Professional practice for future engineers

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Structured abstract

BACKGROUND

There is a need for higher education to address a number of present-day challenges (Barnett, 2000; Brew, 2013; Watson et al, 2001). It is important, for example, to equip students with the skills necessary to survive in the 'real-world' and to work towards solving the many challenges therein (McKenzie et. al. 2002; Macquarie University 2008). While learning through industry-based work experience has long been a core requirement in undergraduate engineering programs, it has recently been receiving renewed attention to ensure it remains of value. Such a review is timely in light of the growth in work integrated learning (WIL) and learning through participation (LTP) programs at universities – including the Professional and Community Engagement (PACE) initiative at Macquarie University.

In this context it bears asking, what do we expect future engineers to gain from their work experience, and how open-minded can engineers and the associated professional bodies be about the range of professional experiences suitable for the development of good engineers? For example, would broad community-based experiences designed to provide opportunities for the development of generic skills (i.e. either in addition to or perhaps instead of development of technical skills), be a useful and acceptable experience of professional practice for future engineers? To what extent should work experience be about the process of learning from experience, rather than what is learnt?

PURPOSE

The motivation behind this study is to revisit the purpose of compulsory work-experience in a program of study leading to an engineering degree, and to determine how open engineering as a discipline should be about what may count as useful work experience in training professional engineers.

METHOD

We report on the aims of PACE at Macquarie University and its implementation in the context of current practice and trends from around the world in engineering, and other disciplines, and on the role of work integrated learning experiences in professional development.

RESULTS

Recommendations concerning the definition of acceptable work experience in training undergraduate engineers to the level of Stage 1 competency will be proposed. Preliminary evidence will be provided to demonstrate why these various experiences should be considered open-mindedly as regards preparing engineers for professional practice and ongoing development.

CONCLUSIONS

We propose that the type of work experience that may count towards the professional practice requirement in an undergraduate engineering degree should specifically include generic skills and attribute development. Whilst it is desirable if there is scope for the development of specific technical skills, we argue that in an undergraduate program of studies there are many other worthwhile experiences of a non-technical nature which are important at this level to the development of engineers for the future.

KEYWORDS

Work integrated learning, project based learning, professional development

Introduction

Stakeholders in tertiary education, particularly students and employers, are keen for graduates to be ‘work-ready’ upon graduation. Whilst this means different things to different people, in practice it usually means some level of broad and 'professional' (i.e. generic but largely discipline-specific) skills development (Male, 2011a). Furthermore, in professional education programs such as engineering, employers and accrediting bodies expect some level of development of professional attitude and perspective. For these and other reasons Engineers Australia currently lists "exposure to engineering practice" as a criterion for professional accreditation of academic programs (Engineers Australia Accreditation Board, 2008).

In recent years the role and value of work experience in professional training has been attracting new attention in the domain of tertiary education. For example, it has been proposed that the transformative nature of work experience, if well integrated with university training programs, may serve to reduce the student attrition rate in engineering degree programs (King, 2008). The value of integrating practice-based experiences into a wider range of disciplines has also been recognised (Macquarie University 2008; Billett, 2011); a National Internship Scheme has been proposed to enhance learning outcomes through work integrated learning, and a number of Australian universities (e.g. Griffith, Victoria, and Macquarie University) are moving to integrate a substantial amount of practice-based experience in their curricula for all disciplines (Universities Australia, 2008).

Given the increasing integration of practice-based learning into university curricula across disciplines, and the diverse nature of experiential activities available to students as a result, It is worth revisiting the role of such experiences in the context of professional development for future engineers. Such consideration leads to a number of questions: "to what extent should work experience be tailored to the specific profession or specialisation?" and conversely, "to what extent might broad (e.g. not strictly technical and discipline-specific) practice-based work experiences of value in professional engineering training programs?" Based on early indications from Macquarie University’s PACE Initiative, we suggest that well organised, academically supported, and moderated generic work experiences can be of similar if not greater value to the development of future professional engineers than the usual 'exposure to engineering practice'. Further, these learning opportunities foster a strong foundation for professional development – one that acts as a link between university and industry and should be seen as starting point of ‘lifelong learning.’

