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The 22nd Annual Conference for the Australasian Association for Engineering Education

5–7 December 2011, Fremantle – Western Australia

Review All papers in these AAEE Conference Proceedings were double-blind peer reviewed to ensure they contained: Clear objectives; Clearly defined methods; Reference to previous work and to theory/practice; Analysis of outcomes; and Discussed the application and/or implication of the work. Authors of papers nominated for acceptance were given the opportunity to revise their papers before inclusion into the Conference Proceedings. The AAEE annual conference appears on the Australian Research Council's ranked outlet list - ERAID #42271.

Editors Yasir M. Al-Abdeli and Euan Lindsay; Publisher Engineers Australia, Engineering House, 11 National Circuit, Barton ACT 2600 (Australia); ISBN 9780858259980.

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203 The Impact of Curriculum Content in Fostering Inclusive Engineering: Data from a National Evaluation of the Use of EWB Projects in First Year Engineering (18)

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Community Engagement in Engineering Education

AUTHORS:
Delwar Akbar, M.G. Rasul, *CQUniversity, Australia*

PAGE 1 - 6

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.

Do Engineers Still Move Mountains? A "New World" Appraisal in Light of Ethics, Engineering, Economics & the Environment

AUTHOR:
John Buckeridge, *RMIT University, Australia*

PAGE 7 – 12

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.

Engineering Education Towards Social and Environmental Justice

AUTHORS:
Julian O'Shea, Caroline Baillie, *University of Western Australia, Australia*

PAGE 13 - 18

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.

Engineering Education, Practice and Engineering Education Research: Critical Realist Insights

AUTHOR:
Linda Kotta, *University of Queensland, Australia*

PAGE 19 - 31

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.

Evidence of Intercultural Competency from Engineers without Borders Challenge Projects

AUTHORS:
Pamela Abuodha, Catherine Layton, Thomas Goldfinch, *University of Wollongong, Australia*

PAGE 32 – 37

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.

Implementation of Industry Sustainability Metrics in Undergraduate Design Projects

AUTHORS:
Margaret Jollands [1], Raj Parthasarathy [1], Mark Latham [2]
[1] *RMIT University, Australia;* [2] *Latham Solutions, Australia*

PAGE 38 – 43

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 students’ 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.

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Learning Conceptual Design Using a Community Development Project in Papua New Guinea

AUTHOR:
Graham Moore, *University of Melbourne, Australia*

PAGE 44 - 49

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.

Making Ethical Engineers: Engineers for Social Responsibility

AUTHOR:
Lawrence J. Carter, *University of Auckland, New Zealand*

PAGE 50 – 54

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. Engineers 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.

Multi-Disciplinary and Cross Year Mentoring: The Development of an Eco-House and a Sustainable Marriage!

AUTHORS:
Michael Bramhall, Chris Short, Abdul Hoque, Jane Blohm, Lesley Campbell, Andy Young, *Sheffield Hallam University, UK*

PAGE 55 – 61

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.

Personal Values and the Ecological Worldview of Civil Engineering and Environmental Science Students

AUTHOR:
Barbara A. Koth, *University of South Australia, Australia*

PAGE 62 – 68

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.

Professional Ethics Education in Engineering

AUTHOR:
Brad Stappenbelt, *University of Wollongong, Australia*

PAGE 69 – 74

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.

Review of the Enhancement of University Curriculum Through Utilisation of Sustainable Engineering and Appropriate Technology Workshops

AUTHORS:
Daniel Loden [1], Wahidul Biswas [2]
[1] *Engineers Without Borders Australia, Australia;* [2] *Curtin University, Australia*

PAGE 75 – 81

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.

Understanding the Community: Getting Engineers on Track

AUTHORS:
Gregory Tibbits, Lydia Kavanagh, Liza O'Moore, *University of Queensland, Australia*

PAGE 82 - 87

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.

The Socially Just Engineer and Social Entrepreneurship — The Case of Waste-for-Life, Argentina

AUTHORS:
Caroline Baillie [1], Doug Foster [2]
[1] *University of Western Australia, Australia;* [2] *University of Surrey, UK*

PAGE 88 – 93

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.

