Abstracts

M21A: Approaches to learning Sustainability

Chair: David Hood, Engineers Australia — Monday 10:30-Noon, Sirius Room

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Abstract

Sustainability is essential part of engineering practice, but its integration in engineering degree curricula is still a work in progress. This panel session will present strategies for embedding sustainability into engineering degree programs, in particular moving beyond the paradigm of simply adding a "Sustainability" subject in the middle years.

M21B: Chartered Status: Updating the Stage 2 Competencies

Chair: Michael Bevan, Engineers Australia — Monday 10:30-Noon, Sirius Room

Michael Bevan

Engineers Australia

Abstract

Throughout 2011 Engineers Australia has been reviewing the Stage 2 Competencies required for achieving Chartered Status.

This presentation will address the changes that have been made, and articulate the updated pathway to CPEng.

M22: Thresholds and pathways to Engineering

Chair: P. John Williams, The University of Waikato, NZ — Monday 10:30-Noon, Pleiades Room

Experience and expertise: Is it all that good?

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Abstract

This paper discussed the impact of experience and expertise on problem solving performance. Interview responses from 22 novice to expert engineers were considered in this paper. The results suggested that experience and expertise though favourably viewed can impact the problem solving process adversely especially when facing new problems.

The two main areas discussed in this paper are the impact of experience and expertise on problem identification and learning. Prior experience and expertise may result in narrow problem diagnosis. Expertise may also slow down learning impacting skills and knowledge development. We propose that open-mindedness and self-efficacy can help to negate these detrimental effects. Findings in this paper can add to existing theories on the education and on-going professional development of engineers in the field of innovative problem solving.

Some potential underlying threshold concepts in engineering dynamics

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Abstract

Engineering academics have a responsibility to continuously improve the educational experience of their students. One approach is to identify the critical thresholds that students need to pass through. As part of an international project, we are using threshold concept theory to improve engineering education. Threshold concepts are transformative in nature and open up pathways to future knowing, but they are potentially troublesome for students to master. By first identifying and investigating the first and second year engineering threshold concepts, we are esigning our curriculum to optimise the transformative experiences that will help our students become engineers. This is the first global study of first and second year thresholds across all engineering disciplines. In this paper we discuss the process we have developed to identify threshold concepts using some examples. The process involved a Divergent Phase in which many

potential threshold concepts were identified and an Integrating Phase in which underlying threshold concepts were identified. Underlying potential threshold concepts discussed are: conservation principle, vectors and vector calculus, system identification and definition, and temporal and spatial frames of reference. These are required for

dynamics and also more generally in engineering. The findings support the significance of spatial visualisation and modelling. The inventory of threshold concepts continues to evolve as the concepts are negotiated across disciplines and universities.

Mapping student approaches to learning within a civil engineering program

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Abstract

Most civil engineering programs include a broad curriculum covering a range of relevant engineering and generic skills, combined with a range of teaching and learning environments. This provides both the breadth and the depth of civil engineering knowledge required by graduates to practise as "work-ready" professional engineers with an appropriate level of specialisation. The approach to learning adopted by students will have a strong influence on their ability to act as "life-long-learners". Integration of courses within the engineering program is one way to improve student performance by motivating them to move beyond surface approaches to their learning. However, the learning approach adopted by students varies from course to course depending on the student's perception of the teaching and learning environment. This paper describes an investigation into the way in which students approach their learning across a civil engineering program. A survey of students has been undertaken to identify where students adopt deep and surface learning approaches. The variation in the way students approach their learning has been investigated across all years of the program, as well as within year-based cohorts of students. The study has identified opportunities within the program to facilitate the development of "life-long-learner" skills by students.

Identification of threshold concepts involved in early electronic engineering: Some methods and results

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Abstract

This manuscript reports the Threshold Concepts (TCs) identified in early circuits & electronics courses through our work to date. We suggest some novel methods used to quantify the identification. We identify some concepts that ought to have been mastered in high-school physics courses but that are often absent from student repetoires. This may be a confusing factor for us and a source of trouble for students.

An evidence-based predictive tool for motivating engagement, completion, and success in freshmen engineering students

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Abstract

In general, teachers deploy several methods to encourage their students to engage early with their learning during their course of study. These methods include: presentation of previous years' pass/fail rates; feedback from previous students; and anecdotal evidence suggesting that active engagement, punctuality in attending lectures, and good performance in interim assessments will contribute to success. We postulate that engineering students will be more inclined to improve their behaviour if they are provided with quantitative evidence that adopting certain behaviours will enhance success and improve course grades. Furthermore, we postulate that students will embrace a conceptual and logical tool that allows them to take control of the course outcome they seek. A tool based on these principles has already been accepted and used enthusiastically by some students in another department at Unitec(Mellalieu, 2011).

Inspired by the success of this approach, we have conducted a data mining analysis of previous students' class attendance and assessment performance records to develop a similar tool for a freshman course within an undergraduate engineering programme at the same institution. The model underpinning the tool demonstrates empirically that better attendance in lectures and higher performance in interim summative assessments are associated with higher final examination results. Furthermore, the tool enables the lecturer to achieve early detection of 'at risk' and struggling students who may not achieve successful course completion without a significant intervention by the teacher, and/or change in behaviour by the student. At Unitec, a conscious effort is made to attract to engineering education students from communities whose participation hitherto has been low. Identifying and following up those who may be experiencing difficulties is crucial for their retention and maintaining diversity. All New Zealand tertiary institutes are now increasing their focus on successful completions (outputs) rather than the number of enrolments (inputs). The tool described is one useful approach to providing necessary and timely additional support to students at risk of failing to complete.

M23: Inclusivity teaching strategies

Chair: Llewellyn Mann, Swinburne University of Technology — Monday 10:30-Noon, Carnac Room

The impact of curriculum content in fostering inclusive engineering: data from a national evaluation of the use of EWB projects in first year engineering

Lesley Jolly[1], Caroline Crosthwaite[1], Lyn Brodie[2], Lydia Kavanagh[1], Laurie Buys[3]

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Abstract

The year of Humanitarian Engineering draws our attention to the need to develop engineers who are not just technically competent but who can effectively address the needs of communities, maintain their ethical responsibilities, and take sustainability into consideration. This is what we understand by inclusive engineering. One approach to introducing such considerations into the curriculum has been the widespread use of Engineers Without Borders (EWB) projects in development settings as first year learning opportunities. We are evaluating different uses of these projects in 13 universities around Australia and New Zealand using a program logic data gathering methodology and a critical realist analytic approach to answer the research question "what works for whom under what circumstances?" In this paper we will concentrate mainly on one of these sites The University of Queensland. Data reveals that the EWB projects have great potential for raising issues of community involvement, ethics and sustainability but that the content of projects alone cannot guarantee that such objectives are addressed. Contextual factors, including: the focus of the course (e.g. professional development versus design), the attitudes of staff, and the pedagogy used all contribute to the successful pursuit of non-technical objectives. Projects with little obvious humanitarian or inclusive content such as one for long-wall supports in mining were found to foster context-sensitive approaches. In addition to project content, educators who are seeking to develop humanitarian and inclusive engineers need to pay attention to consistently expressed goals and values amongst the teaching team and the alignment of assessment (in style and weighting) with clearly stated learning goals.

It only took 2 clicks and he'd lost me: Dimensions of inclusion and exclusion in ICT supported tertiary engineering education

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Abstract

Current conceptualisations of the digital divide have broadened beyond the notion of 'haves' and 'have nots' to include a more multifaceted perspective in which individuals and the contexts in which they learn are explicitly considered. This paper reports on a qualitative case study of a compulsory Engineering foundations course at a tertiary institution in New Zealand.

The course provides a broad introduction to engineering concepts, with particular emphasis on

problem solving, the design process, and use of 3-dimensional computer-aided design (CAD) software. Findings illustrate and illuminate the multidimensional nature of information and communication technology (ICT) inclusion/ exclusion and are described within three themes –technological, conceptual, and aspirational/ professional. Implications are presented for course designers and lecturers interested in providing more inclusive learning environments.

A pathway to regional engineering

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Abstract

This paper discusses engineering in a regional context and the pathways to engineering inclusivity. The Bradley "Review of Higher Education" stated that Australia's higher education was falling behind the OECD countries and recommended "to set a national target of at least 40% of 25- to 34-year olds having attained a qualification at bachelor level or above by 2020." The report identifies specific difficulties in achieving these goals in regional areas and recommends remedies at regional universities to increase the number of professional people living and working in regional Australia. This paper outlines the approach taken at La Trobe University's Bendigo campus to interest and attract potential mathematics/science students in the region to the Civil Engineering course. The paper then discusses how inclusive processes in the engineering curriculum and engineering socialisation have been developed. The paper concludes with comments about the future directions of the course.

Questions arising from the use of peer assisted learning as a technique to increase diverse participation in engineering education

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Abstract

A program of peer assisted study sessions (PASS) was piloted in the second half of 2010 in two first year engineering courses catering to both on-campus and distance students. The student cohort concerned is a diverse cohort of students, a large percentage of whom are non-traditional higher education students accessing the course through distance education. The PASS program was implemented in both traditional face to face on campus sessions as well as in an online mode, which was intended to partially address issues of inclusivity and access to peer support for this diverse cohort.

The program was evaluated using a program logic approach. The evaluation confirmed that participants experienced all of the benefits generally associated with peer assisted learning programs: improvements in learning attitudes and skills, increased focus and motivation, mastery of course content, increased confidence and a positive attitude towards faculty.

Despite the positive results of the evaluation it was noted that the participation rates by students were low, particularly for the online version of the program. Several questions were raised by the evaluation through the dichotomy of positive perceptions and outcomes and the relatively low uptake of the program. This discussion paper reports on the initial stages of a qualitative research project investigating the effectiveness of online peer assisted study sessions for engineering students.

Developing an inclusive stakeholder consultation process: A case study

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Abstract

One of the two aims of the Australian Learning and Teaching Council (ALTC) funded Define Your Discipline (DYD) project is to develop an efficient, inclusive, simple and systematic stakeholder consultation process that can be used by discipline stakeholders to define their discipline. During 2010 the DYD stakeholder consultation process was developed and then trialled nationally to develop a draft set of Graduate Outcomes for the environmental engineering discipline.

The first part of the paper describes the DYD stakeholder consultation process which uses both divergent and convergent strategies to ensure that the individual voices of the participants are captured, as well as group perspectives. Data was gathered on the tasks undertaken by graduates during their first two or three years of practice. Once the 2010 stakeholder consultation workshops had been completed the data were synthesised to define a draft set of Graduate Outcomes for the discipline. Two different types of workshop are being used during 2011 to refine the draft set of Graduate Outcomes.

Throughout this process each outcome remains linked to all of the identified tasks from which it was derived, and the people who submitted those tasks. Thus, the project team can review the importance of the contributions from the various groups of participants (such as academics, graduates and practitioners) as well as some of the characteristics of those groups such as location, and gender.

The second part of the paper discusses the feedback received from members of the stakeholder groups who participated in the DYD stakeholder consultation process: 50 of the 110 workshop participants; the project team; and the client - the Environmental Engineering College Board. Overall, the feedback from all parties was very positive. The feedback from the 2010 workshops was used to fine-tune the DYD consultation process for the 2011 workshops.

M24: Transitions and sustainability of learning

Chair: Janis Swan, The University of Waikato, NZ — Monday 10:30-Noon, Garden Room

School OASIS: Virtual outreach - facilitating the transition to university study

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Abstract

Too few people are choosing engineering careers, and many engineering faculties are attempting to address this problem by reaching out to schools. This paper describes how a home-grown, web-based software tool, already used successfully in university-level engineering courses, is being modified for high-school use. The software package, OASIS, comprises a large question database and server-side program that delivers individualised tasks, marks student responses, supplies prompt feedback, and logs student activity. OASIS can be used for both skills practice and formal assessment. Because the Web server carries out all processing, students need only a computer with internet access and a standard browser, making OASIS well suited to student-centered and distance learning.

Using e-tutor program and pre-lab assessment task to enhance laboratory experience of civil engineering students

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Abstract

Before attending a lab session, students are usually required to be familiarized with laboratory tasks through pre-lab preparation. While it was found pre-lab preparation was an effective way to promote student learning, the benefits of running pre-lab preparation were not fully investigated. Traditional lab description sheets may provide general information on safety operation procedures and pre-lab questions. However, if these pre-lab questions were not assessed, they could easily be ignored by students. In this research, pre-lab problems were designed to give unique parameters to each student. Students were required to solve the problems and obtain theoretical values which were verified later in a practical lab session. To minimize the marking load, the pre-lab submissions were automatically marked using the e-tutor program. Results showed that the pre-lab preparation program was successful in enhancing students' learning interests, in preventing plagiarism, and in increasing the efficiency of labs with the duration of a lab session being significantly reduced.

Improving learning outcomes and sustainability through new laboratory infrastructure

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Abstract

A set of advanced networking laboratory rooms have been designed and built as part of Swinburne University of Technology's new Advanced Technology Centre (ATC) to facilitate the learning of both fundamental and advanced networking concepts and to ensure that students attain conceptual, design, professional and social skills. The main aim is to give students a more realistic network experience, which is achieved through increased access to equipment, and increased flexibility in how equipment can be utilised. This facility allows students to dynamically connect various computers within the room to different physical networking devices through the use of virtual networks. Multiple devices can be interconnected, both within and between enclosures. Overall power consumption is reduced through the use of managed power cycling and end-host virtualization. This paper outlines the physical, logical and teaching rationale behind the design and construction of the laboratory environment. We discuss the use of virtualisation to establish multiple hosts per kit of equipment and its implications on sustainability.

Using Twitter to enhance reflective practice on work placements

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Abstract

Reflective practice is an essential engineering skill for life-long learning.

However, most engineering students regard reflective practice as an onerous chore and do not find any value in doing it. Previous research for trainee teachers on practicum showed that microblogging (e.g Twitter) is a helpful tool for encouraging reflective practice. Tweets are kept short to 140 characters forcing students to be concise.

Because large amounts of text are not required, it is easy for students to blog about their experiences and give and receive feedback. Twitter can be accessed by SMS from mobile phones as well as through the internet. A cohort of 12 volunteers were obtained from third to fourth year mechanical, materials process and biochemical engineering students.

These students created private Twitter accounts using pseudonyms and were given training in using Twitter. Participants were instructed not to reveal information that was commercially sensitive. Students were encouraged to tweet once a day on the following:

What are you doing? What are you learning? What would you like to learn? What equipment/ software are you using? Are you having any difficulties? And what are you enjoying? Tweets were visible to all involved in the project and the researchers and participants were able to give feedback, support, and prompting questions. Tweets were analysed for common themes, how well students were supporting each other, and howmuch integration between placement and university knowledge appeared to be occurring.

Participants were interviewed after their placements to ascertain their views on Twitter and reflective practice. Findings show that students used Twitter regularly. They shared information, gave each other support and commented on what they were doing from day to day. The work placement coordinators could see what the students were doing and give support and feedback.

Effectiveness of formative online quizzes in learning and teaching a structural engineering course

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Abstract

Formative assessments in the form of online quizzes are currently being introduced by several lecturers in order to enhance the students' learning experience and student engagement. Previous research has shown that the use of weekly online quizzes facilitate the students learning especially to resolve problems with weaker students under-performing in particular courses. The online quizzes have been adopted by others to provide flexible assess to self-paced interactive study materials and to self-assess the progress of study for on-campus teaching. While the online or paper-based quizzes are effective in on-campus delivery as reported elsewhere, they become very valuable tool and imperative especially when the courses are offered in dual-mode delivery (on-campus and external) in a flexible online environment as offered at University of Southern Queensland. Online quizzes are considered to be effective learning tools as formative assessments especially to those students who choose to learn through independent mode of study as they can give instantaneous feedback regarding their progress in understanding the key-concepts. Are these formative assessments increase the students' overall performance in their summative assessment where students are required to demonstrate their understanding through assignments and exams? While some studies reported that students who elected to use online quizzes performed better in summative assessments, there are others reporting there is no correlation between the performance in formative quizzes and the subsequent performance on summative assessments. In this study, we evaluate the overall performance of the students in a higher level structural design course where self-assessment quizzes were made available as formative assessments through the Moodle learning management system. Four years of data has been investigated to determine the effectiveness of the online quizzes to their learning of the course. The results showed there is a strong correlation between students who attempt the quizzes and their overall student performance assessed by final grades. The challenges in delivering the quizzes in flexible environment and increasing the student participation are also discussed. This paper will further discuss the important aspects that need to be considered when developing well formulated quizzes for technical courses and thereby maximising their potential as an effective learning and teaching tool.

M25: Engaging with community

Chair: Prue Howard, Central Queensland University — Monday 10:30-Noon, Rottnest Room

Professional ethics education in engineering

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Abstract

There is much debate surrounding professional ethics education, in particular surrounding the question of whether professional ethics can be taught at all (Steneck, 1999; Bauer and Adams, 2005). Professional ethics instruction in engineering is commonly conducted by examining case studies in light of the code of conduct of a suitable professional body. Although graphical presentations of spectacular failures, sobering stories of the repercussions and the solid framework provided by the tenets of a code of ethics may leave a lasting impression, students generally gain their professional identity from relatives and colleagues (Loui, 2005). Their professional ethics tend to be mostly an extension of their personal ethics. Instruction on ethics generally serves only to reinforce students' inclination to act ethically and provides encouragement to act on these beliefs. In this study a survey was conducted (n=576), based on the work by O'Clock and Okleshen (1993), examining the personal ethical perceptions of engineering students. The survey measured how engineering students perceive their own ethical beliefs and how they perceive the ethical beliefs and actions of their peers. As a learning exercise, students were then challenged by examining their personal ethical beliefs in light of the professional ethics requirements of the IEAust code of conduct. After familiarisation with the Engineers Australia code of ethics, students were also invited to comment regarding their beliefs regarding adherence to this code.