Overview of paper

We first review the current rationale and requirements for integrating work experience in professional engineering training programs, as commonly expressed by universities, and by professional accrediting organisations. We then describe the Professional and Community Engagement (PACE) Initiative of Macquarie University, which is a formal part of the undergraduate curriculum; aimed at providing students the opportunity to apply theoretical learning to practice as a part of their degree study. Informed by preliminary indications of student experience in PACE, we argue that non-discipline specific experiences and skills such as those made possible through PACE provide a suitable foundation for the development of future engineers and may be as effective as more traditional, technical internships, especially if complemented by other specific, but not necessarily workplace-based, professional development experiences (e.g. through the curriculum, and through a continuing professional development program following graduation).

Review of work experience in engineering courses

Rationale and requirements for work experience

A review of several university engineering websites reveals a common theme in their rationale for a mandatory period (e.g. 12 weeks) of engineering work experience in Australian engineering courses before graduation, i.e. simply that it is a requirement for professional accreditation. (Note: A period of work experience outside the educational institution, whilst "strongly advocated" by the Engineers Australia Accreditation Board, is not mandatory; however, adequate exposure to professional practice must be ensured by a variety of means (Engineers Australia Accreditation Board, 2008b).)

In some cases the rationale for work experience is expanded upon by the responsible universities. For example, the Engineering website of one major university states "Besides accreditation, work experience has the following two purposes: 1) to expose the student to the workplace and workplace issues (such as human and industrial relations, job organisation, maintenance, safety and environmental issues); 2) to provide direct insight into professional engineering practice." Another major university states on its website that "Out of the 60 days engineering experience which is required, no less than 30 days should be carried out assisting, or under the immediate direction of a professional engineer. This period of employment will provide you with an insight into professional practice and is best carried out after the second or third year of the course." The University of Technology, Sydney, in its Engineering Practice Program student guide (UTS, 2012), states "Practice-based engineering education claims that these attributes [e.g. capacity for creative inquiry and lateral thinking, pride in excellence, etc.] can be more effective when they have been developed in contact with the human and technical challenge of real engineering situations."

Whilst it is clear that to satisfy accreditation requirements some form of practice-based experiences are necessary in professional engineering education programs, and that industry-based work experiences are expected to result in insights into professional engineering practice and/or further development of professional skills that might not be obtained otherwise, in most cases the expected outcomes are not clearly articulated. To some extent a degree of vagueness about outcomes is to be expected, as industry-based work experiences and their outcomes will vary significantly with the placement organisation, the student, and the degree program into which the experiences are embedded. Furthermore, professional development and maintenance of engineering competencies is now regarded as a continuing process throughout one's career (Engineers Australia, 2009). We are therefore left wondering about the value, specifically, of technical industry-based work experiences versus those which are more broadly-based for the purpose of professional development in an undergraduate engineering program. Indeed, a re-evaluation of why and how industry-based work experience should be incorporated into professional engineering programs is currently in progress, sponsored by the Australian Council of Engineering Deans (Male & King, 2013).

The current ABET Criteria for Accrediting Engineering Programs (ABET, 2012) do not include a mandatory period of work experience, but instead concentrate on the development of competency in design, "culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints" (ABET, 2012), which, for example, could be achieved through appropriate coursework experiences (e.g. problem or project-based). If there is any emphasis on professional experience in the ABET Criteria, it is targeted at the Faculty, who are the primary role models for their students.

