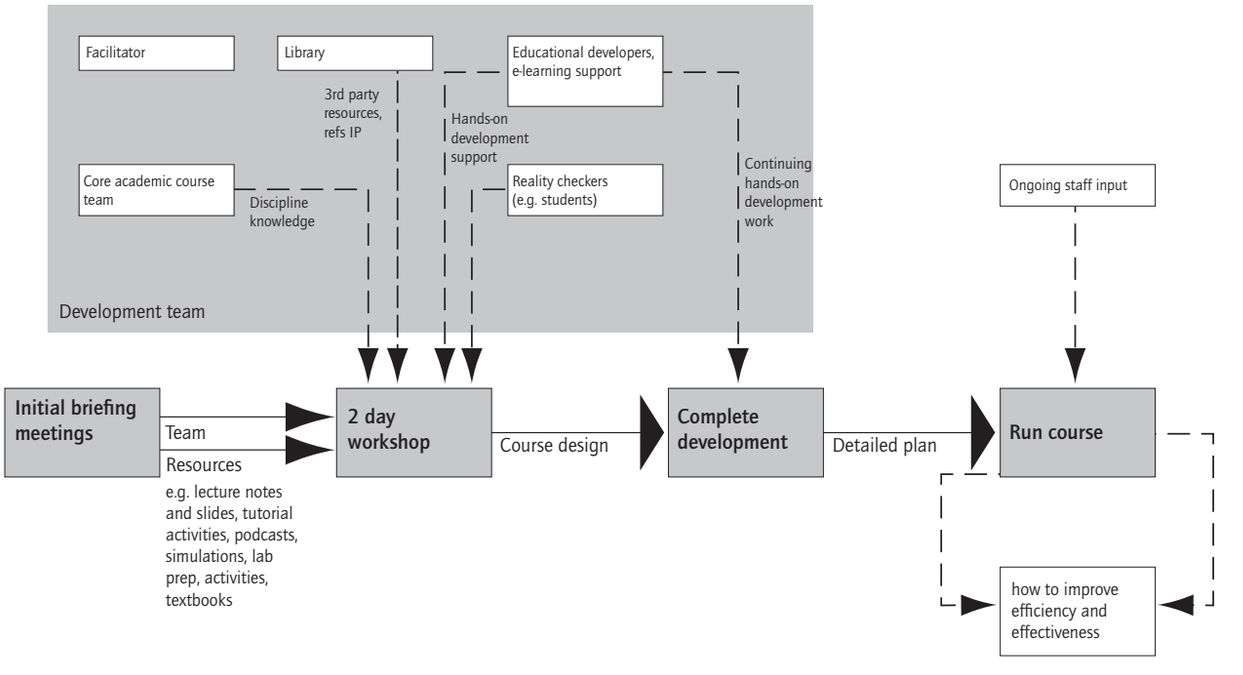
The planned staff activity could then be compared with the actual activity to plan for the same course and for other similar courses, in future.

Evaluation by students involved both the observation of student participation in the online activities while the pilots were running, and a short Survey Monkey questionnaire after the students had completed the final assessment.

Outcomes and what was learnt from them

Table 1 summarises what was learnt from both pilot projects. The two projects had contrasting outcomes, which highlighted the need to take into account the different academic contexts of the students and the staff. However there were some common factors in both projects.

Figure 3: The CREWED process as piloted



Learning and capacity building

Some common outcomes from both projects are:

- identification of additional sources of support for developing and running technology-enabled learning activities, from within the disciplinary community;
- building the experience and the expectation of teamwork with support staff (learning designer, educational technologist, library);
- increased confidence in introducing new technology-enabled learning activities into courses.