Understanding the community: getting engineers on track

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Abstract

It is vital for engineers to develop an understanding of the community or industry they are working in or with and its values. Engineers seeking to be involved with communities without awareness may not create successful outcomes. This research reflects on work within the rail industry and how that culture resists the adoption of simulator technology. The paper details how using a theoretical framework for understanding culture can elucidate why any culture adopts a technology successfully or not.

Making ethical engineers: Engineers for Social Responsibility

Lawrence Carter

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Abstract

Research reported in the literature shows that students who engage in unprofessional conduct are more likely to face subsequent censure as practising professionals. There appears to be an opportunity within engineering education to influence the ethical behaviour of engineers. Engineer for Social Responsibility (ESR) was founded in 1983 at the height of concerns about the effect of nuclear weapons, and engineers' responsibility for their production. It has broadened its remit to include any impact of engineering on people or the environment, and acts in many ways as the 'conscience' of the engineering profession in New Zealand. ESR maintains a separate but working relationship with the Institution of Professional Engineers New Zealand (IPENZ), and has helped formulate the IPENZ Code of Ethics. More recently it has introduced the Engineers' Affirmation, an equivalent of the Hippocratic Oath for engineers. It is proposed here that engineering schools ask undergraduates to sign and display the Engineers' Affirmation during their undergraduate programme, as part of their professionalism training, and in an attempt to reduce unprofessional conduct. The effect of adoption of the Affirmation could be measured.

Learning conceptual design using a community development project in Papua New Guinea

Graham Moore

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Abstract

Humanitarian engineering comes in many forms. This paper describes a case study of how an engineering design subject was transformed by basing the assessment on a call for funding for a development aid project. This, in conjunction with the opportunity for students to participate in an extra-curricular site visit to the community of Ilahita in Papua New Guinea which was the target of the project form a learning environment where students were extremely highly motivated to engage in humanitarian engineering. The case study presented is not intended to be a report of a carefully conducted piece of educational research, but to tell a story about a series of events that led to an extremely rewarding educational and life experience for the students and academic involved. Guidance on what are considered some essential aspects of organising a humanitarian engineering project involving a student site visit is given.

Community engagement in engineering education

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Abstract

Public infrastructure development projects such as dams, weirs and bridge construction – all require community engagement at least in planning and construction stages of the projects. All such projects need to do a mandatory or a voluntary environmental impact assessment (EIA) before resuming the construction activities.

Engineers play a vital role in delivering these projects and they need to engage the community during the project planning, design and construction period, even sometimes during the project operation period. Hence they need to learn the principles and processes of community engagement through to a proper training and/or education course at post graduate or undergraduate engineering education. The purpose of this paper is to give an outline of key principles and processes of community engagement and to identify the importance of community engagement contents into the engineering curriculum.

Workshop M31: Rebuilding bridges: Engineering education and engineering practice

Chair: James Trevelyan
Monday 13:00-14.30, Sirius Room

James Treveleyan

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Abstract

Engineering practice is widely misunderstood in engineering schools: few if any staff members have extensive commercial industry experience beyond short periods (5 years) in technical specialist positions or R&D laboratories.

An almost complete absence of systematic research on engineering practice published in media readily accessible to engineering educators is a further factor. Engineering graduates take 3-5 years of professional development and guidance to become effective engineers in commercial practice, many take much longer, and many leave in frustration. Engineering firms have much to gain from increased productivity by helping to shape engineering education in ways that improve graduate abilities to transition faster to successful commercial practice.

Stated Learning Outcomes

LO1 Employment outcomes for engineering graduates in Australia in recent years

LO2 Graduate professional development: results of longitudinal study of UWA graduates

LO3 Australian engineering competency requirements

Workshop M32: Universities Working in Collaboration with Developing Communities

Chair: Dan Loden
Monday 13:00-14.30, Pleiades Room

Daniel Loden, Julian O'Shea & Jenny Turner

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Abstract

Universities across Australia and New Zealand are a phenomenal repository of knowledge and skills that could be easily harnessed to support developing communities to meet their self identified needs. Engineers Without Borders Australia (EWBA) works in partnership with the university sector, corporate organisations and developing communities. There have been a number of examples of collaboration between universities and communities which are mutually beneficial to both organisations and have included the corporate sector as well. However there is still extensive opportunity to expand this collaboration for the betterment of all involved.

The objectives of this workshop are 1) Provide examples of existing collaborations taking place between universities, communities and corporate organisations across the sector 2) Identify the skill sets of the academic community that could be harnessed to support developing communities 3) Identify potential funding sources to support the further development of these program.

This workshop will be explained within the context of the existing EWBA University partnership model.

Stated Learning Outcomes

LO1 Understand the details of the existing collaborations occurring within the engineering education sector.

LO2 Identify the academic skill sets which will be relevant to working with Developing communities.

LO3 Identify potential funding sources to support this work beyond the conventional avenues of engagement.

Workshop M33: Have Your Say: future priorities for engineering educator support

Chair: Robin King
Monday 13:00-14.30, Carnac Room

Robin King & Wageeh Boles

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Abstract

The ALTC is currently funding the Australian Council of Engineering Deans (ACED) together with its counterpart in Information and Communications Technology (ACDICT) to formulate and provide a system-wide, discipline-based support strategy. Specifically, the Discipline Support Strategy for Engineering & ICT (DSS) is rolling out a program of 2-day workshops on pedagogy and curriculum design and assessment, aimed primarily to support new academics, and a program of workshops and other forums to disseminate outcomes of other, mostly ALTC-funded, projects. These programs will be continued through 2012 to mid-2013 initially as an ALTC Discipline Network program, entitled "The Australian Engineering & ICT Education Support Network". For individual academics' personal and professional development, such supporting programs are useful only as far as they encourage participation, and meet their participants' needs. During 2011-12 the ALTC National Teaching Fellow will be working actively with the engineering education community on assessment strategies for the agreed outcome standards, and develop supporting materials. This important activity will provide further insight into the educators' needs. Whilst the operating context for funding national discipline-based support projects (post-ALTC) is unknown, having informed engineering educator community input at this time will assist to frame the thinking of those who are likely to be involved in formulating and leading future initiatives in engineering education.

Stated Learning Outcomes

LO1 the facilitators will learn the short-term and medium needs of the community

LO2 educators will learn the extent to which their concerns and priorities are shared with others

LO3 both may learn about industry's views on education development priorities

Workshop M34: Collaborative Learning, Assessment and Feedback

Chair: Keith Willey
Monday 13:00-14.30, Garden Room

Abstract

You may have heard the old saying "what gets assessed is what gets learned". If assessment is our chief motivator in determining what and how students learn it is a wasted opportunity if we only use it to measure what students have learnt. Assessments should be designed to motivate learning. In addition, it could be argued that mistakes compress learning, hence we should provide opportunities for students to make mistakes, receive feedback, reflect and be tested again in various contexts. Students need to be involved in the assessment process to develop their critical evaluation skills and judgement. Collaborative learning activities have the potential to both improve learning outcomes and prepare students for workplace learning through processes that are often both informal and collaborative. To improve learning, scaffolding should be provided to promote a positive learning disposition in students, assisting them to take more responsibility for their own learning and focus their attention on learning rather than strategically collecting.

Workshop M35: Improving Students' Transitions through Engineering Thresholds

Chair: Sally Male
Monday 13:00-14.30, Rottnest Room

Sally Male, Caroline Baillie, Dianne Hesterman, Jeremy Leggoe, Cara MacNish, James Trevelyan & Carolyn Oldham

University of Western Australia

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Abstract

Threshold concept theory is a major theory in higher education. It provides a theoretical framework with the potential to help academics improve engineering education by focusing teaching, learning, and assessment on the concepts that are transformative and troublesome for students. We are undertaking the first investigation globally to identify the threshold concepts in foundation engineering programs across all disciplines of engineering. For the purpose of this project, foundation engineering programs are the first and possibly second years of undergraduate engineering programs. The research project encompasses identification and investigation of engineering thresholds at the foundation level, development of a methodology to achieve this, and development of a guide for engineering academics on curriculum renewal using threshold concept theory. This short workshop is a taster for the national series of dissemination workshops on engineering curriculum renewal using threshold concept theory.

Participants will be introduced to threshold concept theory and the working inventory of foundation engineering threshold concepts we have identified and investigated. With this inventory as a framework, participants will investigate ways to renew their engineering curricula.

At the end of the workshop, participants will think about engineering education differently, and be well-equipped to implement immediate and long term improvements to focus their teaching, assessment and curriculum design using threshold concepts as a framework.

Workshop M41: Rebuilding bridges: Engineering education and engineering practice (continued)

Chair: James Trevelyan
Monday 15:00-16.30, Sirius Room

James Treveleyan

The University of Western Australia (Australia)

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Abstract

Engineering practice is widely misunderstood in engineering schools: few if any staff members have extensive commercial industry experience beyond short periods (5 years) in technical specialist positions or R&D laboratories.

An almost complete absence of systematic research on engineering practice published in media readily accessible to engineering educators is a further factor. Engineering graduates take 3-5 years of professional development and guidance to become effective engineers in commercial practice, many take much longer, and many leave in frustration. Engineering firms have much to gain from increased productivity by helping to shape engineering education in ways that improve graduate abilities to transition faster to successful commercial practice.

Stated Learning Outcomes

LO1 Employment outcomes for engineering graduates in Australia in recent years

LO2 Graduate professional development: results of longitudinal study of UWA graduates

LO3 Australian engineering competency requirements

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M42: Using Aptitude Tests to Engage Students in Engineering

Chair: Colin Kestell, The University of Adelaide — Monday 15:00-16.30, Pleiades Room

Lost in transit: Exploring the first-year domestic and international student experience

George P. Banky, David Richards & Aaron S. Blicblau

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Abstract

Research by others has shown that student attitudes and approaches to tertiary learning have significant dependence on their expectations of university study. An aim of the pilot project detailed in this paper is a better understanding of learning issues faced by first-year domestic and international students transitioning from secondary to tertiary education. An anonymous survey of student expectations of both the university environment and their approach to learning during their first year at university was implemented. Over 160 students responded to a series of close-ended questions some of which used a 5-point Likert scale. Analysis of the results indicated that students perceived themselves to be well prepared for teaching styles and learning at university. After one semester of study the majority did not perceive a change in the majority of their learning skills. However, for three of their learning skills, the international students' responses indicated a perceived loss of ability. International students lacked the skill of using problem-solving as a learning tool. These outcomes highlight the need for more targeted orientation of students who are about to commence their tertiary courses.

Building Successful Teams: a pilot intervention embedding inclusive team skills in an undergraduate system analysis, design and project management course (SADPM)

Elena Sitnikova, Patricia Kelly and Diana Collett

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Abstract

This paper discusses a pilot intervention aimed at embedding team buildingskills within System Analysis, Design and Project Management, a second year multidisciplinary course at the University of South Australia. The aim was to help students recognise the behaviours that exclude or include others and thus enhance their life-long capacity to work effectively in diverse groups. The intervention developed through collaboration between the course coordinator, industry mentor and tutors, an academic adviser and a student counsellor. The paper uses the teaching team's contributions and reflections to identify challenges and provide insights from their different perspectives. The results of this study are surprising, with lessons learned for future interventions to increase the communicative capacity of students working in diverse teams.

Is collecting anonymous but code-identified intervention assessment data worth the effort? Reflections on a recent study in electronics

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Abstract

Often the effectiveness of an educational intervention for a large lecture group is assessed by testing the cohort before and after the intervention and measuring any improvement in the aggregated data from pre- to post-testing. A limitation of this method is that not all students may attend the pre-test, post-test or the lectures where the intervention is administered, diluting the significance of the results. An alternative approach is for students to use a unique but anonymous research code that allows researchers to 'tag' each individual student and hence identify those students who participate in all intervention activities and tests ('complete responders'). This paper argues that tagged data can increase the statistical significance of an intervention hypothesis when compared to untagged data even when the statistical sample is small. In a recent study that tested the efficacy of interactive lecture demonstrations (ILDs) in improving students' conceptual understanding for an advanced topic in electronics (AC resonance), the 'complete responders' formed a relatively small subgroup (N=21) of the full group (N=86) that participated in all or only some of the activities or tests ('all responders'). The learning gains for the 'complete responders' were more significant than those of 'all responders'. The reasons for the increased significance are discussed in this paper.

On improving educational outcomes for Indigenous Australian students

Peter O'Shea[1], Bouchra Senadji[1] & Slava Kalyuga[2]

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Abstract

Improving representation and success among equity groups is an important task, and one that deserves to be informed by evidence. This paper looks at the evidence on what impacts positively on educational success rates for Indigenous students. It is seen that aspirations and expectations have a major impact, as do the types of learning modalities and personal relationships. Recommendations for improvement are made based on this evidence. The paper also discusses the QUT experience in improving Indigenous student outcomes.

Gifted first year engineering students: curriculum preferences

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Abstract

As first year engineering classes expand with a first year cohort of increasingly diverse abilities, aptitudes and achievements, designing the appropriate level of challenge and support for all students, especially the gifted and talented, is a difficult task. This paper reports on a study that surveyed first year engineering students at one Australian university to determine the curriculum differentiation options preferred by the students and compared the preferences of gifted and talented students with their peers. The top five options chosen by the students are presented. A greater consistent engagement with the engineering workplace was clearly sought.

M43: Constructive Alignment: Perceptions, Approaches and Outcomes

Chair: Frank Bullen, University of Southern Queensland — Monday 15:00-16.30, Carnac Room

Project management skills for engineers: industry perceptions and implications for engineering project management course

Kriengsak Panuwatwanich[1], Rodney A. Stewart[1] & Kali Prasad Nepal[2]

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Abstract

It is well established that projects play an important part in all engineering sectors and successful projects require effective project management (PM). For professional engineers in Australia, PM forms part of a standard competency specified by Engineers Australia. It has also become a standard component of engineering programs offered at most Australian universities. Nonetheless, there are not enough studies on specific project management skills, which engineering graduates are expected to learn and effectively apply in a project work environment, to help deliver a better targeted and more relevant project management course. The main aim of this research is thus to identify essential PM knowledge areas that engineering graduates require in their early career, with the outcomes expected to provide implications on the design of engineering project management (EPM) courses. The research was achieved through an online survey, which seeks input from industry practitioners and was partly developed using the details of PM knowledge areas provided in the Guide to the Project Management Body of Knowledge. The results from the survey of 30 practitioners showed that project scope management, project time management and project cost management were the three most critical areas and perceived as the areas where graduate engineers may require more improvement. The results further highlighted that such PM knowledge areas should require more emphasis within EPM courses taught to undergraduate engineering students.

Faculty Use of Research Based Instructional Strategies

Maura Borrego and Stephanie Cutler[1], Jeff Froyd[2], Michael Prince[3] & Charles Henderson[4]

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Abstract

Over the last 20 years, significant investments (individual, institutional, state, and federal) have been made to improve engineering education. Multiple Research Based Instructional Strategies (RBIS) have been developed and shown to improve student learning. In order to assess engineering faculty members' awareness and use of these strategies, a survey was developed and distributed through chemical and electrical engineering professional societies targeting academic staff teaching core required courses. Just over 200 electrical and chemical engineering faculty in the US completed the survey. Results show that faculty members most commonly learn about RBIS from colleagues (18%). 98.6% of faculty report knowledge about one or more of the 12 RBIS asked about in the survey. 82.1% of faculty report use of one or more of these RBIS. The most common reason given for non-use was the fear that these strategies would take up too much class time.

Teaching via video conference – comments and observations and the attainment of graduate attributes and learning outcomes

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Abstract

The author taught an engineering course at the School of Engineering and Information Technology; University of New South Wales at the Australian Defence Force Academy, when the author was on an exchange posting at the United States Air Force Academy, Colorado Springs; Colorado. This paper describes the method of teaching this course via video conference. In this instance, teaching via video conference is markedly different to the techniques employed in distance education. This paper will describe the experience of teaching via video conference as well as some of the perceived shortcomings and pitfalls of being a 'talking head'. The paper also describes some of the techniques developed in order to ameliorate some of the perceived difficulties of teaching via video conference. The results of a student questionnaire and the overall learning outcomes will be discussed with reference to University of New South Wales, Canberra and Engineers Australia graduate attributes.

Remote laboratories: enhancing accredited engineering degree programs

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Abstract

Remote laboratories have been subjected to considerable scrutiny, as to their place in educational programs, since their original use in the early 90's. Since this time they have been the focus of academic research, and subsequent reviews, which show that they have potential advantages over traditional laboratories when correctly used. While these advantages are generally understood and agreed on, there is still some concern as to the impact they might have on the accreditation of existing programs. The body responsible for accreditation in Australia, Engineers Australia, takes a holistic approach to the accreditation of academic programs. In order to receive accreditation a program must satisfy all criteria within Engineers Australia's categorical assessment. This paper uses a criterion-by-criterion analysis to show that remote laboratories have no negative impact on any of these criteria and in some cases actually have a positive impact. Therefore the accreditation of academic programs containing remote laboratories are just as likely to have a positive outcome, assuming the laboratory is designed to embody the guiding pedagogical principles of the program in question.

Occupational Health and Safety: An expected learning outcome of Civil Engineering Graduates

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Abstract

The high number of fatalities in the construction industry shows the needs for improvement in Occupational Health and Safety (OHS) measures. Civil Engineers, being regarded as a member of 'top tier' management in construction projects, are prone to have knowledge of OHS procedures and regulations. However, OHS training is not always integrated in engineering education. This paper identifies the need to incorporate the teaching and learning of OHS in Civil Engineering education, and proposes that the knowledge of OHS is an expected learning outcome of Civil Engineering graduates.

Since 2010, The Department of Civil Engineering at Curtin University has recently incorporated OHS topics in a construction management unit of its undergraduate course. To test OHS awareness, pre- and post-lecture questions relating to the basic knowledge of OHS in construction practices, laws and legislations have been distributed to the students in a class of final year students. The answers to the pre-lecture questions are used as the key indication of the weakness and strength in the knowledge and the perception of the students regarding OHS in construction. The lecturer can also use this information to deliver the lectures more effectively towards the expected learning outcome of the topics. The answers to the post-lecture questions provide excellent feedback on the teaching and learning effectiveness. This paper will present the analysis of the answers to the pre- and post-lecture questions based on the contents that are deemed necessary and important for the students to possess the basic knowledge, attributes and skills in OHS. The paper will also present how OHS, as an expected learning outcome of Civil Engineering graduates will improve the relevance of engineering education for industrial practices.