A Curriculum Design Approach Which Creates Increased Opportunity

AUTHORS:
Peter O'Shea [1], Gerard O'Shea [2]
[1] *Queensland University of Technology, Australia;* [2] *JPII Institute, Australia*

PAGE 94 – 99

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.

A Pathway to Regional Engineering

AUTHORS:
Joe Petrolito, John Russell, *La Trobe University, Australia*

PAGE 100 – 106

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.

Australian Engineering Academe: A Snapshot of Demographics and Attitudes

AUTHORS:
Ian Cameron [1], Carl Reidsema [1], Roger Hadgraft [2]
[1] *University of Queensland, Australia;* [2] *University of Melbourne, Australia*

PAGE 107 – 113

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.

Building Successful Teams: A Pilot Intervention Embedding Inclusive Team Skills in an Undergraduate System Analysis, Design and Project Management Course (SADPM)

AUTHORS:
Elena Sitnikova, Patricia Kelly, Diana Collett, *University of South Australia, Australia*

PAGE 114 - 119

ABSTRACT:
This paper discusses a pilot intervention aimed at embedding team building skills 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.

Developing an Inclusive Stakeholder Consultation Process: A Case Study

AUTHORS:
David Dowling [1], Roger Hadgraft [2], Julia Lamborn [3]
[1] *University of Southern Queensland, Australia;* [2] *University of Melbourne, Australia;* [3] *Swinburne University of Technology, Australia*

PAGE 120 – 125

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.

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

AUTHORS:
Peter D. Gibbings, Frank Bullen, *University of Southern Queensland, Australia*

PAGE 126 – 132

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.

Do with and Not to. Building Cultural Understanding, Enabling Communication and Promoting the Spirit of Reconciliation in First Year Engineering

AUTHORS:
Andrea Duff, Tina Brodie, Declan Furber-Gillick, Diana Quinn, Elizabeth Smith, *University of South Australia, Australia*

PAGE 133 – 139

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?'

Gifted First Year Engineering Students: Curriculum Preferences

AUTHOR:
Jolanta Szymakowski, *University of Western Australia, Australia*

PAGE 140 - 146

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.

Increased Female Participation into Engineering Education Through Specialised Courses

AUTHORS:
S. Tavrou, C. Thong, Clint Steele, *Swinburne University of Technology, Australia*

PAGE 147 – 153

ABSTRACT:
Research has shown that female participation into engineering courses has a very poor record especially in mainstream courses such as Mechanical, Electrical and Civil engineering. This paper refers to local and international reports on this issue and the success of the Product Design Engineering course to attract a higher percentage of female students. The study will reveal female enrolment into the course, performance during 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.

Interdisciplinarity as a Path to Inclusivity in the Engineering Classroom: A Design-Based Research Approach

AUTHORS:
J. Kaya Prpic, Roger Hadgraft, *University of Melbourne, Australia*

PAGE 154 - 159

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.

Is Collecting Anonymous But Code-Identified Intervention Assessment Data Worth the Effort? Reflections on a Recent Study in Electronics

AUTHORS:
Alexander P. Mazzolini, Peter J. Cadusch, *Swinburne University of Technology, Australia*

PAGE 160 - 165

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.

It Only Took 2 Clicks and He'd Lost Me: Dimensions of Inclusion and Exclusion in ICT Supported Tertiary Engineering Education

AUTHORS:
Elaine Khoo, E. Marcia Johnson, Rob Torrens, Jim Fulton, *University of Waikato, New Zealand*

PAGE 166 – 171

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.

Linking Engineering Students' Assessment Preferences to Their Learning Approaches

AUTHORS:
Rodney A. Stewart, Angela Walker, *Griffith University, Australia*

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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.

Lost in Transit: Exploring the First-Year Domestic and International Student Experience

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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.

Observing Cultural Interactions in Engineering Design Projects

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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.

On Improving Educational Outcomes for Indigenous Australian Students

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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.

System Thinking: How Universities Can Boost the Retention of a Higher Proportion of Women Engineers in the Engineering Workforce

AUTHORS:
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PAGE 196 – 202

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.