In terms of meeting curriculum priorities and the learning needs of students, the design process worked better for the mining course than for the chemical engineering course. There are a number of possible reasons for this — differences in the team, in students and in the delivery mode. It is not surprising that 1st year students, many of whom have already failed the course, are less skilled as independent learners online than professional graduates. Yet other 1st year courses in the Faculty of Engineering have been able to introduce design project assignments where students work independently in groups, using online support blended with classroom sessions. The design of these courses, however, is much less didactic and content-driven than the engineering chemistry course, which in the main semester version also has a higher than usual failure rate. The course team therefore faced more challenges in the extent of redesign needed, and in developing a shared view of what could be done.

The summer course pilot identified that the timing was problematic, in that it is in a period when academics are busy preparing research grant applications. Showing how PhD students can help with design and assessment work will be very helpful for future blended summer courses.

Pedagogical models and learning design practice

In many engineering disciplines, planning of resources and workloads is part of the discourse. The academics involved in the UNSW pilots immediately appreciated (in theory at least) the concept of designing and planning student and staff time for new learning activities using spreadsheet models and even Gantt charts. On the other hand, some educational concepts and research methodologies are harder for engineering academics to understand (Borrego, 2007). The CREWED process aims to overcome this through participation of skilled educational developers and other support staff working closely, hands-on, with Engineering academics to achieve a tangible result. The focus is on experiential team-based learning to achieve specific and immediate objectives within the discipline. One participant commented that the process is 'staff development by stealth'.

The pedagogical models used may depend on context — the level of study and the institutional program structures. The Salmon 5-step model (G. Salmon, 2004), provided a planning tool for a fully online postgraduate distance course. With a course team who initially were sceptical about the type of online facilitation needed, the measured pattern of student and staff online activity established the validity of this model.

Although the 5-step model was introduced to the team in the undergraduate chemical engineering course, the core academics resisted engagement with it, and preferred to structure the course around content topics. The learning models are still largely individual rather than social. This is problematic in a context where engineering graduates need strong teamwork skills. However, there was progress in that the learning outcomes for the course are now more clearly articulated, and the team are beginning to move towards more active learning models that are enabled by the technology.

Instead of wholesale adoption of particular learning models, the project aims

to adapt and combine pedagogical models to develop discipline and context-specific models that can be owned by the academics involved, and verified by their own experiences of developing and running the courses—building what Argyris (1999) calls 'actionable knowledge'.

Evaluation and conclusions

The pilots proved successful as the first part of an action research process that still has some way to go, particularly in developing a substantial knowledge base upon which to build workload models for designing, developing and running new types of learning activities and embedding these workload models into departmental systems. Further pilots are planned and the two reported in this paper have built the foundations for the next stage. In particular, the work has developed a new design, development and planning process for online and blended courses that can take into account discipline-specific curriculum development needs, and faculty-specific resource constraints. The pilots have also provided local examples of practical solutions to these constraints. While the specific solutions are context-specific, the process for reaching them could be used elsewhere.

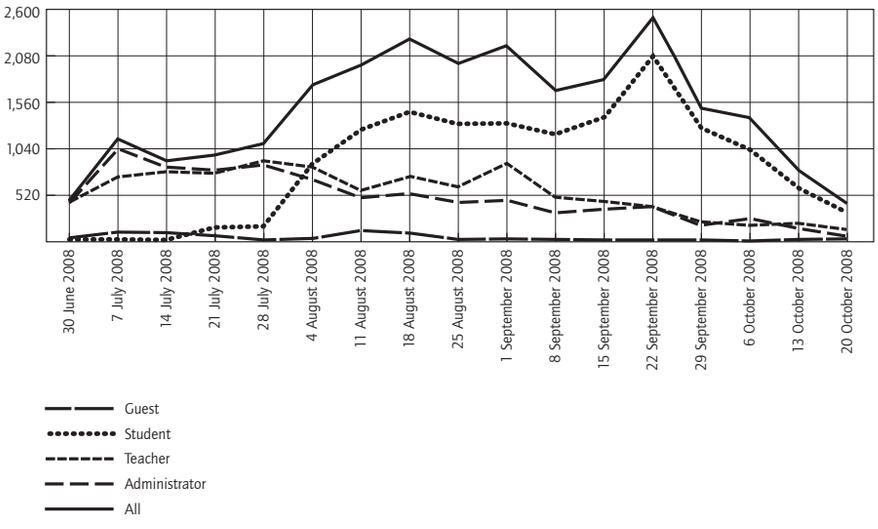
Two more course development projects are underway using the CREWED process. One is a postgraduate blended course, piloting a new institutional online learning management system, run in 2009 semester 2. The other will be another 1st year undergraduate in blended format in the 2009–10 summer session. Both will build on what worked and what didn't work in the pilots.