A survey of strategies for feedback and assessment in engineering subjects: Discussions and examples

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Abstract

One of the most often quoted statements in educational circles is that "assessment tasks drive student learning". Assessment practices in engineering have changed markedly over the years. With the explosion of Problem Based Learning (PBL) styled courses, increased focus on group work, the building of generic skills linked to graduate attributes and more widespread use of online tools, methods for assessment and opportunities for feedback have widened increasingly. In this paper, we survey several experienced engineering lecturers from around Australia and their approach to assessment in their subjects – varying from institution, content, size and year level. Student focus groups are also drawn upon to provide the other side of the picture. It is observed that there is a large diversity in both assessment and feedback practices that may warrant a more comprehensive study.

M44: Developing the responsive engineer

Chair: Lawrence Carter, Auckland University, NZ — Monday 15:00-16.30, Garden Room

Multi-disciplinary and cross year mentoring: the development of an eco-house and a sustainable marriage!

Michael Bramhall, Chris Short, Abdul Hoque, Jane Blohm, Lesley Campbell, Andy Young

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Abstract

The paper initially describes the development of two interdisciplinary projects/ coursework, with the aim of achieving project goals through the use of inter-disciplinary/ multidisciplinary teams. The first, a one-fifth scale eco-house was designed and developed by a multi-disciplinary, cross-year group of engineering students in order for them to apply their engineering knowledge to analyse the efficiency and effectiveness of renewable energy systems. The second involved a group of postgraduate engineering students working with first and second year fashion students to examine the concept of 'throwaway fashion'. This concept enabled students to investigate dissolvable polymeric materials that could be used as fabrics to design a biodegradable wedding gown. The end product was a wedding dress that has been used in exhibitions across the UK.

It then examines results from two internally funded research projects aimed at investigating and enhancing students learning experience through the formation of interdisciplinary links between design/ mechanical engineering final year project students and taught classes in other disciplines.

The paper then describes a Royal Academy of Engineering (RAE) funded "Large Scale Curriculum innovation and Enhancement project" between a collaboration of 6 UK universities with the aims of developing an interdisciplinary learning environment which can ultimately provide a model for embedding such enhancements across a wide range of universities.

What! No Lectures? The facilitation of learning about the engineering challenges of the 21st century

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Abstract

UNESCO's Report on Engineering (2010) urges engineers to address the global challenges of poverty and climate change in innovative ways. This is a worthy call to advocate for a more humanitarian engineering practice. But how is this to be achieved in a meaningful way? The traditional approach to teaching engineering problem solving, where students are limited to finding purely technical solutions, is beginning to be critiqued in the light of rapid globalisation, and an increasing acceptance of the need for graduate engineers to locate technical requirements within their social, economic and environmental context. GENG1003 is a foundation unit in the Faculty of Engineering, Computing and Mathematics at the University of Western Australia (UWA). In order to implement the changes described above, the unit is being taught without lectures; students attend two tutorials per week which culminates in the practical design and written report about a project created in response to a global challenge in different geographical contexts. These tutorials comprise one Information Session where they learn (through brief readings and debate) about core issues such as team work, communication, ethics, and globalisation for example; and one Practical Session where they apply what they have learnt to the design of a specific project. In 2011, the students were expected to design a solution to the specific problem of waste in the context of rural India, Buenos Aires and metropolitan Perth. The role of the tutor in such a unit is crucial; the Information Tutors have a wide disciplinary background (including engineering, forensic science, science communication, anthropology and education) while the Practical Tutors are mostly PhD students in, or graduates of engineering and/or physics. This paper reflects on the experience of the Information Tutors in facilitating learning on a number of topics – globalisation, justice, ethics, poverty – with students who think of themselves as "only being good at maths".

The Need to Teach Environmental Engineers, Scientists, and Economists To Spot Ethical Questions In Their Undergraduate Education: Lessons Learned From A Climate Change Disinformation Campaign

Donald Brown & Mary Lynn Brannon

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Abstract

In light of how climate change policies have been debated in the United States, there is a need to teach environmental engineers, scientists, and economists to have the critical thinking skills to spot ethical issues that arise in the application of their disciplines to environmental policy formation. This presentation will explain why this is important and describe a program developed at the Pennsylvania State University, USA to integrate student modules and faculty development on teaching ethical issue identification into environmental engineering, science, and economic undergraduate education. We will argue that these skills are necessary to enhance the critical thinking skills of undergraduates who intend to participate in environmental policy formation discussions. We will also explain the importance of this undergraduate training in light of a disinformation campaign about climate change science and economics that has recently been waged by interests opposed to climate change policies for economic reasons.

This presentation will discuss there can be failure to spot ethical issues that arise when environmental scientific and economic analyses are deployed to examine environmental problems and their solutions. This failure can often enable those who oppose environmental regulation to hide ethically problematic positions behind what at first glance appear to be "value-neutral" scientific and economic claims. Our approach to teaching undergraduates how to identify and critique these ethical issues is to use case-based exercises by which student's practice critical thinking and problem solving into course materials. The presentation will identify the practical consequences of the failure to spot hidden ethical assumptions or positions using evidence of student performance. As such we will demonstrate that unless controversial ethical issues that are hidden in scientific and economic arguments about climate change policies are identified, it is impossible to critically evaluate controversial scientific and economic claims about climate change policies are identified, it is impossible to critically evaluate controversial scientific and economic claims.

Developing Engineering Performance to Meet Community Expectations

Alexandra Meldrum

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Abstract

This presentation reports on the development of engineering professionals to meet an expected standard of engineering performance. A project undertaken by the Warren Centre for Advanced Engineering resulted in the publication, at the end of 2009, of the Report "Professional Performance, Innovation and Risk in Australian Engineering Practice", including the PPIR Protocol™, which defines the expected performance for engineering professionals. The protocol addresses a number of aspects relevant to community involvement and sustainability. Firstly, it requires the engineer to understand the stakeholders to each engineering task (including the community) and the impact of any action on those stakeholders; secondly, it specifically addresses the need to address all relevant safety, environmental, public health and other public interest issues and thirdly it requires the development of a detailed risk identification and management plan. The presentation also presents the current project for implementation of PPIR, under the title "Engineering Professional Practice" (EPP). The key objectives of this phase are to disseminate the PPIR Report, provide education and training and have the engineering industry and profession adopt the Protocol. Discussions have already commenced with Australian universities with regard to inclusion of PPIR into their syllabuses.

A copy of the PPIR report and details of the PPIR implementation program can be accessed at www.ppir.com.au

M45: Thresholds in Technical Problem Solving

Chair: Ian Cameron, The University of Queensland — Monday 15:00-16.30, Rottnest Room

Employer perspectives on Engineering Technician education in Australia

David Dowling

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Abstract

Both the higher education (HE) sector and the vocational education and training (VET) sector provide two year programs for Engineering Technicians, normally called Engineering Associates in Australia. Advanced Diploma programs are competency based and offered by VET institutions while the higher education Associate Degree programs were, until recently, only offered by universities. This paper reports on the results of an online questionnaire that 25 engineering employers completed during the 2010. The aim of the questionnaire was to gather information from current employers about the reasons why they have supported an employee who was studying an Engineering Technician program part-time, the level of support they provide and any barriers that inhibit the employment of additional students. The respondents were from regional and rural areas in two Australia states and represented 21 separate organisations: ten private companies, eight local authorities and three government departments. The four key findings were: (1) the majority of the employers saw their support for students as one way to address current skills shortages in their industry, particularly in government instrumentalities;(2) most of the employers said they would continue support students who graduated and then articulated into an engineering degree program; (3) they would like more engagement with education providers; and (4) they believed that federal and state governments should offer financial incentives to encourage employers to offer engineering traineeships or cadetships.

Engineering Technician students: do they understand their future role?

David Dowling & Elizabeth Godfrey

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Abstract

Two studies undertaken during 2010 reported on the characteristics, motivations and career aspirations of engineering students in Diploma, Advanced Diploma and Associate Degree programs at universities and Vocational Educational and Training (VET) institutions around Australia (Dowling 2010a, 2010b).

This paper presents a qualitative analysis of the responses to one open-ended question included in the studies, exploring student understandings of the role of Engineering Technicians. These understandings were cross referenced to the age, work experience, type of qualification being studied and career aspirations of the students.

From their responses, it appears that few, if any, of the students are familiar with the role definitions prepared by Engineers Australia. They had a very superficial level of understanding of the role their qualification was preparing them for, with some depth only emerging predominantly from those with work experience. The paper concludes with a discussion on the implications of the findings, and highlights the importance of the need for clarity and consistency in job descriptions and promotional activities across the industry, particularly by educational institutions.

A sufficiently complex construction" and other conceptions of technology held by engineering students: A case study from Sweden

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Abstract

Engineering has been described as a particular community of practice with its own tacit assumptions about the nature and purpose of engineering and technology. In this paper we investigate how engineering students conceptualise technology. Data was collected through ten interviews and the data was analysed using a phenomenographic approach, leading to six different conceptions of technology. Interestingly, the social dimension of technology was almost invisible in all conceptions. We discuss how these results can be used as an educational intervention to help engineering students to develop a more complex understanding of technology. We also outline the structure of a course aiming to increase students' understanding of engineering as well as the relationship between science, technology and society.

Do we succeed in developing problem-solving skills – the engineering students' perspective

Tom Steiner, Louri Belski, Jennifer Harlim, James Baglin, Roy Ferguson & Tom Molyneaux

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Abstract

This paper examines findings of a problem-solving skills survey conducted at RMIT in 2010-2011, involving 320 student respondents. It will discuss the following questions: (1) Are there any differences in perceptions of students from different schools on their problem-solving skills? (2) Do students perceive themselves as better problem solvers as a result of their engineering degree studies? (3) What activities improved students' problem-solving skills the most? The findings suggest an approach to enhance student perceived effectiveness of their problem-solving skills.

A teaching tool (ISM) for development and assessment of learning outcomes in the emerging area of infrastructure management

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Abstract

Developing capabilities in management of civil infrastructure systems is an essential skill for a current Civil Engineering graduate. This new area of curriculum encourages students to appreciate the needs of the stakeholders and the community, objectives of sustainability as well as their prior technical knowledge on assessing performance of Engineering materials and systems. In developing the teaching program a challenge faced is the need for integrating a diverse range of activities and the knowledge base.

The subject Infrastructure management developed at RMIT University is aimed at achieving the above objectives through incorporation of an industry based project as the major assessment task. Students select an infrastructure system for their major project and develop an asset hierarchy to divide the system in to assessable components. They then understand the deterioration mechanisms, failure modes, mechanisms and signs of distress to develop a condition rating method for the selected system. Finally, they develop a deterioration prediction method which is subsequently used to identify intervention level and to forecast maintenance cost, leading to an efficient Infrastructure Management Process.

To enable more effective assessment of the projects, a customised tool called Infrastructure Systems Manager was developed by the teaching team to capture the student input and the decision making process. The tool simulates the complete infrastructure management process and simulates the work place while allowing the educators to ascertain the students' understanding of the course content. The paper presents the process adopted in the development of the tool and the early outcomes

Adaptive tutorials to target Threshold Concepts in Mechanics – a community of practice approach

Gangadhara B. Prusty[1], Carol Russell[1], Robin Ford[1], Dror Ben-Naim[1], Shaowei Ho[1], Zora Vrcelj[1], Nadine Marcus[1], Timothy McCarthy[2], Tom Goldfinch[2], Roberto Ojeda[3], Anne Gardner[4], Tom Molyneaux[5], &Roger Hadgraft[6]

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Abstract

We present our work on introducing Adaptive Tutorials in first and second year mechanics courses in Engineering. Adaptive Tutorials are interactive online modules where an Intelligent Tutoring System adapts the instruction level to learners, based on their individual performance. Through an ALTC-funded project, we formed a community of practice of Engineering Mechanics educators from a range of Australian universities. As a team, we began by identifying Threshold Concepts that if they are not grasped inhibit students' learning before developing a set of Adaptive on-line Tutorials to target them. These Adaptive Tutorials were used by students throughout the first half of 2011, and were found to be both engaging and conducive to learning. In this paper, we present our approach and findings and discuss our strategy of giving educators pedagogical control over such advanced technologically-based instructional methods with the goal of increasing adoption and ultimately improving students learning.

Poster M5: An experience interacting with students defining their own assessment tasks

Monday 16:30-18.00, Indian Ocean Suite

Iain Skinner

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Abstract

This paper discusses an example of assessment in which students are

encouraged to define their own tasks for completion in a course on engineering ethics, sustainability and leadership. If they do not choose to set their own task, they need to write a formal report on a randomly assigned topic of ethical contention. From 2008 to 2010, 29 % (of 522 total students) defined their own tasks. Students submit a proposal

detailing (i) what will be done, (ii) which learning outcomes will be demonstrated, and (iii) how success will be assessed. The minimal requirements on tasks are that each student must invest 15-20 hours of effort and they engage with 3 or 4 learning outcomes.

The marking criteria must include an allowance for the effectiveness of the

communication of ideas. Any team project must argue why each person is necessary. Students are given the list of possible report topics and the marking criteria used for reports. Student proposals are approved on a case by case basis. Negotiations can be

protracted, needing 20-25 hours in 2010. These negotiations changed the dynamic of interaction with the class and provided detailed conversations about how the class understands the course outcomes. The relationship between lecturer and class changed

for the better. Students who self-define do perform better on the assignment, though no differently in the rest of the course.

Poster M5: Teaching Ethics to the Millennial Students: Preparing Graduate Teaching Instructors to teach ethics using new media

Monday 16:30-18.00, Indian Ocean Suite

Kyle A. Brannon[1] & Mary Lynn Brannon[2]

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Abstract

The undergraduate student of today is the millennial learner technologically connected and visually literate. Research indicates that the learning preferences of these students are to be engaged in activities and participate in social interaction. Using the Internet, social media, YouTube and digital images are regular tools for these students. Additionally, to become globally engaged and aware the undergraduate engineering student needs to be involved in discourse about ethical issues. In this poster session we will describe a collaborative pilot project between the instructor of a seminar for graduate teaching assistants at Pennsylvania State University, USA and an assistant professor of media arts at American University, USA. This project is designed to teach Graduate Teaching Instructors (GTIs) to integrate the teaching of ethics into the engineering courses that they teach by using methods that incorporate new media materials.

Graduate Teaching Instructors, at the College of Engineering, Pennsylvania State University, who have a teaching assignment, are required to enroll in a one-credit course, The Graduate Teaching Assistant Seminar. This seminar prepares GTIs to teach. The instructor believes in the importance of using current technologies in delivery of content, and in the value of teaching ethics. As such, a lesson was designed where the GTIs enrolled in the seminar hade a discussion on teaching ethics; and subsequently how to use and evaluate appropriate new media tools to develop ethics lectures. The learning objective is that the GTIs will be able to design a teaching module on ethics using current technologies. Those instructors who are interested in using new media tools in their teaching or preparing graduate student instructors to teach will find this poster useful.

Poster M5: Changing the Values and Behaviours of Engineering Students via Authentic Learning Environment

Monday 16:30-18.00, Indian Ocean Suite

Steven Goh

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Abstract

Authentic learning environments open up opportunities to help students learn about the value of research skills and the importance of professional sources. The research is framed around relational and constructivist pedagogy in that if students are immersed in a rich and authentic professional environment with real-time input from industry practitioners, they are more engaged with the learning experience as designed. The methodology used in this research is based on description case study approach, and the preliminary data collected from survey instrument is presented.

This paper argues that authentic learning environment designed around scaffolded learning opportunities have the ability to change the values and behaviours of engineering students. Our findings suggest that though the intervention within one course is somewhat effective in changing certain behaviours, and definitely provide renewed engagement with the learning opportunities presented, the underlying values and entrenched behaviours do not change.

Poster M5: From a final year engineering project to full technology commercialisation

Monday 16:30-18.00, Indian Ocean Suite

Aiguo Patrick Hu[1], Fady Mishriki[2], Kunal Bhargava[2] & Stephan Hussmann[3]

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Abstract

This poster presents a practical example about how a final year BE (Bachelor of Engineering) electrical and computer engineering research project at the University of Auckland, New Zealand, has led to successful commercialization of wireless power transfer technologies for industrial applications. Based on an excellent fundamental research platform of IPT (Inductive Power Transfer) developed by the Power Electronics Research Group of the University, a project on a low power contactless solution for driving moving sensors was initiated and implemented by a group of two students from February to September 2003. The project was designed such that the research content was closely linked to real industry needs, so students were able to see the real engineering problems and learn how to use theories and lab skills they learned to provide a practical solution. They have achieved excellent results, and based on the project, the students won the IPENZ (Institute of Professional Engineers New Zealand) Young Engineers Design Award in 2005. They also entered a University of Auckland Entrepreneurship Competition in 2003 named Spark, and took second place, in addition to the Inaugural Universitas 21 Global Technology Commercialisation Business Plan Competition in 2004 in Singapore where they took first place. After graduation they continued their passion, and started to commercialise the wireless technologies for industrial applications. Now PowerbyProxi they run has become a world leading wireless technology provider in many areas such as forestry harvesting machines, wind power pitch control, and wireless battery charging. In return each year PowerbyProxi continually sponsors final year and postgraduate research projects for new technology developments at the University of Auckland.