The Impact of Curriculum Content in Fostering Inclusive Engineering: Data from a National Evaluation of the Use of EWB Projects in First Year Engineering

AUTHORS:
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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.

The Role of Engineering in a Career Change Pathway into Technology Teaching

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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.

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.

Representing and Valuing Non-Engineering Contributions to Engineering Graduate Outcomes in Engineering Combined Degrees

AUTHORS:
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PAGE 222 – 228

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.

Alternative Models of Assessment for 21st Century Engineering Doctoral Students

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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.

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.

Gatekeeping or Filtering?: Investigating the Connection Between Peer Review and Research Quality

AUTHORS:
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PAGE 241 – 247

ABSTRACT:
Arguably, the most important opportunity to acquire the standards and norms of the discipline and develop researchers' judgement is the peer review process — but this depends on the quality of the reviews. 'Good' 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 authors' 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.

Profiling Graduate Outcomes for Stage 1 Professional Engineers

AUTHORS:
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PAGE 248 – 253

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.

Student Performance in an Online Postgraduate Course on Fibre Composites for Civil Engineers

AUTHORS:
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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.

Work Integrated Learning: A Realistic Evaluation of KMUTT's Chemical Engineering Practice School

AUTHORS:
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PAGE 260 - 265

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.

A Pilot Study on Engineering & Technology Education in Primary Schools

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PAGE 266 – 272

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.

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.

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 laboratories”, 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.

"A Sufficiently Complex Construction" and Other Conceptions of Technology Held by Engineering Students: A Case Study from Sweden

AUTHORS:
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PAGE 286 – 291

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.

A Survey of Strategies for Feedback and Assessment in Engineering Subjects : Discussions and Examples

AUTHORS:
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PAGE 292 – 297

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.

A Teaching Tool (ISM) for Development and Assessment of Learning Outcomes in the Emerging Area of Infrastructure Management

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PAGE 298 – 304

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.

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Adaptive Tutorials to Target Threshold Concepts in Mechanics — A Community Of Practice Approach

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PAGE 305 – 311

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.

An Evidence-Based Predictive Tool for Motivating Engagement, Completion, and Success in Freshmen Engineering Students

AUTHORS:
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PAGE 312 - 318

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.

An Experience Interacting with Students Defining Their Own Assessment Tasks

AUTHOR:
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PAGE 319 - 324

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.

An Innovative Delivery and Assessment of Thermofluid Engineering: A PBL Course in Undergraduate Engineering Program

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PAGE 325 – 330

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.

An Investigation into the Use of ICT to Teach Calculus to Australian Primary Schools

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PAGE 331 – 337

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.

Blending Project-Based Learning and Traditional Lecture-Tutorial-Based Teaching Approaches in Engineering Design Courses

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PAGE 338 – 343

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.

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.

Comparative Study of Project-Based Learning and Traditional Lecture-Tutorial Teaching Approaches in Undergraduate Engineering Courses

AUTHORS:
Kali Prasad Nepal [1], Kriengsak Panuwatwanich [2]
[1] *Victoria University, Australia;* [2] *Griffith University, Australia*

PAGE 351 – 356

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.

Computer Based Experiments for Off-Campus Teaching and Learning of AC Electricity

AUTHORS:
Graham Wild, Geoff Swan, Steven Hinckley, *Edith Cowan University, Australia*

PAGE 357 – 363

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.

Creation of a Construction Practice Laboratory

AUTHOR:
Steven R. Davis, *University of New South Wales, Australia*

PAGE 364 - 369

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.

Creating Better Learning Environments by Cross-Disciplinary Collaboration: A Civil Engineering and Surveying Linkage

AUTHORS:
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PAGE 370 – 375

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.

Developing Engineering Design Expertise Through Reflection

AUTHORS:
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PAGE 376 - 381

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.

Diversity and Longevity: A Framework for Graduate Attribute Development in Engineering Education

AUTHORS:
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PAGE 382 – 388

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.

