Re-engineering for Australia's engineering skill shortage

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To address Australia's engineering skills shortage, the University of South Australia has teamed with Open Universities Australia to create an online version of an approved Associate Degree in Engineering from 2012. This initiative involves large-scale pedagogical and technical staff development. Content is being modularised. Current lectures are being recorded and summarised for delivery using our new Moodle-based Personal learning environment. Asynchronous assessments and activities are being written and tested for individual and small group learning and community building. Simulations, visualisations and interactive experiments are being created and sourced to support practical skill development. Mahara ePortfolio systems are helping to engage students in reflection and support collaborative learning and career planning. Virtual classrooms provide regular synchronous Helpdesk consultations. The re-engineering process is creating a blend of traditional and cutting-edge learning experiences which is also re-energising our current face-to-face and regional teaching as well as satisfying the needs of a new cohort of students.

Keywords: engineering, OUA, Moodle, Mahara, Echo360; online, blended, practical, simulation

Changing demands, changing directions

Australia has a growing demand for engineers. The domestic supply continues to be low with Australian higher education providers graduating only half of the numbers of engineers required to meet our local demands (Pearce *et al*., 2010). In 2010 the Australian Government funded the establishment of the Australian National Engineering Task Force (ANET) to investigate and address engineering labour shortfalls that are constraining Australian innovation and growth (ANET, 2010).

Improving pathways into Engineering

Opportunities exist for Higher education providers to address this shortfall of engineering graduates by improving pathways to engineering programs and supporting retention of students (Godfrey & King, 2011). To improve pathways, the University of South Australia (UniSA) has recently developed an Associate Degree in Engineering (Hamilton & Dansie, 2011). Access to the program was broadened through supplementing standard entry mechanisms with the ATN engineering selection test (ATNEST). The program comprises four introductory courses to supplement prerequisites, eight common first-year courses and four specialisation courses from the second year of the students' preferred engineering stream. Opportunities to transfer to the full degree become available once students have completed at least eight Associate Degree courses.

Removing constraints in higher education

The Australian government provides funding to universities through the Commonwealth Grants Scheme (CGS). To provide more opportunities for people to study at university, in 2012 the limits on the number of students that universities can enrol in undergraduate programs will be revised to allow student enrolment numbers to be demand driven (DEEWR, 2011). Another change has allowed Open Universities Australia (OUA) to offer programs, rather than just units, and therefore attract CGS funding. Currently OUA does not offer undergraduate engineering units as part of its offerings. Late in 2010, OUA approved the development of the existing UniSA Associate Degree in Engineering for delivery through OUA from 2012.

Engaging staff in online learning

New tools

Over the last 3 years, UniSA has been progressively built a new Personal Learning Environment (PLE), called learn**online**, that comprises several fully-integrated components including:
- Moodle 1.9 as its Learning Management System (LMS),
- Copyright monitoring tools
- Turnitin anti-plagiarism (embedded in Moodle's Assessment module)
- Mahara ePortfolio
- Adobe Connect Virtual Classroom
- Echo360 Automatic Lecture recording system (LRS) and Personal Capture at desktop, and
- UniSA Program and Course Management system (UniSA, 2011).

By 2012, all components of learn**online** will be operational.

New processes

The learning objectives and assessment for each of the courses to be transformed are already approved and accredited and remain unchanged. Only the teaching and learning arrangements are being adjusted for OUA.