Poster M5: Women in Engineering

Monday 16:30-18.00, Indian Ocean Suite

Jolanta Szymakowski & Denise Hare

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Abstract

In considering the community of female engineers in Western Australia, the Engineers Australia Women in Engineering - Western Australia Division (WIEWA) works to the four themes - attract, retain, support, and celebrate Women in Engineering. In this year of Humanitarian Engineering, a basic human need - clothing - has been part of WIEWA's activities. The poster presents a concept map of this year's activities and demonstrates how the WIEWA committee is committed to improving the circumstances of female working within a male dominated industry. Some of the key activities include: Support (a seminar on how to improve career prospects in a male-dominated industry, a presentation on how to deal with discrimination in the workplace, development of appropriate PPE clothing for women, A presentation on working in developing countries and donation of business clothing for the Ready to Work program), Retention (a golf evening was held to develop and improve golf skills for female engineers, an important skill for bonding with colleagues and networking events), Attraction (a resume skills workshop aimed at university students, a presentation for engineering students on engineering and the law and presentations to high school students to generate interest in engineering studies) and Celebration (IEEE International Conference on Women in Science and Engineering and nomination of committee members for the Women in Resources Awards).

Poster M5: FlexPDE for Modelling Viscous Dominated Flows in Undergraduate Programmes

Monday 16:30-18.00, Indian Ocean Suite

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Abstract

With the rapid development of computerization power, Computational Fluid Dynamics (CFD) is gaining more popularity these days. CFD allows the analysis of Fluid Dynamics problems to be more universal, flexible, accurate and cost effective compared with the traditional analytical and experimental methods. FlexPDE is a finite element software which allows students to experiment interactively with the problem definition in its coding script, which is important in introducing the concept behind CFD. This feature is usually unavailable in other similar software packages. In conjunction with this, the software has user-friendly features such as FlexPDE user forum for assistance, no coding logical sequence requirement and friendly coding languages.

This research aims at incorporating FlexPDE in undergraduate programmes as a supplementary educational tool to the analytical and experimental approaches. The Fluid Mechanics 2 paper at the University of Auckland, which is orientated around viscous fluid flow, was used as the foundation for this study. The models used in this research were extracted from the class examples including flows inside a pipe and around a sphere. Integrating FlexPDE into this course will enable students to gain a better understanding of fluid mechanics problems and an appreciation for the importance of model calibration and verification. Furthermore, the knowledge gained in utilising CFD software will be very applicable in their professional career. A study at University of Tasmania in 2010 showed an increase from 36% to 80% in students' performance with the integration of CFD. In conclusion, the incorporation of FlexPDE in undergraduate programmes is highly advantageous. With careful implementation of the teaching module, students will benefit both academically and professionally!

Poster M5: Under-representation of Aboriginal Australians in the Engineering Profession: Curtin's Indigenous Australian Engineering Summer School

Monday 16:30-18.00, Indian Ocean Suite

Larissa Andrews

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Abstract

Curtin University hosts the Indigenous Australian Engineering Summer School (IAESS): an initiative of Engineering Aid Australia, designed to expose Aboriginal students with an aptitude for science and mathematics, to the benefits of a career in engineering. Aboriginal Australians are underrepresented in the engineering profession and through this program it is hoped that a pathway into engineering will be facilitated for participating students. During the IAESS, participants take part in hands-on laboratory activities, information sessions and site visits, engage with engineering role models and have opportunities to network with industry representatives. Evaluation of the program shows the IAESS experience to increase participants' interest in studying engineering and has also enabled identification of factors that

can impact on their decision, or ability, to pursue future studies in engineering. The

identification of these barriers has led to a culturally appropriate program being developed to provide ongoing mentoring and support to participants in order to maintain engagement and help them to complete their secondary studies at the required academic level.

Poster M5: Encouraging the embedding of energy efficiency knowledge and skills within engineering education, a national perspective

Monday 16:30-18.00, Indian Ocean Suite

Cheryl Desha & Karlson Hargroves

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Abstract

Energy efficiency as a concept has gained significant attention over the last few decades, as governments and industries around the world have grappled with issues such as rapid population growth and expanding needs for energy, the cost of supplying infrastructure for growing spikes in peak demand, the finite nature of fossil based energy reserves, and managing transition timeframes for expanding renewable energy supplies. Over the last decade in particular, there has been significant growth in understanding the complexity and interconnectedness of these issues, and the centrality of energy efficiency to the engineering profession. Furthermore, there has been a realisation amongst various government departments and education providers that associated knowledge and skill sets to achieve energy efficiency goals are not being sufficiently developed in vocational or higher education.

Within this context, this poster presentation showcases the emergence of a national energy efficiency education agenda in Australia, to support embedding such knowledge throughout the engineering curriculum, and throughout career pathways. In particular, the presentation provides insights into the national priorities for capacity building in Australia, and how this is influencing the engineering education community, from undergraduate education through to postgraduate studies and professional development. The presentation is intended to assist in raising awareness about the central role of energy efficiency within engineering, significant initiatives by major government, professional, and training organisations, and the increasing availability of high quality energy efficiency engineering education resources. The authors acknowledge the support for and contributions to this paper by the federal Department of Resources, Energy and Tourism, through members of the national Energy Efficiency Advisory Group for engineering education.

Poster M5: Physical and computer demonstrations in enhancing student understanding of structural mechanics courses

Monday 16:30-18.00, Indian Ocean Suite

Hong Guan & Benoit Gilbert

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Abstract

Structural Engineering, a highly technical discipline, includes foundation knowledge for a range of engineering professions and is traditionally restricted by rigorous accreditation requirements. Focused in this paper are fundamental and analytical courses in structural engineering and mechanics. These courses are generally

perceived by most students as challenging at times due firstly to complicated theory and analysis concepts covered and secondly the difficulties associated with visualising how structures behave when subjected to loads. In order to help students visualise the behaviour of structures and to better understand difficult and abstract concepts, complex methodologies and computational procedures, we have endeavoured to produce a series of scaled-down physical models, hands-on demonstration and digital animation tools as visual aids, with explanations of the matching concepts and calculations being covered.This approach has been highly valued by all students. Despite the difficulty of structural mechanics content, students still find these courses challenging but also interesting and enjoyable which contributes to motivating students and maximising their learning abilities, as evident in student evaluations. This paper presents the methods used at

Griffith University and the learning objectives behind them. In view of the positive feedback received from the students, this paper concludes that future research will be undertaken to quantify the efficiency of using visual demonstrations in structural mechanics courses.

Poster M5: The relationship between environmental factors and usage behaviors at 'Hole-in-the-wall' computers

Monday 16:30-18.00, Indian Ocean Suite

Jennifer DeBoer

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Abstract

This paper gathers and analyzes self-reported user behavior data for public computers installed in varied neighborhoods in India to explore the relationship between environmental factors such as urbanicity and reported usage behaviors. There is evidence of large differences in usage behavior between urban and non-urban sites. Children at urban sites fit a profile of dedicated and independent kiosk-goers, while rural children are more likely to use the computers in groups. Total overall computer usage, however, appears similar in both environments. The sites used for the study have other important characteristics, such as proximity to a school complex, which could have large mitigating effects on the measured behaviors. Further study could yield other interesting and more generalizable results. This study provides insight into children's behavior patterns at free-access 'Hole-in-the-Wall' computers as well as offers exploratory findings for the designers of free-access computers in developing nations where alternative educational development via technology could be implemented.

Poster M5: Engineers Australia Online Library Delivers Research Produced by Engineers to Engineers

Monday 16:30-18.00, Indian Ocean Suite

Elena Vvedenskaia

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Abstract

Engineers Australia is committed to providing its members with easy access to some of the best engineering resources in the world. The Engineers Australia Online Library offers its members exclusive access as member benefit.

The electronic Library consists of full-text conference proceedings and research papers; Engineers Australia magazine; engineering handbooks online; bibliographic references to news items and technical papers across all engineering disciplines. The Magazine of Engineers Australia, one of the largest monthly circulated professional magazines in Australia, is available online as an exact digital copy of the print edition. All these collections, selected by information specialists, are not readily available to the general public and therefore represent a unique, invaluable and comprehensive engineering resource.

T22: Novel approaches to learning

Chair: Rosemary Levy Chang , Swinburne University of Technology — Tuesday 10:30-Noon, Pleiades Room

Scratch that itch to learn: a comparative study

Keith Willey & Anne Gardner

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Abstract

Engineers today are required to make critical judgements involving decisions that often extend beyond traditional discipline boundaries. This requires professional engineers to undertake ongoing learning. Much of this learning is informal, learnt on the job from peers from different disciplines. To enable students to develop the skills required for professional practice they need opportunities to experience, practise, reflect and improve their ability to work in a collaborative environment. One method used at the University of Technology, Sydney to develop these skills is collaborative activities incorporating immediate feedback. Subject topics are tested through quizzes that are initially undertaken individually and then collaboratively using immediate feedback assessment technique (IF-AT) cards. These activities allow students to first identify and subsequently have gaps in their learning addressed initially by their peers within the one activity. This paper reports on a comparative evaluation of the collaborative use of IF-AT quizzes in four subjects taught by the authors. We found that these methods not only consistently improved student engagement, learning and developed skills required for life-long learning, but also promoted changes in their learning culture by having them take more responsibility for their own learning.

An investigation into the use of ICT to teach Calculus to Australian Primary Schools

Irene Penesis, Christopher Chin, Dev Ranmuthugala & Andrew Fluck

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Abstract

Integral calculus is often taught in high schools to students aged fifteen or older, and is essential for students planning a career in engineering. However, the uptake of mathematics in schools is falling, partially due to inappropriate learning techniques. This project investigates the possibility of introducing these concepts and capabilities to students aged 10 to 12 years using computer based algebra system software. After eleven lessons the students completed a test constructed from questions equivalent to a first year engineering calculus examination. The findings of this study showed that properly structured learning programmes utilising appropriate technology can impart high level knowledge and skills to students and provide them with a good understanding of the applications, thus motivating them to engage in such studies.

Enhanced graduate attributes by engaging engineering students in teaching episodes

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Abstract

Presentation skills are increasingly becoming essential in the engineering profession. This research addressed the importance of presentation skills for engineering students and presents the results of a peer-assisted learning "student-teaching" episode.

The assessment has been carried out through a questionnaire completed during the teaching episode to ascertain the skills required for effective presentation. Initial results indicated students appreciated the opportunity to engage with a student-led session and believed that this approach enhanced relationships amongst themselves and their lecturers.

Staff and student perceptions of the effective use of contemporary lecture theatre technology

Steven Grainger, Colin Kestell & Craig Willis

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Abstract

With increasing class sizes, even the most traditional Australian Universities have invested heavily in modern lecture theatres that are now equipped with the latest multimedia, conferencing, recording, networking and online facilities. These wired systems also provide opportunities for the seamless integration of portable devices that can assist the presenter in communicating with the class. More importantly there is compelling evidence that the inclusivity of this new 'post PowerPoint' generation of communication tools can offer significant pedagogical advantages when used effectively. Having made the investment, the universities obviously advocate the use of such technology and in some cases insist upon it. However, amidst the growing teaching and research performance expectations, the question arises as to whether or not these tools are being broadly adopted to their full pedagogical potential. Are staff able to find the time in which to develop the newly required skills and is the necessary training available? Two pilot studies (one canvassing the perceptions of the students and another staff) were therefore conducted to establish if academics are adopting this contemporary technology in favour of traditional 'chalk and talk', and whether or not those that are making an attempt are actually doing so effectively. The aim of this paper is not simply to determine the effectiveness of these new technologies in the lecture theatre, because in many cases this has already been demonstrated; but to present the preliminary findings of a pilot study that indicate the inclusivity and popularity of these contemporary lecture theatre tools amongst academics and to determine whether, broadly, students believe staff are using them effectively.

A pilot study on Engineering & Technology Education in Primary Schools

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Abstract

This paper reports on the first phase of an Engineering Education action research project aimed at developing interest and understanding among primary school students in engineering and technology (E&T) as potential career choices in order to redress the inadequate supply of appropriately trained professionals. The research team in collaboration with students, teachers and school administrators worked on developing engineering curriculum modules to extend existing science curricula in primary schools.

Participating students completed pre and post assessments that included questions about general E&T concepts. Analysis revealed that students had a limited understanding about E&T. Post assessments indicated statistically significant improvements to student understanding after exposure to the engineering curriculum. This research demonstrated a successful development to enhance and measure excellence in teaching and learning of E&T concepts at primary school students' level.

T23: Student centred learning approaches

Chair: Roger Hadgraft, The University of Melbourne — Tuesday 10:30-Noon, Carnac Room

Is self-assessment effective in enhancing student learning?

Badri Basnet, Marita Basson, Jo Devine, Carola Hobohm & Sandra Cochrane

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Abstract

It has been argued that self-assessment deepens student learning. This study examined that proposition through online assessment of an assignment in a first year course, with a large percentage (85%) of students enrolled in a distance mode. The aim of the study was to examine the effectiveness of self-assessment in student learning. One hundred and fifty-two students completed a self-assessment of their assignment using assessment guidelines, a marking rubric and model answers. The learning effectiveness of self-assessment was appraised through content analyses of student comments in the self-assessment, and in a survey. In this study, self-assessment of the assignment was found to be effective in enhancing student self-awareness and engaging students in metacognitive processes. Most survey respondents agreed that self-assessment helps students identify the strengths and the weaknesses of assignment answers and highlights areas where performance could be improved. Overall, self-assessment of the assignment was shown to be effective in positively influencing student learning in this learning environment.

Peer review of teamwork for encouraging equal commitment to the group effort

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Abstract

An important graduate attribute is the ability to work in teams, so many university courses incorporate this as part of the learning experience. However, it is inevitable that in some teams there will be members who do not contribute as much to the overall effort as others, leading to frustration in those members who carry the majority of the burden. When there are students enrolled in distance-education mode, this can be exacerbated because many of the teams cannot meet face-to-face, so it can be difficult to exert sufficient influence to force problematic individuals to amend their behaviour. In an effort to mitigate against this problem, self and peer assessment was used for both team assignments in a Problem-Based Learning (PBL) course and the results of the peer assessment were used to scale the team mark for the corresponding assignment to obtain individual grades. After submitting their final assignment, a survey instrument was used to investigate the success of this process. The students overwhelmingly supported the idea of distributing marks based on the value of the individual's contribution because in many teams it had the desired effect of motivating underperforming members to involve themselves more in the second assignment. There was some dissatisfaction about the process used to distribute marks, which the authors will attempt to address by providing better scaffolding in subsequent uses of the software tool. Regardless of these difficulties, we found that a transparent mechanism for distributing team marks to individual grades is beneficial for encouraging equal commitment to the team effort by all team members.

Blending project-based learning and traditional lecture-tutorial based teaching approaches in engineering design courses

Kali Prasad Nepal & Graham A. Jenkins

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Abstract

Project based learning (PBL) has been widely recognised as a collaborative, progressive, student-centred, interactive, active and deep learning approach. The benefits of PBL have been well documented in the existing literature and the approach has been practised, to some extent, in most engineering schools in Australia. However, the majority of undergraduate engineering programs, except a few PBL-centred engineering schools, still use traditional lecture-tutorial approach. Both of these learning approaches have advantages and disadvantages. Some engineering students dislike the PBL approach as they need to adopt a self-directed learning strategy to complete often unclear and open-ended tasks. It may also not suit their individual learning styles and needs, which may be different than the team learning needs. Some teaching staff also criticise the PBL approach as it takes too much of their time and effort, especially for large classes. Academic institutions often hesitate to embrace the PBL approach as it demands more resources. This study investigates the use of a blended approach (mix of PBL and traditional) with the aim of eliciting the advantages of both approaches to enhance student learning outcomes. It formulates the strategies to combine both approaches, implements the strategies to an undergraduate engineering design course and relates the effectiveness of such strategies through a student survey. The results show that the blended approach, designed appropriately, helps to minimise the problems of both approaches.

Comparative study of project-based learning and traditional lecture tutorial teaching approaches in undergraduate engineering courses

Kali Prasad Nepal[1] & Kriengsak Panuwatwanich[2]

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Abstract

Project and/or problem based learning has been widely recognised as active, collaborative, cumulative and integrative learning approach that engages learners and centres on practical education. However, its widespread implementation in engineering curricula at Australian universities has not been realised due to a number of issues including resources required for large classes, teaching staff's reluctance to embrace it and students' learning styles, beliefs and expectations. On the other hand, traditional lecture-tutorial teaching approach is also criticised for being passive, surface learning and exam-focused. This study compares the data from students' actual performance, course evaluation and expectation in two large undergraduate courses over the last two years. This study is interesting in that both courses were taught by the same teaching staff using entirely two different learning and teaching approaches to the same cohort of students in the same semester within the same degree program. The analysis shows that there are significant differences between students' actual performance, course evaluation and expectation. Such conflicting differences might have negative impact on teaching staff who wish to adopt project and/or problem based learning in their undergraduate engineering courses.

An innovative delivery and assessment of Thermofluid Engineering: a PBL course in undergraduate engineering program

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Abstract

The intent of project based learning (PBL) in undergraduate engineering courses at CQUniversity is to expose students to real life engineering problems. Delivering Thermofluid Engineering as a PBL course aims to facilitate students developing and demonstrating mastery of technical skills required for analysis, formulation and design of the various thermofluid systems. In addition to the technical skills development, this course aims to provide students with opportunities to continue with practice and development of professional skills such as team work, creativity, critical thinking, oral presentation, written communications and lifelong learning skills. Students gain a wide range of exposure to thermofluid engineering with appropriate applications of theory. This paper presents an overview of the course curriculum and innovative techniques used for both delivery and assessment for achieving excellence in "research informed" teaching and learning processes in thermofluid engineering. It is believed that, from this course of study, students could achieve effective learning techniques and gain advanced knowledge through research informed learning which they could practice in their professional career. The paper focuses on how the outcome of this study will impact on the progressive educational trend in the learning process and will give a better outcome for engineering as a profession.

T24: Inclusivity and engagement

Chair: Syed Mahfuzul Aziz, University of South Australia — Tuesday 10:30-Noon, Garden Room

Increased female participation into engineering education through specialised courses

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Abstract

Research has shown that female participation into engineering courses has avery poor record especially in mainstream courses such as Mechanical, Electrical andCivil engineering. This paper refers to local and international reports on this issue andthe success of the Product Design Engineering course to attract a higher percentage offemale students. The study will reveal female enrolment into the course, performanceduring the course and employment after graduation over a ten year period that this course has been offered at Swinburne University of Technology, Melbourne, Australia.