Do We Succeed in Developing Problem-Solving Skills — The Engineering Students' Perspective

AUTHORS:
Tom Steiner, Iouri Belski, Jennifer Harlim, James Baglin, Roy Ferguson, Tom Molyneaux, *RMIT University, Australia*

PAGE 389 – 395

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.

Dynamic and Static Worked Examples in Student Learning

AUTHOR:
Iouri Belski, *RMIT University, Australia*

PAGE 396 - 401

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.

Effectiveness of Formative Online Quizzes in Learning and Teaching a Structural Engineering Course

AUTHORS:
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PAGE 402 – 407

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.

Employer Perspectives on Engineering Technician Education in Australia

AUTHOR:
David Dowling, *University of Southern Queensland, Australia*

PAGE 408 – 413

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?

AUTHORS:
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[1] *University of Southern Queensland, Australia;* [2] *Education Research Consultant, New Zealand*

PAGE 414 - 420

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.

Enhanced Graduate Attributes by Engaging Engineering Students in Teaching Episodes

AUTHORS:
Fouad Kamel, Margaret Baguley, David Thorpe, *University of Southern Queensland, Australia*

PAGE 421 – 426

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.

ePortfolios to Empower Students in Providing Evidence of Learning and Professional Development

AUTHOR:
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PAGE 427 - 433

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.

Experience and Expertise: Is it All That Good?

AUTHORS:
Jennifer Harlim, Iouri Belski, *RMIT University, Australia*

PAGE 434 – 440

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.

Exploring a Cross-Disciplinary Research Initiative with Remote Access Laboratories: Robot RAL-ly as a Stimulus for Consideration of Engineering Pathway

AUTHORS:
Andrew Maxwell, Karen Noble, Alexander A. Kist, Roderick Fogarty, Peter D. Gibbings, Warren Midgley,
University of Southern Queensland, Australia

PAGE 441 – 447

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 co-constructed 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.

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Faculty Use of Research Based Instructional Strategies

AUTHORS:
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PAGE 448 – 453

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.

Getting Tutors on the Same Page

AUTHORS:
Keith Willey, Anne Gardner, *University of Technology Sydney, Australia*

PAGE 454 - 459

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.

Identification of Threshold Concepts Involved in Early Electronic Engineering: Some Methods and Results

AUTHORS:
Jonathan Scott, Ann Harlow, *University of Waikato, New Zealand*

PAGE 460 – 465

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 repertoires. This may be a confusing factor for us and a source of trouble for students.

Improving Learning Outcomes and Sustainability Through New Laboratory Infrastructure

AUTHORS:
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PAGE 466 – 472

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.

Improving Student Engagement with Self-Assessment Through ePortfolios

AUTHORS:
John Fielke, Diana Quinn, *University of South Australia, Australia*

PAGE 473 – 478

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 first-year 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 self-assessment 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 self-assessment. 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 self-assessment has better supported and more deeply engaged our students in the development of self-assessment of their professional engineering skill level.

Instructor's Considerations for Assessing Individual Students' Learning in Team-Based Coursework

AUTHORS:
Matt Eliot, Prue Howard, *CQUniversity, Australia*

PAGE 479 – 483

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.

Introducing Undergraduate Electrical Engineering Students to Reflective Practice

AUTHORS:
Friederika Kaider, Juan Shi, *Victoria University, Australia*

PAGE 484 – 490

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.

International Senior Design for Mechanical Engineering Students

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PAGE 491 – 497

ABSTRACT:
In recent years, many international opportunities for engineering students have been developed through organizations such as Engineers Without Borders (EWB) or Engineers for a Sustainable World (ESW). While these opportunities appeal to young people's sense of responsibility for making a positive difference in the world, most projects are aimed at infrastructure enhancement or development and, as such, are geared towards students majoring in civil, environmental, or geological engineering. The infrastructure projects typically have need for one or two engineers outside of these disciplines; however, a mechanical engineering student working on developing a water purification system for a remote village will likely play an ancillary role in the design and construction of a facility such as this. Further, many senior design projects in mechanical engineering at Michigan Tech are centered around building a faster racecar or building a cleaner engine — projects which have little to no appeal for many young women. In September of 2009, the decision was made to offer a new type of design project, a project with a humanitarian focus and an international component, for senior mechanical engineering students. The new international design program would include options for the design of assistive devices for handicapped children in India (India has the highest rate of birth defects of any nation in the world). In preparation for this international senior design option, two faculty from the mechanical engineering department traveled to India in April of 2009 to meet with various individuals and make plans for the coming year. The international senior design option was implemented in the 2010–11 academic year, culminating in a faculty-led student trip to India to test the devices and to identify projects for the following academic year. This paper describes the program, lessons learned, funding challenges, and outcomes from the development of this humanitarian engineering program.