A particularly useful outcome has been the development of a course design spreadsheet template. The template is a simple tool to collect, capture and represent different aspects of a course design and its constituent learning activities along with the teaching work involved, and has already proved useful for other course development projects. There

Table 1: Learning from pilot projects

	Postgraduate distance course	Undergraduate blended course	Outcomes and comments
Development process	Initial consultations from March 2008. Design & build workshops April. Build and test May-June. Course ran July-Nov 2008, with adjustments and additional resources added when required. Final review Dec 2009. Learning outcomes already fairly well defined and most time spent on design of activities for online environment.	Initial consultations and lecture recording from Sept 2008. Design & build workshops October. Course ran Nov 2008-Feb 2009. Final review Feb 2009. Much work needed to clarify learning outcomes. Links between class and online activities problematic, as were relationships between topics and learning outcomes/assessment.	The 1-day plus half day design and develop sessions were reasonably successful. Adequate preparation of resources beforehand is necessary, and academics need help with this. The UG course team were more content-focused than the PG course, making the design process harder work and results poorer.
Course design	Moodle online tools and resources (quizzes, video, notes, discussion forums, group assignment, final assessment by individual work-related project report) Used 5-step model to structure activities and plan facilitation.	Final design built around 5 distinct content topics. Online topic-related quizzes and built-in feedback. Conditional release of lectures recordings for subsequent topics on quiz scores. Lab work, computer assessments and final exam as in classroom mode, with 1 f2f tutorial.	Salmon 5-step model useful for distance course, but less so for blended UG course. PG course assessment workload too high for staff and students. UG blended pedagogy needs more work, but pilot provided useful online resources for use in main session course, which may help better use of f2f time.
Student response	21 students, started, 15 completed and passed (typical for PG Mining). Feedback indicated students were engaged, but found assessment workload heavy. Appreciated response to requests for additional resources.	9 students started, 2 dropped out immediately, 4 of remainder had failed course previously. Direct Qs only in online forum, quizzes appreciated, but lecture recordings (main resource) not used as intended. Students poorly prepared for f2f tutorial and only 3 passed exam.	Much better results with PG distance course than with UG blended course. This could be because of student independent learning skills and motivation at PG level, combined with more coherent course design. Some useful learning on design of online group tasks.
Staff workload	5-step model reflected in student and facilitation activity (See Figure 4). Small School with specialist academics. Library rep ran one activity. Drafted in additional academic to help run online activities and mark assignments.	Academics unavailable for online facilitation. Research student converted existing tutorial questions to online activities with feedback, and responded to students' online Qs.	Both courses needed more facilitation input than the academics anticipated and involved an additional person. Use of research student to augment academic staff worth repeating in other courses.

Figure 4: Student and staff online activity in the Mining Engineering course



is potential to develop this idea further, perhaps using some of the other available tools. The use of such tools is not new, but their integration with local conditions and staff planning is a new development. By using a simple tool such as a spreadsheet, it was possible to discuss and negotiate, without imposed preconceptions about pedagogical models or the shape of the course activities, and to map out the practical resource implications while discussing options.