The paper will support the position that higher female participation in the engineering profession is a necessity and that educational institutions have the ability as well as the responsibility to offer specialised courses that are conducive to higher female participation.

Development and Validation of a Regional University's Model for Community and Industry Engagement

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Abstract

Participation by rural and remote area students has been identified as a critical element in increasing enrolments in higher education in Australia. This paper describes a research project to develop a model based on a regional university's investigation of a strategic alliance with the extractive energy industry to engage high schools in the local communities in engineering related activities, and ultimately to encourage participation by students in higher education. A key component of the model and adopted strategy was the design and conduct of engineering camps. This involved year 10 to 12 students in 2010-2011, from 13 regional high schools attending the university to work on real-life projects surrounding coal seam gas extraction. Students were also provided an opportunity to participate in site visits to experience life as an engineer in the energy industry. The desired outcomes of the model were: from the university's perspective to give students a taste of life as a student at university; from the students' perspective to raise awareness of issues surrounding the energy industry in their geographic area; and from the discipline perspective to demonstrate practical relevance of science, technology, engineering and mathematics (STEM) subjects. The planned outcomes would then help to engage the local communities through the students' schools, make students aware of opportunities for further study, demonstrate the ease with which they could transition from high school to university life, and thereby encourage high school students in these communities to aspire to a career in engineering and spatial science. The interactive model resulted in camps that have become an annual event due to their unquestionable success. The model has now been embraced by industry, and opportunities have also been identified to further develop the model through a strengthened high school engagement.

A curriculum design approach which creates increased opportunity

Peter O'Shea[1] & Gerard O'Shea[2]

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Abstract

There are very few curricula which are robust enough to succeed in diverse cultural settings over an extended period of time. The Montessori curriculum is an example of one that has – it has been adopted on every continent, it has sustained itself for over a century, and its success has been validated by well controlled scientific studies.

Importantly, also, the Montessori curriculum has proven to be very effective when used with equity groups such as the mentally handicapped and those in low socio-economic groups. This paper looks at the curriculum design approach used by Montessori and extracts the key underlying principles used in the design process. The paper then discusses how one can use the Montessori approach for curriculum refinement in a first year university unit.

Do with and not to. Building cultural understanding, enabling communication and promoting the spirit of reconciliation in first year engineering

Andrea Duff ,Tina Brodie, Declan Furber-Gillick, Diana Quinn & Elizabeth Smith

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Abstract

Engineering accreditation bodies throughout the world (ABET; Engineers Australia), highlight the importance of graduates becoming both discipline experts and empathetic communicators. As the role of the engineer has moved beyond borders the ability to collaborate cross culturally has become more important. At the University of South Australia, building cultural competence begins at home. The authors present a sustainable curriculum aimed to develop professional competencies of engineering graduates working with Aboriginal and Torres Strait Islander communities. The 'Indigenous Content in Undergraduate Programs' (ICUP) project has opened a dialogue between all first year engineers and a diverse range of teaching staff committed to the spirit of reconciliation. The project builds both the cultural competencies of students and bridges between cultures. This paper describes a curriculum which (in two years) has engaged more than 500 students in the central question 'Why is it important for engineers to understand cultural diversity?'

System thinking: How universities can boost the retention of a higher proportion of women engineers in the engineering workforce

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Abstract

Ascertaining ways in which higher education institutions could assist in the retention of a higher proportion of women engineers in the workforce, was the focus of one strand of a recently completed project, supported by the Australian Council of Engineering Deans. The project was addressing shortages in the engineering workforce by investigating curriculum design and support systems that could attract and retrain people from under-represented and non-traditional backgrounds. Consultation with key informants from industry, academia and members and ex-chairs of the Engineers Australia National Committee for Women in Engineering emphasised that the major barrier to women engineers continuing in the workforce lay with workplace culture, lack of access to flexible work conditions and lack of career path. Although it appeared that educational strategies were initially considered of minor importance, a second cycle of discussion widening the circle of informants, elicited seven recommendations focusing on: the wider provision of flexible short courses, employer and higher education funding for part- time study, opportunities for women to work part-time in engineering faculties as well as the importance of culture change within many engineering workplaces including academia.

T25: ERM Invited Paper Session: Understanding and Developing Engineers For Social Justice

Chair: Lesley Jolly, Strategic Partnerships

Tuesday 10:30-Noon, Rottnest Room

Engineering education, practice and engineering education research: critical realist insights

Linda Kotta

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Abstract

Given that 2011 has been declared, by Engineers Australia, the year of Humanitarian Engineering, it seems fitting that the conference theme is engineering for social justice, encompassing community involvement, ethics and sustainability. This opens the door for the introduction of new approaches for engaging with the world, which extend the current mandate of the engineering professional, as well as that of the engineering educator and engineering education researcher. The invited paper draws on critical realist insights to argue that the world of the engineering professional is stratified and complex. These insights are used to argue that the engineering education research mandate needs to be emancipatory and thus prioritise the uncovering of structures and mechanisms which cause the effects (social, environmental etc) and phenomena that we see in the world. Engineers, in all their activities, whether in practice, in pedagogy, in research, and in engineering education research, need to ask the question, 'what does the world have to be like for things to be as they are?' In order to do this, a multiplicity of approaches will be required underpinned by concerns with both being (ontology) and knowing (epistemology), and which do not privilege 'scientifically verifiable' evidence over other notions of evidence. Further, it is argued that such positivist epistemologies, which have sustained and continue to sustain scientific activity and research, cannot be assumed to be appropriate for emancipatory engineering work.

Implementation of industry sustainability metrics in undergraduate design projects

Margaret Jollands[1], Raj Parthasarathy[1] & Mark Latham[2]

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Abstract

RMIT University Chemical Engineering has a stream of project based learning courses from first to final year. These courses are excellent vehicles for developing graduate attributes. This paper reports on implementation of sophisticated industry sustainability metrics in multiple projects from first to final year. The GEMI Metrics Navigator™ is a tool that assists organisations to develop metrics that support business strategy and contribute to business success. It facilitates analysis of complex issues in terms of environment, social and economic life cycles including stakeholder input. It uses worksheets to facilitate analysis of the most relevant business issues. The students used pair-wise comparison to rank and weight relevant issues with stakeholder input. In first year, the stakeholders were the students themselves. In the final year, students ran a community forum and questioned "stakeholders" who were role-played by a consultant engineer and social science academics. In later year projects students used additional worksheets to prioritise key areas. The students successfully used the tool to analyse process design alternatives in depth and to identify the key issues for the company and the community objectively. They learned to identify which issues can be controlled and influenced and how to incorporate stakeholder views in their design choice. The feasibility reports produced by the final year students showed a mature and considered evaluation of the design alternatives. The concept maps of year 2 students showed their understanding of sustainability increased significantly. This study found that students can use sophisticated industry metrics to develop their ideas about sustainability. Collecting and using data from a meeting with stakeholders introduced authentic community involvement into student projects. The studentsÐ learning in future years will be enhanced by returning to and building on their learning of sustainability concepts from earlier years. A longitudinal study of student learning outcomes is planned.

Engineering Education towards Social and Environmental Justice

Julian O'Shea & Caroline Baillie

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Abstract

The impact of the engineering industry on communities and the natural environment can be considerable, both positively and negatively. Recognising this, this impact is a key motivator for developing professional engineers who are equipped to critically examine their role, and who can ensure their actions are in the best interests of the community. The required theme of social and environmental justice goes beyond the standard definitions of ethical professional conduct, to where engineering solutions are implemented with community outcomes at their core.

Educating engineers with the embedded skills and mindset to consider these issues is a challenge for academics and educators. This paper discusses a project on this topic being undertaken for the Australian Learning and Teaching Council on the topic of Engineering Education for Social and Environmental Justice. This program is being led by researchers at the University of Western Australia and involving academics at five institutions in Australia and the United States. This project involves developing, delivering and evaluating courses that have been designed to provide exposure to, and increase understanding of, social justice issues amongst engineering students. This paper is in two parts and includes preliminary outcomes from a pilot study into the student experience within one such course, using threshold concept theory to determine barriers to learning. The second part of this paper outlines future research within this project.

Educational Research Methods (ERM) Session

Aims and Objectives

There is a long-standing tradition of engineers being called to account for their impact on natural and social systems. The theme of this year's conference "Developing Engineers for Social Justice: Community Involvement, Ethics & Sustainability" raises the question of what we need to do as educators to make sure engineers are capable of meeting their non-technical professional obligations. The Educational Research Methods session is convened to consider how research can clarify what is necessary for us to know about engineering education and practice in order to assist engineering educators in this endeavour. Specifically, the objectives of this session will be:

- Identify some key conceptual and epistemological considerations in understanding how engineering can serve social justice
- Discuss potential research methods for improving our understanding of the issues
- Consider ways in which research findings about such topics can be better incorporated into the standard engineering curriculum

Format

This session will offer participants the opportunity for extended discussion of these complex issues by using a format of short presentation followed by facilitated discussion which some will be familiar with from other conferences including REES. The invited authors who will make up our panel are Linda Kotta, Matt Eliot, Margaret Jollands and Julian O'Shea, We expect to use the 90 minutes like this:

- Introduction by session chair (5 minutes)
- Invited paper authors each have 5 minutes to present the main idea in their paper and articulate one question for discussion (20 minutes)
- Facilitated discussion with main points recorded on whiteboard by chair (50 minutes)
- Summary and implications by invited discussant (10 minutes)
- Author responses (5 minutes)

What you will get out of this session

This session will expose you to questions and points of view that you may not have encountered before and we hope will stimulate you to diversify your own research approaches. The open discussion has the potential to help you identify future research partnerships. You will get the most out of this session if you have read the invited papers before-hand, or at least the abstracts.

Follow-on Session

There will be a workshop on Wednesday entitled Understanding how we develop engineers for social justice which continues this theme and allows you to compare your own experience with the findings of a large ALTC project.

Workshop T32: Building Organizational Infrastructure for Inclusivity

Chair: Jennifer Karlin
Tuesday 13:30-1430, Pleiades Room

Jennifer Karlin, Cassandra Groen & Logan Wiley

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Abstract

Embracing equity and diversity throughout all levels of engineering education and practice requires a climate where individuals feel comfortable asking difficult questions, engaging in meaningful dialogue across boundaries of rank or discipline, and sharing a vision for and commitment to the goals of the organization. Group leadership plays an important role in assuring that this climate is created, maintained, and continuously enhanced as well as promoting a sense of value of each of the individual members of the group.

Building a sustainable climate of inclusivity in any engineering department or college requires a healthy organizational infrastructure. While very few engineering educators and leaders are trained in how to design and develop an organization, it is possible to learn a set of key traits of the group and the leadership that will encourage:

- Members of the group to clarify their personal visions for their careers and education, including understanding their own underlying assumptions, values, and beliefs;
- Leadership of the group to clarify and articulate a shared vision that has "buy-in" from the group members; and
- The organization to see interrelationships rather than linear cause-effect; the ability to think in context and appreciate the consequences of actions on other parts of the system.

Participants in this workshop will discover these key traits and how to implement them through discussion and hands-on activities. Additionally, participants will learn the fundamentals to creating a healthy organizational infrastructure in any size or level of group, including the classroom, research group, department, and university.

Stated Learning Outcomes

LO1 Discover the fundamental traits of a healthy organizational infrastructure, including patterns of behaviour that suggest higher or lower levels of each trait.

LO2 Practice activities that encourage positive organizational infrastructure growth among the group.

LO3 Learn mechanisms to encourage a healthy climate for inclusivity regardless of the group level (e.g., classroom, research group department) or the participant's level of institutional authority.

Workshop T33: Developing and Using Formal Models for Curriculum Competency Mapping for Pathways Progression in Engineering and Related Disciplines

Chair: Geoffrey G Roy
Tuesday 13:30-1430, Carnac Room

Geoffrey G Roy[1] Jocelyn Armarego[2] & Alex Rassau[1]

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Abstract

The development of formal curriculum mapping processes and models require assessment techniques and appropriate measurement scales. It is well recognised that learning outcomes (LOs) and graduate attributes (GAs) need to be measured on appropriate scales so that varying levels of achievement can be described. These are often based on well established learning theory as exemplified by Bloom's Taxonomy of Learning Outcomes (Bloom, 1956). Formal assessment models of this type are a key to the establishment of pathways through various higher educational courses and work experience episodes to allow appropriate accreditation outcomes to be achieved.

The workshop will provide an introduction to a number of common assessment scales and their application in curriculum-competency mapping tasks. Specifically the workshop will cover:

- Measurement scales, their definitions and descriptions covering a number of common examples including Bloom, CDIO, Dreyfus, SFIA and EQF.
- Developing a suitable measurement scale for a given context area with discipline-appropriate descriptors with a focus on engineering.
- Developing target levels of achievement from competency frameworks, using EA Stage 1 Competencies and ECU Undergraduate Curriculum Framework models.
- The process of assessment - identifying information sources and their linkage to competency requirements, and making the assessment.
- Using graphical reports to provide overviews of outcomes and compliance measures.
- Tracing the assessment processes for auditing purposes to provide evidence-based assessments.

The workshop will require an involvement of the participants to develop and apply example assessment tasks. Participants will be assisted in developing a range of reports to document the process and provide the basis for compliance assessment.

Stated Learning Outcomes

LO1 Introduced to the Engineers Australia Stage 1 Competency frameworks.

LO2 Introduced to a range of competency assessment methods based on well developed learning theory that can be used in engineering and related domains.

LO3 Provided with a demonstration copy of the CCmap software package installed on their own computer.

LO4 Instructed in how to use this tool to develop a competency profile for an example course and/or person.

Workshop T34: Exploring inclusivity using sociodrama

Chair: Juliana Prpic
Tuesday 13:30-1430, Garden Room

Juliana Prpic Prpic

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Abstract

Inclusivity in engineering involves an awareness of the social systems in which it is immersed. These social systems are inevitably complex, as is their impact on the practice and teaching of engineering. Inclusivity challenges us to consider issues such as transdisciplinarity, gender, stakeholder and cultural diversity, and to confront questions such as "Who or what do we include or exclude?" and "Where do we place the boundaries?" and particularly, "What changes to engineering education does inclusivity require?" The aim of this workshop is to explore inclusivity using sociodrama, an action-oriented method that is firmly grounded in systems theory. Sociodrama is a learning method that creates deep understanding of the social systems that shape us individually and collectively. The method improves understanding of a social system or situation, by allowing discussion and active exploration of complex issues in ways that develop insight and understanding. This workshop will provide participants with an opportunity to explore as a group some of the social systems and issues that impact on engineering education today.

Stated Learning Outcomes

LO1 New insights into aspects of inclusivity and how they can be addressed in engineering education.

LO2 A deeper understanding of the social systems that impact on engineering practice and education.

LO3 Experience of a method that allows exploration and analysis of social systems.

Workshop T35: Engineering Education for Social and Environmental Justice Enthusiasts' Network: Preliminary Workshop

Chair: Rita Armstrong
Tuesday 13:30-1430, Rottnest Room

Caroline Baillie & Rita Armstrong

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Abstract

The Engineering Education for Social and Environmental Justice project is funded by the Australian Learning and Teaching Council (CG10-1519). This project addresses an issue of pivotal importance: an internationally recognized need for engineers to critically understand, and practically address, inequality and injustice which may arise from the environmental and social impact of their work. To achieve this critical understanding, the interdisciplinary project team developed a set of core concepts which would form the basis for curriculum development, and identified significant areas where engineering practice could be informed or transformed by an interdisciplinary approach. These areas include Mining, Waste, Energy, Water, War and Indigenous Knowledge. The team is now in the process of writing a series of interdisciplinary education guides for engineering and non-engineering lecturers in those areas.

The aim of the workshop is to:

- provide a forum for the discussion of pedagogical case studies where an interdisciplinary approach has been implemented: the University of Western Australia, Murdoch University, University of Sydney and Rennselaer Polytechnic (USA).
- invite submissions from interested enthusiasts for small grants ($1 – 2,000) to implement an innovation within their own teaching framework that supports the Engineering Education for Social and Environmental Justice project. They will be asked to report on the outcome of their innovation by 2 November 2012.

Stated Learning Outcomes

LO1 participants will learn about knowledge mapping and curriculum development.

LO2 members of the Enthusiasts Network will learn how to implement curriculum changes with support and feedback from other members of the Network.

T41: Research and practice: implications for learning

Chair: Elizabeth Godfrey, University of Technology Sydney
Tuesday 15.00-16.30, Sirius Room

Gatekeeping or filtering?: Investigating the connection between peer review and research quality

Keith Willey[1], Lesley Jolly[2], Gregory Tibbits[2], Anne Gardner[1]

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Abstract

Arguably, the most important opportunity to acquire the standards and norms of the discipline and develop researchersÐ judgement is the peer review process – but this depends on the quality of the reviews. „GoodÐ feedback - which we take to mean feedback that has the capacity to improve subsequent practice - has been identified as being timely, specific and relevant. Yet often reviews lack these basic qualities. In this paper we report an investigation of the peer review process at the 2010 Australasian Association of Engineering Education (AAEE) conference. Authors at the conference were given the chance to rate their reviews and we subsequently analysed both the nature of the reviews and authorsÐ responses. Findings suggest that the opportunity to use the peer review process to induct people into the field and improve practice is being missed. As in other disciplines there is also ample evidence that the review process does little or nothing to ensure the standard and relevance of conference presentations. It is therefore legitimate to ask whether there may not be better processes to attain these ends and we conclude with some discussion of how the review process may be made more helpful for everyone involved.