Interdisciplinary Learning for Final Year Engineering Projects: Case Studies

AUTHORS:
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PAGE 498 – 504

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.

Internet-Hosted Assessment System for Effective Teaching and Enhanced Learning for Engineering Subjects

AUTHORS:
Ali Saleh, Jianchun Li, James Lucas, *University of Technology Sydney, Australia*

PAGE 505 – 509

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-Task 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.

Is Self-Assessment Effective in Enhancing Student Learning?

AUTHORS:
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PAGE 510 – 515

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.

Large-Class Peer-Marked Assignments for Improving Second-Year Student Performance in Electrical and Computer Engineering

AUTHORS:
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PAGE 516 – 522

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.

Mapping Student Approaches to Learning Within a Civil Engineering Program

AUTHORS:
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[1] *Griffith University, Australia;* [2] *Victoria University, Australia*

PAGE 523 – 529

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.

Modelling Competency Standards to Facilitate Accreditation: A Pathways Perspective

AUTHORS:
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[1] *Edith Cowan University, Australia;* [2] *Murdoch University, Australia*

PAGE 530 – 535

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.

Occupational Health and Safety: An Expected Learning Outcome of Civil Engineering Graduates

AUTHORS:
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PAGE 536 – 542

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.

ORIENTHUNT: The Development of a Scavenger Hunt to Meet the Needs of a First Year Engineering Orientation

AUTHORS:
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PAGE 543 – 549

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.

Paving a Professional Pathway: Work Integrated Learning in Construction Management and Nursing and its Implications for Engineering Students

AUTHORS:
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PAGE 550 – 556

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.

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Peer Review of Teamwork for Encouraging Equal Commitment to the Group Effort

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PAGE 557 – 562

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.

Problem Comprehension is the Key to Client Problem Solving

AUTHORS:
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PAGE 563 – 568

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.

Project Management Skills for Engineers: Industry Perceptions and Implications for Engineering Project Management Course

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PAGE 569 – 575

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.

Physical and Computer Demonstrations in Enhancing Student Understanding of Structural Mechanics Courses

AUTHORS:
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PAGE 576 – 581

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.

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

AUTHORS:
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PAGE 582 – 587

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.

Remote Laboratories: Enhancing Accredited Engineering Degree Programs

AUTHORS:
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PAGE 588 – 593

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.

School OASIS: Virtual Outreach — Facilitating the Transition to University Study

AUTHORS:
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PAGE 594 - 600

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.

Scratch That Itch to Learn: A Comparative Study

AUTHORS:
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PAGE 601 – 606

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.

Staff and Student Perceptions of the Effective Use of Contemporary Lecture Theatre Technology

AUTHORS:
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PAGE 607 – 611

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.

Secondary Student Research Projects in Engineering: Optical Fibre Bragg Grating Sensor Applications

AUTHORS:
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PAGE 612 – 618

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.

Some Potential Underlying Threshold Concepts in Engineering Dynamics

AUTHORS:
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PAGE 619 - 625

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 designing 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.

Teaching via Video Conference — Comments and Observations and the Attainment of Graduate Attributes and Learning Outcomes

AUTHOR:
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PAGE 626 - 632

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.

Using e-Tutor Program and Pre-Lab Assessment Task to Enhance Laboratory Experience of Civil Engineering Students

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PAGE 633 – 638

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.

Using Twitter to Enhance Reflective Practice on Work Placements

AUTHORS:
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PAGE 639 - 644

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 how much 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.

Using Wiki as a Facilitative Tool for Group Work

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PAGE 645 – 650

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.

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