The processes being used to support the development of Associate Degree courses to OUA units include:
- a central team website incorporating course portfolios and links to development sites
- scheduled regular meetings with unit development teams
- the use of a project management documentation (Unit Development Plan, UDP)
- the use of a reflective ePortfolio to support staff development
- creation of a standardised website and presentation design for program (Figure 1)
- financial incentives and infrastructure support for each course coordinator
- facilitated content modularisation with existing course coordinators (Smith, 2008)
- support of an instructional designer and PLE expert for website building
- the employment of the senior tutor to support development of engaging learning activities to support the different stages of learning in the unit (Salmon, 2004; Conrad & Donaldson, 2011),
- facilitated capturing of live lecture materials
- preparation of accessible lecture summaries (scripted voice over PowerPoint)
- creation of eReaders of copyright compliant resources
- exploration of relevant simulations and experiential online activities
- creation of embedded Teachers notes wiki for each unit to support new teaching teams
- development of intensive face-to-face laboratory sessions where required for delivery in partner

universities in each State or approved workplaces or community settings
- ensuring copyright compliance of resources through training, support and audit
- creation of standard resources (e.g. self-readiness quizzes, unit logos, time budgets, guided web site tours) and communication protocols
- integrated formative and summative evaluation
- evaluation by current course coordinators for parity of learning outcomes and
- assessment of units by OUA against their rubric.

Implications

Much of the development processes used for OUA has capitalised on what we have learnt from experiences in our engineering programs (e.g. embedding of experiential learning opportunities (Duff *et al*., 2007), the use of social software (Quinn *et al*., 2008; Johnston, *et al*., 2009), reflective ePortfolios (Fielke & Quinn, 2009) and the creation of shared blended learning courses as part of the federally-funded Engineering Hubs and Spokes project with the Australian National University (Blackmore *et al*., 2010)).

Module 1: Getting Connected and Engineering Drawing

Welcome to our first module of study for *Computer Techniques*. By the end of this Module you will be established as a student in *Computer Techniques* (text books, study plan, orientation, nearby students and assessment) and aware of the expectations of you in this unit. You will have downloaded and installed the Computer-Aided Drawing tool, *SolidWorks*, and activated the licence on your computer and started to use it to solve engineering problems. You will have an introduction to the key concepts of engineering drawing standards for effective communication using various drawing views and terminologies, and tested yourself to see if you can do some of the mental visualisation techniques yourself.

> **Learning Goals/Outcomes**
>
> Upon completion of this module, the student will be able to:
>
> - Explain the requirements for success in this unit
> - Visualise mechanical, civil and electrical items into their geometric parameters
> - Use SolidWorks software to create a 3D solid model of the item.

Getting connected

Allow 3.5 hours to complete this group of activities

Aim: To form the inter-student connections and familiarise yourself with the requirements required to be successful in this unit.

Forum: Arrival gate and FAQ (30 min + 10 mins)
Lesson: Introduction (15 min)
Activity: Explore the web site (allow 2 hours)
Quiz: Self-assess your readiness (20 min)

Engineering drawing using SolidWorks

Allow 6.5 hours to complete this group of activities

Aim: To introduce the basic concepts and skills of using SolidWorks for Engineering communication. You will need to dowload, install and activate the SolidWorks software on your own computer.

Lectures

The lectures in Engineering drawing using SolidWorks consist of 2-3 lessons covering different topics. Each lecture is presented in a variety of formats including recordings from previous offerings of this unit, printable slides and a lecture summary.

Note that references may be made in the recordings to the on-campus version of this unit, Computer Techniques COMP1036, which has identical objectives and assessment to the OUA unit.

Worksheets for lectures in Modules 1-5 are provided. Print these out before accessing the lecture material. Complete the activities in the worksheet when prompted in the lecture. A worksheet solutions page will be released at the end of the week.

Lecture summary with audio (~15 mins)	Full Lecture (2 hours, recorded 2011)			Lecture slides
Play Flash	Play Flash	Play movie	Play audio	Print
for computers	for Computers on fast (high) and slow connections	for iPad/iPhone	for mp3 players	for offline reading

Activity: Download, install and activate SolidWorks 2010 (90 mins)
Tutorial: "Getting started with SolidWorks" and "Lesson 1: Parts" (60 mins)

Support resources

Forum: SolidWorks Questions and Answers Anytime
Helpdesk (Live tutor time, Wednesdays, 2-3 pm)
Text: Introduction to SolidWorks Guide