Work integrated learning: a realistic evaluation of KMUTT's chemical engineering practice school

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Abstract

ChEPS is a 2-year Masters program which is based on work-integrated-learning principles. The program produces chemical engineers possessing attributes industry requires through the integration of chemical engineering courses and real-life problems experienced through placement in industry. Since its inception in 1997, the program has produced nearly 260 graduates and over half of them are now working for leading companies in Thailand. In general, ChEPS graduates are highly sought after by industry. As part of a program review concentrating on student learning at placements, program effectiveness, and sustainability, Realistic Evaluation [Pawson & Tilley 1997, Realistic evaluation, Thousand Oaks, California: Sage] was used to evaluate the perspectives of key stakeholders: current students, alumni, university, placement sponsors, and subsequent employers. Through the RE framework, the paper illustrates how the placement contexts have impacts on program outcomes. An understanding of the contextual impacts could lead to a better understanding between the university and the placement, and the awareness of mentor teaching strategies.

Profiling graduate outcomes for Stage 1 Professional Engineers

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Abstract

A study has been conducted to identify a clear set of desired target achievement levels for the Stage 1 professional competencies specified by Engineers Australia for graduate level engineers. The Stage 1 competencies provide detailed statements of required competency, but it should be acknowledged that these are not simply pass/fail achievements.Different levels of expectation can be assigned to these competencies for different levels of graduate capability and professional experience. A survey was distributed to a wide range of senior professional engineers to identify their judgements on what levels of achievement towards these competencies should be expected of a graduate engineer. These senior engineers were also asked to assess the actual competency levels they would attribute to most recently graduated engineers, using a well defined scale of achievement. While a fair degree of variation was evident, aggregation of this data set has allowed us to define a desired competency target map for the Stage 1 professional engineering competencies. Commonly perceived shortfalls in the competency achievement levels of recent graduates have also been identified. This data is very useful when looking to perform professional competency mapping at an undergraduate degree course level, both to improve graduate outcomes, and for accreditation purposes. The paper describes the survey methodology and the results obtained and represents, to the best of the authors' knowledge, one of the first attempts to formally assess the Engineers Australia competencies by practicing professional engineers.

Engineering education research groups in Australia: Implications for Australasian engineering educators

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Abstract

Learning and teaching innovation is becoming more necessary in engineering, particularly with the new Engineers Australia Stage 1 Competencies and the 'voucher' system starting in 2012. There is also increasing pressure on academics to undertake research and publish. In Australia, a small number of groups have formed to meet these challenges and help engineering academics develop their education research practices. However while these groups have developed in and are focused on their local context, the factors that influenced their creation and support or hinder their growth have implications for similar groups in future. This paper aims to compare and contrast three such groups to identify essential elements of engineering education research groups in Australasia. Three case studies are presented from the perspective of the coordinators of the groups, along with a thematic analysis conducted across the three cases.

Student performance in an online postgraduate course on fibre composites for civil engineers

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Abstract

This paper presents an evaluation on the performance of students from 2008-2011 in the Australia's first online course on fibre composites for civil engineers. The evaluation focused on the overall performance of the students to determine the effectiveness of the course content and delivery. In its 4 years of delivery, the course gained significant popularity as seen by the increased in the number of enrolled students coming from different demographics. The introduction of innovative learning resources resulted in the increasing level of interest on the different study modules. There is also a high satisfaction of the students to the course as shown by their active participation, quality of overall performance and feedback. It was found out that postgraduate and senior undergraduate students performed better than students who have not taken the fundamentals of engineering design. Based on the results of this study, improvements are planned to further enhance the course delivery and to ensure a more effective student's learning.

T42: Reflections on approaches to learning and teaching

Chair: Graham A. Moore, The University of Melbourne — Tuesday 15.00-16.30, Pleiades Room

Introducing undergraduate electrical engineering students to reflective practice

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Abstract

A major feature of engineering courses at Victoria University (VU), Melbourne is a problem-based and work-related approach to student learning aimed at equipping students with both technical competencies and generic employability skills. Engineering courses at VU are accredited by the professional association, Engineers Australia (EA) and thus subscribe to developing in students the competency standards required of graduate engineers.

This paper reports on student responses in a reflective practice assessment task newly introduced in a unit of study in the Bachelor of Engineering (Electrical and Electronic). The assessment task was comprised of two elements, a self- audit on EA competencies and a guided self reflection on the students' strengths, skills gaps, and improvement strategies. An assessment in reflective practice was instituted because of the considerable literature attesting to the benefit it has for student learning. As Hinett (2002) states, reflective practice enables students to: 1) understand what they already know; 2) identify what they need to know in order to advance understanding of the subject; 3) make sense of new information and feedback in the context of their own experience and 4) guide choices for further learning. Reflective practice is not common in engineering courses and it was believed that this exercise would heighten students' awareness of EA competencies, how they were tracking on attaining them and what they needed to do to improve. This paper reports the preliminary findings of how students responded in their assessments in the first unit of study. Although this is primarily presented as a case study, the responses have been quantitatively and qualitatively analysed. The early findings demonstrate how student perceptions on their proficiencies changed between the start and end of semester; the skills that they felt were most lacking; and the difference in value and accuracy of self-audits compared to guided reflections.

Interdisciplinary learning for final year engineering projects: case studies

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Abstract

Recent research has highlighted that today's engineering graduates need to have stronger interdisciplinary communication and teamwork skills as well as a broader perspective of the issues that concern their profession such as social, environmental and economic issues. We review a number of interdisciplinary project based case studies to determine what motivates students to learn and achieve and compare our experience with Problem Based Learning (PBL) and Project Based Learning (PjBL) frameworks. Our analysis uncovered factors other than those traditionally identified in PBL or PjBL that appear to play a significant role in learning achievement.

Dynamic and static worked examples in student learning

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Abstract

This paper investigated the effectiveness of static (text and pictures) and dynamic (video plus audio) worked examples in student learning. Seventy-one RMIT students enrolled in a third year unit on electronic engineering used both dynamic and static recordings of solutions of tutorial problems. It was found that students did not use worked examples regularly, but studied them just before events of summative assessment.

The majority of students did not download worked examples, but rehearsed directly from the RMIT unit site. Student perceptions that dynamic worked examples significantly helped them in improving their course knowledge was supported by statistically significant improvement in final examination performance attributed to dynamic worked examples.

Large-class peer-marked assignments for improving second-year student performance in Electrical and Computer Engineering

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Abstract

Peer-marked assignments (PMAs) have been used successfully to improve student engagement in small tutorial groups in a first-year engineering course at the University of Auckland. This paper reports on an investigation to determine whether PMAs could also be used in the second year of the programme, when small tutorial groups are no longer available.

Research methodology included holding fortnightly PMA sessions in classes of 150+ students in the core course ELECTENG 202, Circuits and Systems. Peer marking was carried out under the guidance of a lecturer, and with the help of teaching assistants. Sessions lasted about half a lecture period (25 minutes) each. Students received a 1% mark for doing an assignment, and marking another's. They were required to interact with the tutorial material both from the perspective of one solving the problem, and also from the perspective of a marker. 92.2% of students participated in the peer-marked sessions. The research was evaluated formally by surveys of students involved, and by an assessment of examination performance. The great majority of students indicated that they found PMAs very helpful, and the course was given a very high 'satisfaction' score. Another second-year course will trial large-class PMAs shortly.

Getting tutors on the same page

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Abstract

In large engineering subjects, it is common to have multiple tutors where each tutor is responsible for grading the assessment tasks for students in their tutorial. An issue regularly faced by subject coordinators is how to achieve a consistent standard of marking and feedback quality amongst different tutors. To address this issue the authors initially used a number of methods including double blind marking to support consistent grading. However, with increasing demands on academics these time-consuming activities became an unrealistic option. This process was improved by using a software tool to compare both the marking and feedback provided by different tutors for a number of randomly selected project tasks. In this paper, we report using new software features developed as a result of this previous research to quickly establish and build a community of assessment practice amongst subject tutors. The reported process promotes inclusiveness by using a software tool to anonymously record and report tutor assessments allowing all opinions to be considered during a subsequent discussion activity. Even though this pilot exercise was undertaken by experienced tutors it significantly influenced their feedback skills and to a lesser extent their marking standards.

T43: Pathways and practical experience in engineering education

Chair: David Dowling, University of Southern Queensland — Tuesday 15.00-16.30, Carnac Room

Creating better learning environments by cross disciplinary collaboration: a civil engineering and surveying linkage

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Abstract

Many of the teaching elements in Civil and Environmental Engineering and Spatial

Science/Surveying are strongly related to multidisciplinary real-world situations. Professionals in each discipline commonly work collaboratively, knowing each other's professional and technical limitations and requirements. Replication of such real-world situations allows students to gain an insight and acquire knowledge of professional practice for both civil engineering and spatial science disciplines. However, replication of an authentic design project is not always possible in a single unit basis where empirical project situations are often created with controlled sets of constraints, inputs and outputs. A cross-disciplinary design-based project that is designed to promote active student learning, engagement and professional integration would be the preferred option. The central aim of this collaborative project was to create positive and inclusive environments to promote engaging learning opportunities that cater for a range of learning styles with a two-way linkage involving third year civil engineering and spatial science (surveying) students. This paper describes the cross disciplinary project developed and delivered in 2010 and 2011. A survey was conducted at completion of the project to assess the degree of improvement in student engagement and their learning experiences. Improvements were assessed in a range of dimensions including student motivation, learning by cross-disciplinary collaboration and learning by authentic design project experiences. In this specific cross-disciplinary linkage project, the study findings showed that teaching approaches utilised have been effective in promoting active student learning and increasing engagement.

Secondary student research projects in engineering: optical fibre Bragg grating sensor applications

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Abstract

In this paper, we present a study of secondary student research projects on fibre Bragg grating (FBG) based optical fibre sensors. Our study has shown that simple experimental procedures can be developed and implemented by students with minimal prior knowledge. In these experiments, students gain a significant understanding of FBG properties and performance, as well as an understanding of research, data analysis and communications skills required by researchers. Student satisfaction and enjoyment with the programme is very high, based on feedback received. These research-based projects would be ideal for implementation into undergraduate engineering learning programmes.

Computer based experiments for off-campus teaching and learning of AC electricity

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Abstract

In this work, we show the implementation of a computer based Digital Storage Oscilloscope (DSO) and Signal Generator (SG), using the computers soundcard for off campus AC electronics experiments. The microphone input is used for the DSO, and the speaker jack is used as the SG. In an effort to reduce the cost of implementing the experiment, we examine software available for free online. A small number of applications were compared in terms of their interface and functionality, for both the DSO and SG. With the choice of a suitable app for both the input and the output, simple AC experiments were completed using the computer based DSO.

Paving a professional pathway: work integrated learning in Construction Management and Nursing and its implications for Engineering students

Abstract

Many disciplines are currently exploring ways to either initiate or improve the engagement of their students in work integrated learning (WIL). The disciplines of Construction

Management (Con Mgt) and Nursing are no exception and have collaborated in an Australian

Learning and Teaching Council (ALTC) research grant entitled 'Facilitating work integrated learning through skills-enabled e-Portfolios (electronic portfolio platforms were reviewed as part of the project as a potential tool to support and document WIL experiences, these platforms are not reviewed in this paper) in the Con Mgt and Nursing disciplines' led by The University of Newcastle,

Australia. In both of these disciplines, employers expect students to be 'work ready' on graduation. Nevertheless, students often question the relationship between the theoretical concepts they are taught at university and their experiences of the 'real world'. This paper investigates this issue, the nature of student engagement of theory whilst on placement, and offers a possible solution through reflexive practise. To do this, the paper briefly describes the ALTC research project and discusses findings from the quantitative and qualitative data gathered from the competency statements of accreditation professional institutions, focus groups and an on-line survey. Initially, it aligns the competencies Con Mgt and Nursing students garner during their placements and then proposes a reflection framework as a means of closing the gap between theory and practise. This framework offers an example of how students could reflect on their level of competence through reflective questions. The paper then explores students' own views on their placement experiences, such as methods of integrating practise and students' feelings of preparedness to enter their professional placement. Engineering disciplines that align with Con Mgt may find value in this study.

Teaching Module of Conceptual Engineering Design for Civil Engineering Undergraduates

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Abstract

Fundamental strategies of conceptual engineering design, such as construction of weighted objective trees, performance of function-mean analysis and employing of morphological charts are useful not only to develop alternative designs but also to evaluate and select the best alternative design. Because of this reason, many universities have introduced new modules on conceptual engineering design into their engineering curriculum. Weighted objective trees are used to analyse and weigh the intended objectives of the product to be designed, while function-mean analysis is performed to investigate how the same function could be achieved by different means. Morphological charts depict all the information in a tabular form enabling the designer to assess each alternative design. This presentation presents the details of the teaching module of conceptual engineering design, which is suitable for engineering students of 1st year or 2nd year before they learn the comprehensive detailed design methods. The expected learning outcome of the module is to develop ability of analysing and then synthesizing the information gathered from the existing products, such as engineering structures, in order to develop totally novel product conceptually without going in to details. It is proposed that a group of Civil Engineering students are taught the fundamental concepts of Conceptual Engineering Design and project based assignment is given to them before they are taught comprehensive detailed design of structures/structural elements. To test the learning outcomes, whether the students can apply this knowledge to their comprehensive design projects later on, the same group of students will be inquired after they are taught comprehensive detailed structural designs. The presentation will highlight how the teaching of conceptual engineering design can assist the students to achieve the expected learning outcomes and possess graduate attributes and skills in the more broaden perspectives towards comprehensive engineering designs in practice.

Designing a Specialist Engineering pathway from Year 8: how does one engineer that?

Peter Scaife

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Abstract

Secondary education has begun an exciting new sphere with the commencement of the Engineering Studies, an accredited course by Curriculum Council which can be counted towards one's university entry. Such a course entices schools and their communities to break from traditional offerings because it is exciting and relevant for today's students who often seek strong links with university pathways. It was just a matter of time, thereafter, for schools to consider to profile themselves as Specialist Engineering schools. The Department of Education and the Midland community saw the opportunity, heard the voices of industry and the tertiary education sector and answered the call. Governor Stirling Senior High, a public school which had been serving both the country students who bordered at Swanleigh Residential Boarding as well at students in the Swan valley since 1958, was about to be reborn in a new multimillion dollar complex, but its new design was only half the excitement; it was to be reborn as an Engineering 'lighthouse' school.

This presentation shares the story of the journey and planning that has been undertaken to breathe excitement into Western Australia's first dedicated Department-endorsed Specialist academic Engineering school. It will elucidate how Governor Stirling Senior High School in consultation with its community identified that Engineering studies was a key priority for students in the region and opted for this distinctive profile.

The selection process is already currently under way with Year 6 students applying for entry into the 2013 Year 8 intake. Peter Scaife, the Associate Principal at the school, will outline the selection process, issues and decisions which administrators, teachers and the school community have wrestled with in shaping the programs and mapping out the vision for its students in the Engineering streams. He will also outline the support provided by university and industry groups on that journey.

Notes

T44: New technologies for inclusive problem solving

Chair: Irene Penesis, The Australian Maritime College at the University of Tasmania Tuesday 15.00-16.30, Garden Room

Using Wiki as a facilitative tool for group work

Amir Abdekhodaee, Palaneeswaran Ekambaram & Rosemary Borland

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Abstract

Setting an effective learning experience for students is a very complex process and yet, this has become even more challenging as the numbers of students in lectures are increasing. Apart from the usual complexities such as additional administration processes and errors associated with large units, there are other critical issues that need to be addressed. In particular, students may not have the opportunity of reasonable interaction with the lecturer and their classmates. Certainly larger units have the potential to provide an opportunity of having a wider range of lateral thinking and innovative ideas. However, these opportunities are often overlooked as there is no practical tool to support them. In this paper we report on our ongoing work using a Wiki for two different units, one an undergraduate unit and another at a postgraduate level. We found that while there are considerable differences between our perception and students' perceptions on using a Wiki, it can be a powerful tool for providing a space for students to present and record their efforts. Through using Wiki students can effectively disseminate their work and interact beyond their tutorial classes.

Internet-hosted assessment system for effective teaching and enhanced learning for engineering subjects

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Abstract

Despite of their popularity, online Learning Management Systems suffer serious limitations as a reliable and effective assessment tool in their implementation for engineering education, partly due to their demand for equation manipulation and multiple stage problem solving. An innovative spreadsheet based assessment tool (e-Task) which is designed to overcome such shortcoming and provides effective teaching and enhanced learning for engineering subjects has been proposed by the authors. The tool was developed for both formative and summative assessments with a capability to automatically collect not only results but also feedback from students on their perceived learning. Building on the previous work, this paper presents a further development by introducing a new deployment concept of the e-Task through internet-hosting of the system in order to enable effective teaching and enhanced learning of engineering subjects. The proposed internet-hosted assessment system (e-Task) integrates state-of– the-art cloud computing technology by incorporating a spreadsheet-like environment that can accommodate a wider range of users and course developers as well as enables easier expansion of the system in the future. It greatly enhances the fundamental concepts proposed in the original e-Taks by offering better accessibility, flexibility and controllability. It obviates any need of a specific software or hardware for the operational platform and requires only Internet access for its operation. Features of the Internet hosted e-Task include: the ability to access it by various Internet browsers, embedding learning and diagnostic feedback, individualised data sets for each students and automated marking & feedback.

Problem comprehension is the key to client problem solving

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Abstract

This paper seeks to understand the causes of the poor perception of engineers' service quality in the context of their approach to solving the problems of clients. The present study was restricted to the building and construction industry as it involves a large proportion of multidisciplinary consulting engineers with a distinct and identifiable client base. We draw on architects' perceptions of engineer performance because in a previous study engineers frequently referred to project architects as their clients. When interviewing 11 engineers and six architects, we observed disparities between engineers' perception of their roles and what was expected of them by the architects. The engineers described their role as providing engineering design in projects as well as solving problems presented by clients. The architects indicated they felt engineers' role was to provide solutions that met their broad architectural needs. However, all the architects described engineers as not being proactive enough in understanding their problems and unwilling to offer alternative solutions.