The two pilot projects were designed using an underlying conceptual framework that treats disciplinary learning and teaching as a complex adaptive system. The outcomes have illustrated some specific benefits in this approach. In particular, the CREWED process allows for pedagogical models to be negotiated in a curriculum development context, and for activities using learning technology to be designed and adapted along with the development of team processes. Whereas a focus on the quality of the learning design might have produced a better short term outcome for students in both courses, it could have done so at the expense of academic staff 'burnout', as described by Laurillard (2002)—had it been possible to engage the relevant academics in the first place. The CREWED approach aims to address the whole learning and teaching support system, so that academic staff can negotiate how much of their own time is spent, as part of a team. Linking with curriculum development priorities was essential for gaining formal support and resources, and the results provide evidence of value that can be used to argue for more resources.

The initial phases of this action research have therefore confirmed the necessity for research that deals with learning technologies as an integral part of a broader learning and teaching system—not just the pedagogical design, but also the academic context and staff workloads. The two pilot projects have extended the work done in UK universities to introduce teamwork and build capacity, by adding an explicit investigation of staff workloads and skills. This has given specific information to the two academic departments concerned, which will enable them to plan future online and blended courses more effectively, avoiding some of the academic workload barriers by using additional support staff and more teamwork. Without such explicit proof of the need for, and benefits from, extra support and skills, it is hard to argue for budget allocations and staff time.

While the pilots themselves are limited in scale and scope, they have laid some groundwork that can be built upon within the UNSW Faculty of Engineering, and further afield. The Chemical Engineering course also exemplified barriers to teamwork across departmental boundaries, in service teaching arrangements. This is a central curriculum development issue in Engineering, which also occurs in other professional disciplines.

References

Argyris, C. (1999) *On Organizational Learning* (2nd edition ed.). Oxford UK: Blackwell

Borrego, M. (2007) *Conceptual Difficulties Experienced by Trained Engineers Learning Educational Research Methods.* Journal of Engineering Education (Washington, D.C.), 96(2), 91–102

Diego, J. P. S., Laurillard, D., Boyle, T., Bradley, C., Ljubojevic, B., Neumann, T., et al. (2008) *Towards a user-oriented analytical approach to learning design*. [research paper]. ALT-J Research in Learning Technology, 16(1), 15

Kezar, A. and Eckel, P. (2002) *Examining the Institutional Transformation Process: The Importance of Sensemaking, Interrelated Strategies, and Balance*. Research in Higher Education, 43(3), 295–328

Laurillard, D. (2002) *Rethinking University Teaching: a conversational framework for the effective use of learning technologies* (2nd ed.). London: Routledge Falmer

Laurillard, D. (2008) *London Pedagogy Planner* (LPP). London: JISC

Mitleton-Kelly, E. (2003) *Complexity research — approaches and methods: The LSE Complexity Group integrated methodology*. In A. Keskinen, M. Aaltonen & E. Mitleton-Kelly (Eds.), Organizational Complexity. Helsinki: Tutu Publications, Finland Futures Research Centre

Russell, C. (2009) *A systemic framework for managing e-learning adoption in campus universities: individual strategies in an institutional context.* ALT-J Research in Learning Technology, 17(1)

Salmon, G. (2000) *E-moderating: the key to teaching and learning online.* London: Kogan Page

Salmon, G. (2001) *Approaches to researching teaching and learning online.* In C. Steeples & C. Jones (Eds.), Networked Learning. London: Springer-Verlag

Salmon, G. (2004) *E-moderating: the key to teaching and learning online* (2nd ed.). London and New York.: Routledge

Salmon, G., Jones, S. and Armellini, A. (2008) *Building institutional capability in e-learning design.* ALT-J Research in Learning Technology, 16(2), 15

Trevitt, C. (2005) *Universities learning to learn?* Inventing flexible (e)learning through first and second-order action research. Educational Action Research, 13(1), 5783

Uys, P., Buchan, J. and Ward., L. (2006) *Digitally enhanced blended learning: a comparative study of Australian Universities.* Paper presented at the ASCILITE

Zuber-Skerritt, O. Y. T. (1992) *Action Research in Higher Education: examples and reflections.* London: Kogan Page