Assessment

Allow 30 mins to complete this group of activities

Aim: To assess your progress in Module 1

Quiz: Module 1 - Engineering drawing concepts (practice version)
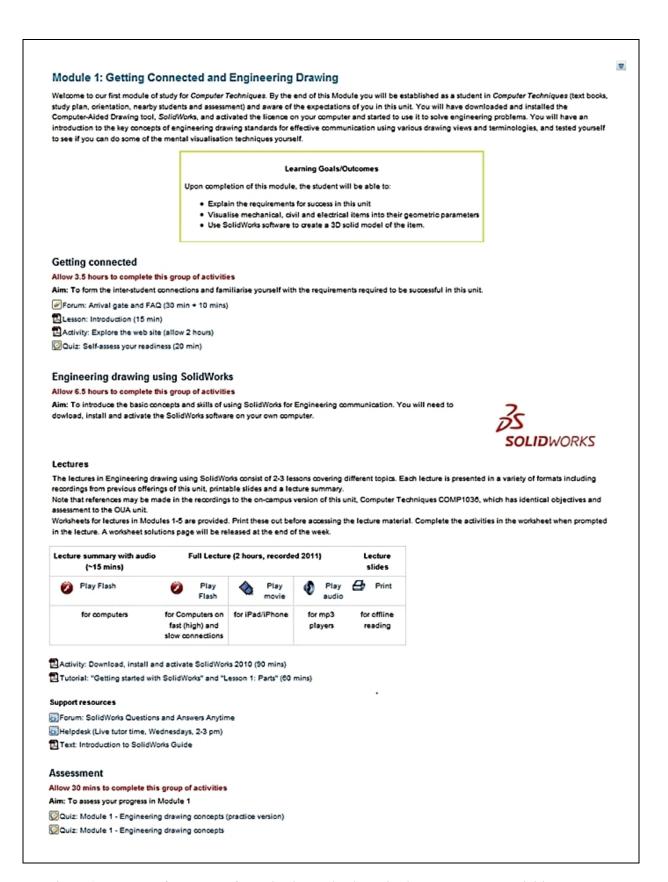Quiz: Module 1 - Engineering drawing concepts

Figure 1: Example of a module of learning in a unit with objectives, engagement activities, recorded lectures, learning activities, synchronous and asynchronous support resources and assessment

Ongoing staff development is a major component of the project. Engineering course coordinators have already been using aspects of the developing PLE for 18 months and our first year engineering teaching team has been

particularly encouraged to be involved in user group testing and pilots of the new integrations as they become available. The UDPs and learn**online** ePortfolio tool are being used to support unit development teams with their continuing development, especially around the redesign of practice-based learning and the creation of equitable and accessible learning experiences for online learners across all the units of the program. Staff and schools are also benefiting from the modularisation of learning process and appreciating that well designed learning modules can be reused in many different ways. Systems to develop and credential incoming tutors for facilitating online learning in engineering are being developed in time for first delivery of the OUA units in February 2012.

Our investment in online resource creation has already had a positive flow on effect for on-campus students as greater choice and flexibility becomes available for students to access their learning. Presentation quality in lectures for face-to-face students has also improved through simple changes such as standardized PowerPoint templates, mandatory voice amplification and minimisation of white board use in large lecture theatres.

Our students studying engineering at our regional campuses are also benefitting from the transformation process through the development of new online course materials and trials of new learning activities and communication systems. It is possible that our regional commitments in engineering may permanently shift to largely online provision, replacing the hardware-focused videoconferencing approach that currently requires duplication of lecturer effort.

Ultimately, this re-engineering process will help Australia address its shortfall in engineers as greater numbers of students, who would normally have been excluded from, or delayed their engineering education because of work or family commitments, will now be able to commence on a pathway to an engineering degree. Coupled with improved admission procedures through the ATNEST and changed Higher Education Policy, this initiative is a positive step towards addressing Australia's engineering skill shortage.

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