These qualitative interviews indicate that service quality issues may arise from engineers' inability to fully comprehend and identify problems. Engineers in our study appeared to be more comfortable when solving clearly defined problems, and less comfortable with the time commitment needed to fully explore client problems. We suggest that engineering educators could improve students' problem comprehension skills, by expanding the current focus on finding solutions to pre-defined problems to better expose students to complex problems that graduates encounter when they enter the workplace.

Exploring a cross-disciplinary research initiative with Remote Access Laboratories: Robot RAL-ly as a stimulus for consideration of Engineering pathway

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Abstract

A well-established project exists within the Faculty of Engineering and Surveying at the University of Southern Queensland (USQ), where students are provided remote access to video-supported laboratory experimentation so as to actively engage in contextual action-orientated learning. In this paper we describe a project in which

Remote Access Laboratory (RAL) technology developed for university engineering academics at USQ was expanded to explore the cross-disciplinary application of the system. A team of academics from USQ's Faculty of Education joined the existing RAL technology team from the Faculty of Engineering and Surveying to develop a workshop for primary school children. The children were aged between seven and twelve, and included both boys and girls. This project aimed at providing a stimulus for these children to engage in Engineering-inspired activities so as to promote this as a possible pathway for further study. At the end of the workshop, the children participated in a coconstructed focus group discussion. A thematic analysis of this focus group recording indicates that the remote manipulation of real objects provides children in this age-group with opportunities for rich learning experiences. The initial perspectives of academics were also explored through critical reflection on the program's design and delivery and a thematic analysis was performed. The paper concludes that, regardless of access and mode of study or discipline background, high quality interactions, with peers and academic staff in an informal context, are vital to the building of enhanced capacity for rich learning experiences and motivation for further experimentation.

Diversity and longevity: a framework for graduate attribute development in engineering education

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Abstract

The phrase "Graduate Attributes" invokes many feelings; hope, fear, disappointment, and perhaps most commonly, confusion. The first key question "Do we want graduate attributes?", is largely decided with most Australian universities deciding that Graduate Attributes are important. Investigation of the second key question, "Which graduate attributes do students need?", is now well under way at these institutions. The third key question "How do we develop and document the development of graduate attributes?" is still in its infancy and this is the question addressed in this paper. After considering the problems associated with teaching graduate attributes, a framework is proposed. Within this framework the role of ePortfolios is discussed.

Creation of a construction practice laboratory

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Abstract

A Construction Practice Laboratory was set up to give students a better understanding of some of the processes carried out on a construction site. These processes involve construction of a scaffold, assembly of formwork for a concrete slab, and demonstration of a climbing safety screen. In addition to knowledge of the physical aspects of these processes the students also gain insight into other aspects, such as teamwork and OHS. The Construction Practice Laboratory is unique. Students do not just plan the activities, but actually carry them out using full size industrial equipment

T45: Embracing student preferences

Chair: Margaret Jollands, RMIT University — Tuesday 15.00-16.30, Rottnest Room

The role of engineering in a career change pathway into technology teaching

P. John Williams and Janis Swan

University of Waikato

Abstract

The University of Waikato developed an innovative two-year engineering/education qualification to attract a group of learners traditionally excluded or disadvantaged in their access to tertiary study and secondary teaching as a career choice. The factors that prompted and supported collaboration between the Faculty of Science and Engineering and the Faculty of Education to develop and deliver a programme that enables industry-trained and qualified learners to gain the engineering qualification required for teaching technology in secondary schools is described. A cross-sequential – patch-up research design was used to collect data from students in both years of the two-year programme to assess the effectiveness of the pathway.

Representing and valuing non-engineering contributions to engineering graduate outcomes in engineering combined degrees

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Abstract

Efforts to incorporate broader cross-disciplinary learning pathways within engineering programs face a number of barriers. An essential requirement is a reliable mechanism for representing and valuing the non-engineering components that engineering students may have previously completed or may wish to include. The paper presents an alternative method for compiling and reviewing aggregate learning outcomes in engineering degree combinations that enables the contribution of the non-engineering component to be more readily defined and justified in engineering terms. The proposed method enables ready cross-disciplinary translation of outcomes achievement without requiring specific cross-disciplinary expertise or engagement by academic staff involved, and without additional workloads or information burden. The proposed method is demonstrated through an outcomes analysis of an existing engineering combined degree but has potential application in the review and validation of cross-disciplinary learning outcomes more generally.

Linking engineering students' assessment preferences to their learning approaches

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Abstract

The very nature of an Engineer implies that one has an inherent passion for investigation and problem solving. The secondary school system and to some extent the traditional university system is focused on teacher-centred learning; however, this approach does not ideally foster deep learning approaches, research-based learning (RBL) and teamwork that are vital attributes of any graduate engineer. Previous studies have confirmed that engineering students thrive and feel comfortable with traditional teacher-centred learning, which is focused on exams, and rote learning. These research studies instigated a strong resolve of many engineering educators to implement project/problem-based learning (PBL) approaches in program curriculum in order to enhance graduate outcomes. This study offers one of the first attempts to link engineering students' approaches to learning with their assessment type preferences. The study empirically confirmed the proposition that deep learners also had a greater preference for deep assessment items and surface learners preferred surface assessment methods.

Surface learners ranked both surface and deep assessment items on average lower than deep learners, indicating that surface learners do not have the same level of engagement in their learning through assessment in general. The paper concludes with some recommendations for engineering education policy and practice.

Observing cultural interactions in engineering design projects

Thomas Goldfinch[1], Catherine Layton[1], Anne Gardner[2], Giles Thomas[3], Alan Henderson[3] & Timothy McCarthy[1]

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Abstract

The University of Wollongong and partner institutions UTAS, UTS, and QUT have engaged in an ALTC funded project to address issues of intercultural competence in engineering. As a major component of this project, observational research techniques are being employed to assess the current state of intercultural competence in first and second year engineering students. The research described in this paper is a process employed by the authors to observe cultural interactions between students in first or second year design subjects. The process involves simple video recordings of the groups' interactions over the course of a normal project team meeting, which are then coded and analysed using NVivo 8. To identify cultural diversity within the observed groups and perceived intercultural competency, the observation session is followed by a brief survey which incorporates dimensions of self and peer evaluation. This research will be conducted at all four participating institutions over the teaching semesters of 2011. As well as establishing an overview of the current state of intercultural intelligence amongst engineering cohorts, these research outcomes will be used to develop packaged teaching modules for developing intercultural intelligence amongst both engineering students and teaching staff.

Interdisciplinarity as a path to inclusivity in the engineering classroom: a design-based research approach

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Abstract

Engineering as a professional practice frequently involves multifaceted, interdisciplinary teams addressing complex problems. Consequently there is increasing demand on engineering education, which is often constrained by strict discipline boundaries, to equip students with the necessary competencies to contribute effectively in multidisciplinary contexts. This paper introduces one approach to reducing these boundaries and describes the theoretical basis for, and the design of, an interdisciplinary project-based subject presented at third year level, where students from a range of disciplines worked together on a real-world project. It addresses some of the challenges and issues experienced and discusses possible ways forward in introducing interdisciplinarity into an engineering curriculum.

Australian engineering academe: a snapshot of demographics and attitudes

Ian Cameron[1], Carl Reidsema[1] & Roger Hadgraft[2]

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Abstract

This paper provides a preliminary review of survey data gathered from engineering academics across Australia during late 2010 and into early 2011. Previously, little has been done to gather and interpret the demographics and attitudes of engineering staff in higher education institutions. The survey was done as part of several Australian Learning & Teaching Council (ALTC) projects addressing challenges in enhancing engineering education practice.

This "snap-shot" of the survey data provides some interesting insights into the current status of engineering higher education professionals. It should provide a basis for on-going considerations around challenges, opportunities and barriers related to quality and change management in engineering education. The paper outlines some key areas in engineering academe and educational practice from over 600 respondents covering all major university groupings such as the Group of Eight (Go8), Australian Technological Network (ATN), Innovating Research Universities (IRU) and non-aligned institutions, and over 15 engineering sub-disciplines.

Workshop W21: What is Modern Engineering?

Chair: Andrew Perren
Wednesday 10:30-Noon, Sirius Room

Andrew Perren & Daniel Loden

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Abstract

This workshop will be an interactive Science and Engineering workshop designed for year 8 to 10 students. Engineers Without Borders will conduct a demonstration of this workshop with teachers present at the event. This will be an excellent opportunity to see the program in operation and determine if it is appropriate for your science class curriculum. The workshop provides students with exposure to the application of science in engineering utilising the context of the developing world. Participants will learn how science and engineering can be utilised to help disadvantaged people around the world.

Stated Learning Outcomes

LO1 Basic Science and engineering principles applied to the real world.

LO2 Creative and Interactive learning environment.

LO3 Understanding of different science and engineering contexts.

Notes

W22: Engineering for social and environmental justice

Chair: John Buckeridge – RMIT University | Wednesday 10:30-Noon, Pleiades Room

Do engineers still move mountains? A "new world" appraisal in light of ethics, engineering, economics & the environment

John Buckeridge

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Abstract

The preamble to the Washington Accord stipulates that engineering must be carried out responsibly and ethically, and be environmentally sound and sustainable.

Without these criteria being met, engineering programmes will not be accredited. As a profession, engineers enjoy high social status and the privileges that flow from this; in turn engineers are expected to discharge their duties in a responsible, ethical fashion.

That ethical behaviour is discussed on six separate sections in the 15-page document of the Accord's graduate attributes should give us cause to contemplate the importance that our profession places on ethical behaviour. This paper reviews why ethical awareness is so much a focus in the accreditation of undergraduate degrees in engineering; it then outlines a course on professional ethics that has been successfully taught for two decades in Australia, Germany and New Zealand. When initiated, this course was designed to serve the environmental engineering undergraduate but is now used in a plethora of programmes, including management and the humanities. It has also served a useful purpose in international benchmarking of the engineering curriculum. Over two decades, course handouts have evolved too - into texts, the latest of which, 4 Es: Ethics, Engineering, Economics & Environment is in its second edition. The paper then reflects upon how our profession has changed in the last few decades and whether we can, in light of environmental constraints, still contemplate the moving of mountains.

Evidence of intercultural competency from engineers without borders challenge projects

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Abstract

In 2010, the Faculty of Engineering at the University of Wollongong incorporated the Engineers Without Borders (EWB) Challenge into a first year design subject as a compulsory project. New tutorial activities and guest lecturers were incorporated into the subject to cover some of the broader aspects of culture and their impacts on engineering design as support to the EWB Challenge. Using NVivo to analyse a sample of students' EWB design reports, the authors then evaluated the extent to which students identified cultural issues associated with their EWB designs. This qualitative analysis coded relevant text in students' reports according to five dimensions of aboriginal culture, which are country, kinship, culture, journey and connectedness; and whether these references related to technical, social or cultural aspects of their design. The analysis found that the type of project students selected for their EWB challenge design was related to how deeply they considered cultural factors within the design. The research also indicated that the design groups' consideration of cultural factors was not necessarily reflected in their marks, or the tutors' recognition of the quality of their work. This finding has implications for assessment design where learning outcomes stipulate development of intercultural competency. Moreover this research suggests that, in setting engineering design tasks, the focus of the design project, i.e., the object or system to be designed, and not just the design context, needs to be carefully selected to maximize opportunities for students' development of intercultural competency.

The socially just engineer and social entrepreneurship – the case of Waste-for-Life, Argentina

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Abstract

In this paper, the authors develop both academic and broader social recognition of modes of social innovation and values-based action for engineering practice that may have close affinities with social entrepreneurship. The notion of social innovation predates the more recent conceptual and social development of social entrepreneurship (this should not be confused with the post-hoc re-descriptions of social entrepreneurs and social entrepreneurship), and it is interesting that Illich should develop his understanding of social innovation early on, amidst concern about technology and in the context of Latin America. 'Waste for Life' is a real attempt to enact socially just engineering with co-operatives in Buenos Aires. However it is still fraught with difficulties, this paper considers the Socially Just Engineer potentially joining the Social Entrepreneur as radical characters in late modernity. One way of developing a socially just mindset in engineering students might be to expose students to the wealth of knowledge in the social entrepreneurship arena.

Review of the Enhancement of university curriculum through utilisation of sustainable engineering and appropriate technology workshops

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Abstract

In 2010 Engineers Without Borders Australia (EWBA) began to work with the Engineering faculties of WA based universities to develop a new education program designed to provide a practical and meaningful task for engineering students to undertake as part of their coursework through EWBA outreach activities. This program was designed to meet the broader requirements of Engineers Australia's Professional Engineering Attributes focusing on engineering sustainability outcomes and to facilitate engagement between university and secondary school curriculum via sustainable engineering and appropriate technology workshops.

This paper builds on the work completed in 2010 to evaluate the success of the program in meeting its university curriculum objectives and students' satisfaction. Evaluation of the program though written feedback and online survey of participating students and schools found that the program was successful in meeting the university learning outcomes aligned with the Engineers Australia Professional Engineering Attributes whilst undertaking practical and meaningful service within the community. The feedback also demonstrated some opportunities to improve the quality of the Future Engineers program by providing more contextual information and details of professional practice and by improving the coordination of the location and timing of outreach visits which will be incorporated into the program next year.

Personal values and the ecological worldview of civil engineering and environmental science students

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Abstract

Civil and transport engineers and the discipline, with a preoccupation with design and operational standards, have historically been accused of leading infrastructure transformations that degrade the integrity of natural ecosystems and impersonalise the public arena (Bergen et al. 2001; Harris 2008; Postman 1992). The public perception is vastly improved given curricula that integrate sustainability principles (Koth et al. 2009), innovative construction materials with low embodied energy, and more public accessibility into consensual decision-making. The sustainability debate, however, has turned to questions of unlimited growth and the implied climate change crisis. There is a dearth of information on how environmental attitudes held by engineering students have transitioned to keep pace with evolving values in western industrialized societies with regard to stewardship of planetary resources. The New Ecological Paradigm (NEP) was administered to final year civil engineering (CE) students, along with Schwartz's Values Survey detailing deeply held, life guiding principles. The study found a cohort (33%) of CE students whose responses across the scale mirrors those of environmental degree students also studied, in being 'greenest' and more concerned about ecological crises. However, CE students show the greatest, significant mean differences with environmental students in dimensions associated with inter-species equity, an optimism that supports modifications to the natural world, and resiliency in the balance of nature. The bottom ranking of beauty as an important life principle also distinguishes civil engineering students. The work offers ideas for course content that addresses what may be fundamental value differences between CE graduates and the environmentalist public.

W23: Capabilities and development: transforming students learning

Chair: George Banky, Swinburne University of Technology — Wednesday 10:30-Noon, Carnac Room

Improving student engagement with self-assessment through ePortfolios

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Abstract

Self-assessment is an integral component of learning from experience and a core skill for engineers to continue their professional development. Programs that accredit engineers need to provide course assessment and learning activities that develop these essential skills. One tool that has been identified as important for supporting development of self-assessment is the ePortfolio. A three year longitudinal study of firstyear engineering student engagement with and success in self-assessment using ePortfolios has been conducted. The self-assessment task was embedded within students ePortfolios that they compiled to display and reflect upon their CAD modelling and engineering drawings. In each of the three years, students were introduced and supported in self-assessment through ePortfolios with similar orientation experiences, focused computer practical sessions, mentor support and developmental feedback from teaching staff and helpdesks. The proportion of students that participated in the selfassessment activity, the depth of their reflection and their ability to predict their final grade compared to the actual grade, were used to evaluate student's self-assessment skill development. A significant positive shift in these measures of self-assessment was observed when the ePortfolio tool was changed from PebblePad to Mahara in 2011. Students were more deeply engaged and thus participated more in the self-assessment activities. Through this process students were demonstrably more accurate in their selfassessment. A link between a student's ability to self-assess and the level of student engagement in the course was also observed. It is proposed that Mahara's simplified interface was able to more clearly articulate what was expected of the students to be successful in the course, compared to a similar self-assessment task using the Profiler tool in PebblePad. Although more problematic to aggregate, using Mahara-based selfassessment has better supported and more deeply engaged our students in the development of self-assessment of their professional engineering skill level.

Modelling competency standards to facilitate accreditation: a pathways perspective

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Abstract

Accreditation forms the basis of many professional societies, with members able to present themselves as competent to provide a range of services. Within Engineering in Australia, there is growing interest in developing formalized processes with international recognition. Current interest in accreditation management includes development of a methodology to map between curricula of engineering programs and the appropriate competency standards, as well as assessment of the education and experience of those not undertaking accredited programs. An additional incentive is the increase in diversity of education pathways into the engineering workforce, which need to be assessed. This paper focuses on the achievement of Engineers Australia's Stage 1 Competency as a Professional Engineer. The goal of the paper is to offer a proposal for a process that can be used to document and analyse complex competency frameworks. We show that the modelling process can identify whether the assessed elements are sufficient to achieve accredited status or highlight areas requiring further development. The value of this work is the relative ease with which a program or a person may be assessed against the competency standard, once a suitable model has been developed.

A review of three approaches to determining students' capabilities for studying engineering

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Abstract

The staff at a number of Australian engineering schools are using a range of aptitude tests to: (a) grow student numbers in engineering programs by facilitating the entry of students who have an aptitude to study engineering but do not meet entry requirements;(b) identify 'at risk' students and provide them with counselling and remedial classes to facilitate a successful transition to university; (c) empower students with self-awareness and learning skills; and/or (d) identify the factors that lead to success in first year engineering studies. Some examples of the tests currently being used include the Australian Technology Network Engineering Selection Test (ATNEST); the Preparing for First Year Engineering (PFFYE) competency test; and the Student Learning Profiles online test. This paper reviews these three approaches currently being used in Australian universities and describes the methods used to deploy the tests, and the experiences gained from implementing the tests. The paper discusses the outcomes of the tests and explores the feasibility of synthesising the best features of the existing tests to develop a single multi-purpose test. Engineering schools could then be able to select and deploy the test, or components of the test, to meet their requirements.

Change Strategies for Educational Transformation

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Abstract

The authors present a position paper suggesting that while there is evidence for change within engineering curriculum towards best practice, there are significant barriers primarily at the operational level which bring into question the likelihood of more widespread adoption of hard won gains. It is argued that transformational change is required which "(a) alters the culture of the institution by changing select underlying assumptions and institutional behaviours, processes, and products; (b) is deep and pervasive, affecting the whole institution; (c) is intentional; and (d) occurs over time" (Kezar & Eckel 2002) and that change leadership of this nature must be distributed, not solely laid at the feet of Deans and Vice Chancellors. A strategy for change is presented based on observations and evidence from the ALTC project "Design based curriculum reform within engineering education" and the recently completed ALTC Discipline Scholars' Survey of Engineering Academics grounded in the research for transformational change within businesses, universities and teaching and learning. This model for change proposes the development of a network of change agents built on a brokerage model to improve best practice and leadership capacity through systematically and directly engaging with the strategic/tactical and operational levels of engineering faculties.

ePortfolios to empower students in providing evidence of learning and professional development

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Abstract

University teachers are always asking: 1) how do we know that our students are achieving the expected learning outcomes in our courses, and 2) what evidence do we have to support the claim that they do? Program leaders and deans/associate deans face the same questions at the program level. These are questions that are invariably on the agenda of every visiting accreditation panel. However, the answers to these questions are not always straightforward. In the context of increasing emphasis on quality assurance, as evidenced in Australia by the establishment of the Tertiary Education Quality and Standards Agency (TEQSA) and the creation of discipline-based Threshold Learning Outcomes (TLOs), the higher education sector needs to take a more evidence-based approach to answer these questions. This paper presents a case study in a computer hardware design course taken by students of computer engineering and related programs. It uses an ePortfolio-based approach to support student self-assessment and reflection, leading to the creation of a Career Episode Report (CER) using Engineers Australia's CER templates. The CER contains the students' narration of how they developed certain professional competencies and is supported by evidence. The paper presents the experience gained along with student survey results, comments and peer feedback.

W24: Addressing student needs and enhancing understanding

Chair: Les Dawes, Queensland University of Technology — Wednesday 10:30-Noon, Garden Room

A sequential Project Based Learning programme designed to meet the graduate attributes of engineering students

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Abstract

Current Australian engineering curriculum focuses strongly on engineering science and is typically technically based and content driven. Often insufficient emphasis is placed on relating content to current industry practice and generic skills. Courses taught with many practical examples drawn from real life or incorporate industry practice better prepare students for situations that they have not previously experienced. Theoretically bias courses are often taught at speed, without providing students with time to assimilate the material. Many institutions utilise "assignment projects", "problem based learning" (PBL), or "project based learning" (PoBL), but are they adequately structured and assessed? There is a need for better alignment of assessment with the overall course outcomes therefore bringing about the desired behavioural change within undergraduate students, enabling them to attain the required graduate attributes.

The Australian Maritime College is progressively developing new techniques to deliver and assess these attributes through holistic tasks, thus ensuring a broader coverage of the Attribute Spectrum within an environment of limited resources and time. This provides students with realistic and challenging tasks, a far cry from the traditional mundane „engineering laboratoriesÐ, thus promoting interactive and practical problem based learning, making the study of engineering enjoyable! The paper shows that by integrating PoBL aligned with industry practice and assessed against graduate attributes, it is possible to addresses the needs of both industry and society.

Ready for first year? The use of pre-teaching diagnostic tests to prompt greater preparation and engagement among first year engineering cohorts at The Universities of Auckland and Queensland

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Abstract

Having learnt of The University of Queensland's successful use of an on-line competency test for new undergraduate students prior to the start of their first semester, The University of Auckland launched its own 'Ready For First Year Quiz' in 2011. This paper provides direct comparisons on each institution's motivation for the quiz, analysis of the cohort completing the quiz, their engagement with the quiz, and preliminary feedback from staff and students on the usefulness and effectiveness of the quiz. The impacts of both campuses' quizzes upon student behaviour and performance are also compared and recommendations are made for future improvement.

ORIENTHUNT: The Development of a scavenger hunt to meet the needs of a first year engineering orientation.

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Abstract

Orientation is an essential part of the transition into engineering studies. A successful orientation introduces students to their department and to university studies, providing important information and assisting the students in making friends and acclimatising to the university lifestyle. Scavenger Hunts have the potential to satisfy the objectives of university orientation, delivering information to students through the active learning environment of a campus-wide roaming team-based activity. Through the combination of team work, communication and information processing, the pitfalls of "traditional" orientation programs can be avoided. This paper describes the development and implementation of a Scavenger Hunt for First Year Engineering Orientation. The goals of traditional orientation programs will be discussed, with the challenges and flaws of these approaches identified. The development of the Scavenger Hunt is presented, highlighting how the items on the list map to the objectives of Orientation. The paper concludes with a reflection upon a trial implementation of the scavenger hunt with a subset of the first year engineering cohort.

Instructor's considerations for assessing individual students' learning in team-based coursework

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Abstract

The effective assessment of individual students' learning in team-based coursework is a complex process which may not be fully understood by academic practitioners, much less mastered.

To help bring greater understanding to this pedagogical challenge, this research team developed an

ALTC-funded project to investigate current assessment practices in the team-based context and to derive an effective assessment framework. This paper reports the current results of the ongoing data analysis, and includes a discussion of their import: for academic staff offering team-based subjects as well as those interested more generally in the assessment of student learning.

Developing engineering design expertise though reflection

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Abstract

The three key elements of engineering design expertise - framing, systemic thinking and the conscious application of first principles - have been shown to be difficult to acquire by both students and practicing professionals. Because of this, it is of value to investigate how framing, systemic thinking and the application of first principles can be better developed in engineering students which will in turn develop better graduate design engineers. This paper reports on a project to do this in two mechanical engineering design subjects. Students were introduced to one or all of the three key elements of engineering design expertise, encouraged to apply them in a design project and practice questions throughout the semester of study. Finally, students were examined on their framing ability and their ability to apply first principles. It was found that only around 15% to 20% had a developed framing ability. Further, the ability to apply first principles appeared to be bimodal some students could apply them almost completely, some could not apply them at all and only a few could apply them partially. This suggests that skills related to engineering design expertise can only be learned by some students or that the current education system (including earlier schooling) has not developed sufficient related skills in the majority of students. This requires further research.

W25: Engagement, energy, empowerment

Chair: Keith Willey, UTS

Wednesday 10:30-Noon, Rottnest Room

Pre-adulthood Developmental Psycho-social Influences Behind Women Becoming Engineers in Contemporary Australia

Andrew Ruscoe

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Abstract

This presentation will highlight the results of a study that explored the pre-adulthood development of female engineers with a focus on influences behind their career choice. This area of study derives its importance from the continuing low proportion of women in engineering, the gender bias that this may indicate, and the benefits of increasing the number of women in engineering. The presentation will give details of the phenomenological methodology which utilised semi-structured interviews with 10 female graduate engineers aged 22 to 25 who had completed primary, secondary, and tertiary education in Australia. Content analysis revealed several potential influences behind career choice for these women, some of which do not appear in the literature. Potential influences included playing with blocks and Lego in childhood, perceived compatibility with maths and science at school, gender bias from fellow students, perceived compatibilities with male culture (while much literature examines male-female incompatibilities), being a female "nerd" may be sometimes challenging and sometimes facilitative, and a male propensity to swear more than females may interfere with facilitative male-female relationships. These potential influences on career choice may highlight aspects in pre-adulthood in Australia that warrant further investigation and may be useful in reducing gender bias and increasing the proportion of women in engineering.

Alternative models of assessment for 21st century engineering doctoral students

Jiabin Zhu[1], Monica F Cox[1] & Stephanie Adams[2]

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Abstract

Many have approached doctoral education as a "sink or swim" exercise. This random approach of pursing a Ph.D. is no longer sufficient. The strongest, most determined doctoral students survive, but at what cost? Doctoral training should not be left to chance. Given the purpose of a Ph.D. and the leadership opportunities given to Ph.D.s in academia, industry, government, and non-profit sectors, one would expect training of doctoral students to be more consistent across disciplines, departments and institutions within the United States. Although programs such as "Preparing Future Faculty" and "Re-envisioning the Ph.D." provide resources for students considering or pursuing Ph.D.s., students who actively seek such resources are the most likely to benefit from the guidance offered. Anecdotal and empirical findings confirm that the experiences of doctoral students differ greatly. Upon graduation, there is variability in the skills demonstrated by new Ph.D.s. Students who report having positive experiences typically have received either formal or informal training during their Ph.D. experiences. Several questions remain, however. Whose responsibility is it to train Ph.D. recipients in areas in which they are weak? Does this responsibility rest on the major professor, the dissertation committee, the department, or the institution? This paper presents an overview of the global preparation of engineers and implications for doctoral engineering education; a summary of the measures that might be used by departments and institutions to level the playing field for all those pursuing doctoral degrees; and a model of assessment to measure students' engagement with teaching, industry, and professional skills.

Improving occupational health and safety (OHS) of the construction industry through education of Civil and Structural Engineers

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Abstract

The construction industry has considerable room for improvement in occupational health and safety (OHS). Australian construction workers are twice more likely to be killed at work than workers in other industries1. There were 37 deaths in the construction industry in 2007/08, the second highest number of deaths after the transportation and storage industry1. There were 14,410 serious workers' compensation claims in the construction industry, representing 10.7% of claims across all industries in 2007/081. Aligned with the AAEE 2011 Conference theme, this recent project in partnership with the Office of the Federal Safety Commissioner attempts to contribute to improving safety in the construction industry through reviewing a sustainable approach of inclusion of OHS throughout the TAFE and University curricula of Engineering (Civil and Structural). This presentation provides a summary of the occurrence of OHS, the extent of design OHS content and evaluates the degree of how OHS is embedded into the curricula of construction industry professionals and para professionals of Civil and Structural Engineering disciplines across Australia. Educators, course accreditation organisations and employers need to play a role in attempting to improve the occupational health and safety knowledge and skills in the construction industry. These findings are important to educators from Australian TAFEs, Universities and educators and health and safety professionals from government and industry.

Reference: 1ASCC, 2009, Work-related injuries in Australia, 2005-2006: Construction Industry, ASCC, Canberra

Teaching Simulation Based Energy Conservation Techniques to the Undergraduate Engineering Students

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Abstract

The aim of teaching simulation based energy conservation techniques to the undergraduate engineering students is to involve students with real life engineering problems and to enhance the students' technical knowledge and problem solving skills.

The classroom teachings and an engineering simulation based project work have been designed so that the students receive a broad range of introductory exposure to the effective energy management techniques with relevant applications of the theory. This paper highlights an overview of the course curriculum, simulation principles and assessment procedures for achieving scholarships in teaching, learning and research. It is anticipated that the students will be competent to make use of the advanced knowledge earned in this course in their future career.

A review of community engagement-service learning in engineering curricula in response to student-led humanitarian efforts during the devastating christchurch earthquakes

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Abstract

On 4th September 2010, a magnitude 7.3 earthquake struck Christchurch forcing closure of most public buildings for one week, including the University of Canterbury (UC). Using the Facebook ™ network, UC students self-mobilised to the worst affected suburbs to assist in clean-up efforts. On 22nd February 2011, a magnitude 6.3 earthquake (repeated on 13th June) of greater ground acceleration caused larger devastation to Christchurch with a loss of 188 lives, crumbled buildings, no water or power for weeks and unprecedented infrastructural damage. The University campus closed for at least 5 weeks with some units remaining closed. In response, the students initiated the Student Volunteer Army (SVA) to provide on-going humanitarian aid to local communities in need. Their model was replicated by rural farming communities (the 'Farmy Army') and capitalised on by UC marketing officials releasing a series of 'UCan' campaigns. The student-led humanitarian initiatives provided an opportunity to examine where community engagement and service learning (CE-SL) are afforded in our engineering curricula. It appears that most CE-SL is facilitated in capstone final year projects or through engagement in volunteer efforts. A new course (ChCh 101) is helping to embrace CE-SL, incorporating humanitarian efforts, to meet some professional skills required by the engineering accrediting institution. The course can be credited towards an elective in engineering programmes and includes a major practical volunteering component. For 2011, students can retrospectively credit their efforts during the earthquake recovery period, while enrolment fees for the course will be reimbursed to students who successfully pass it.

Workshop W41: Engineering in the Shed -How to Capture and Motivate Engineers of the Future?

Chair: Brett Boughton
Wednesday 13:30-15.00, Sirius Room

Brett Boughton & Paul Hogg

Willetton High School (Australia)

Abstract

Brett Boughton (physics) and Paul Hogg (metal work) are high school teachers at Willetton who have teamed up to teach the new TEE course called Engineering Studies. Brett and Paul would like to share the key elements of their highly motivational engineering course and offer tips to others who may be brave enough to introduce a similar course in high school.

Brett and Paul's workshop will highlight the importance of;

1. Project relevance e.g the design and production of electric commuter vehicles for a fossil fuel depleted world,
2. An equal share of theory and workshop time which reinforces the teachers' firm belief of a "Hands on, minds on" learning culture, and
3. Letting the students take some design risks and in so doing, letting them learn from their mistakes.

Further, samples of student work will be on display. As you appreciate, this is the "acid test" as to the degree of concept and skill transfer to students.

Thirty seven year 11 students have beavered away at Willetton this year learning about the properties of materials, statics, mechanisms and dynamics with Brett for approximately 50 instructional hours and Paul has tasked the students with building ten full scale electric commuter trikes over an equal amount of time. The student built "Eco Warrior" is a low powered (500W) environmentally friendly machine which can conceivably be developed into a production commuter vehicle. See image attached.

In parallel with the theory, workshop time immerses the students in drawing, machining, welding, wiring, and assembly tasks. After passing a rigorous safety check, the students will start yr 12 next year by testing the braking and cornering ability of their respective machines. As you can imagine, student motivation for this course is high as there is an enervating and mutually reinforcing split between theory and workshop practice resulting in the students "champing at the bit" to road test their respective creations.

Workshop W42: Using Aptitude Tests to Engage Students in Engineering

Chair: Lorelle Burton
Wednesday 13:30-15.00, Pleiades Room

Lorelle J. Burton[1], David G. Dowling[1], Lydia Kavanagh[2] & Tim Aubrey[3]

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Abstract

The staff at a number of Australian engineering schools are using a range of aptitude tests to:

- Grow student numbers in engineering programs by facilitating the entry of students who have an aptitude to study engineering but do not meet entry requirements;
- Identify 'at risk' students and provide them with counselling and remedial classes to facilitate a successful transition to university;
- Empower students with self-awareness and learning skills; or
- Identify the factors that lead to success in first year engineering studies.

Stated Learning Outcomes

LO1 To learn about the aptitude tests and strategies currently being used in Australasian universities to recruit and engage students, including the contexts of the institutions

LO2 To share experiences about the success of the methods used to deploy the tests, including opportunities for implementation

LO3 To discuss the outcomes of the tests from student, staff and institution perspectives, including the concerns institutions experience with their incoming cohorts

LO4 To discuss institutional priorities for recruitment and/or retention, including identifying students 'at risk' and strategies for supporting the commencing cohort

Workshop W43: Supervising an engineering education PhD

Chair: Gregory Tibbits
Wednesday 13:30-15.00, Carnac Room

Gregory Tibbits

The University of Queensland (Australia)

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Abstract

The aim of the workshop is to provide content knowledge of the differences and similarities between a PhD in Engineering (E) and a PhD in Engineering Education (EE), particularly, for academics to apply this knowledge when considering supervising an EE PhD. The target audience are engineering academics considering supervising an Engineering Education PhD or already supervising a student. The long term goal is better supervision of EE PhD students.

Stated Learning Outcomes

LO1 Content knowledge of the differences and similarities between PhD in Engineering (E) and PhD in Engineering Education (EE), at the level of epistemology, methodology, method and analysis.

LO2 Strategies for applying this knowledge when considering supervising an Engineering Education PhD.

Workshop W44: Understanding how we develop engineers for social justice

Chair: Lesley Jolly
Wednesday 13:30-15.00, Garden Room

Lesley Jolly

The University of Queensland (Australia)

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Abstract

The workshop will draw on the experience of participants from a number of institutions currently involved in an international evaluation of the use of the Engineers Without Borders projects. These participants will offer scenarios from their own and the project's findings and will help attendees work through the implications for engineering academics to address the areas of social justice, ethics, community involvement and sustainability that many teachers feel are beyond their training and expertise. Activities will be organised around the key themes of content factors, pedagogy and curriculum and resources. Participants should benefit from the opportunity to compare their own and others' practice and will work to begin developing strategies to address their local implementation concerns.

Stated Learning Outcomes

LO1 Explored key themes in group discussion and compared their own practice with that of colleagues.

LO2 Identified how the findings of the international evaluation project can be used to help their own practice.

LO3 Collaborate with colleagues and EWB to begin to develop strategies for local implementation.

Workshop W45: Engaging Indigenous Youth in Engineering

Chair: Larissa Andrews
Wednesday 13:30-15.00, Rottnest Room

Simon Forrest[1], Larissa Andrews[1] & David Lichtenstein[2]

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Abstract

Participation rates for Indigenous students in Engineering degrees are extraordinarily low, with only a handful of students enrolled across the country. There are a broad range of initiatives that have been targeted at improving the situation, with varying levels of success. This workshop is intended to address the complexity of the problem, and to raise awareness of potential solutions - both individual and institutional - to the problem.

This workshop will address three topics:

An overview of the range of programs and initiatives currently available to engage indigenous youth in engineering, such as Summer Schools and Mentoring programs.

The causes - both direct and indirect - for the low levels of indigenous participation in engineering.

Strategies that can be used to encourage indigenous students to choose engineering, and to support those that do so.

Stated Learning Outcomes

LO1 Be aware of the range of initiatives currently in place to promote Indigenous students in engineering.

LO2 Understand the causes for low levels of indigenous participation in engineering.

LO3 Alter their own practice to be more supportive of indigenous participation in engineering.

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