The current ABET Criteria for some sub-disciplines of engineering, however, include proposed changes such as "The curriculum must prepare graduates to understanding of concepts of professional practice, project management, and the roles and responsibilities of public institutions and private organizations pertaining to environmental policy and regulations" (ABET, 2012). Importantly, the latter aims could be realised through most practice-based work experiences, not necessarily in an engineering workplace, if duly supported through an academic framework.

The Engineers Australia accreditation criteria are consistent with the ABET requirements, with the emphasis of accreditation guidelines and criteria relating to curriculum (i.e. criterion 4.2.4) on 'personal and professional skills development', 'engineering application experience', and 'practical and 'hands-on' experience'. Formal work placement is secondary to the more encompassing "Exposure to professional practice" (criterion 4.2.5). Whilst there is no doubt that technical or discipline-specific work experience can be valuable for developing a sense of professional identity, it is recognised that the associated attributes may also be developed through a range of other activities and experiences, such as listed on page 18 of the Engineers Australia Accreditation Criteria Guidelines (Engineers Australia Accreditation Board, 2008b). This breadth is consistent with the "PACE" initiative at Macquarie University, which is integrating a diverse range of practical learning opportunities for its undergraduate students (Macquarie University, 2013a).

Trends in graduate skills requirements and the PACE initiative at Macquarie University

Whilst educational approaches and frameworks to facilitate the integration of theoretical and practical understanding have long been established (e.g. the World Council and Assembly on Cooperative Education- WACE, 1983), approaches to Work-Integrated Learning (WIL), Co-operative Education, Service-Learning (SL) etc. must evolve in response to the challenges facing universities (ALTC, 2010; Barnett, 2000; Billett, 2011; Brennan, 2013; Brew, 2013; Watson et al, 2011).

The PACE Initiative at Macquarie University, is one such example. In 2008, Macquarie University undertook a review of its academic programs to ensure alignment with the institution's strategic direction, as well as develop an approach that would meet the needs of future students. It was argued that Macquarie students increasingly face "a globalising world of major environmental change and resource constraints, of scientific and technological advance and ethical challenge, of continuing political instability and possible international conflicts, of unlimited creativity and increasing social surveillance" (Macquarie University, Review of Academic Programs, White Paper, 2008).

The resulting curriculum was underpinned by nine 'Graduate Capabilities', informed by "cognitive capabilities, personal dispositions, and interpersonal or social dispositions" (Macquarie University, 2008). Specifically, the Graduate Capabilities are: 1) Discipline Specific Knowledge and Skills; 2) Critical, Analytical and Integrative Thinking; 3) Problem Solving and Research Capability; 4) Creative and Innovative; 5) Effective Communication; 6) Engaged and Ethical Local and Global Citizens; 7) Socially and Environmentally Active and Responsible; 8) Capable of Professional and Personal Judgement and Initiative; 9) Commitment to Continuous Learning (Macquarie University, 2008).

The curriculum also included the introduction of the Professional and Community Engagement (PACE) initiative which is aimed at mutually beneficial learning by providing "opportunities for students and staff to actively contribute to positive social change, while developing valuable career skills" (Macquarie University, 2008). In particular, PACE is integrated into the undergraduate curriculum through PACE units, provid[ing] the academic framework through which students can build a professional mindset, engage with the community, learn through participation, and develop their capabilities, creating a combination of skills that employers value (Macquarie University, 2013a).

The PACE activities (experiential components) which students can undertake through PACE units cover a very wide spectrum of approaches (e.g. WIL, service learning and otherwise). In the context of the Faculty of Science at Macquarie University, in which Engineering is a Department, this may include but is not limited to: Engineering internships (ENGG400); group research projects in Environmental Management (ENV301); mathematical mentoring and tutoring (MATH399); and tailored activities which match the interests and skills of any undergraduate degree-enrolled student (FOSC300).

The relationship between PACE and Engineering, which has an established Engineering Industry Partnership Program (EIPP) (McGill & Town, 2008), continues to evolve, and this paper is largely a result of deliberations regarding the range of PACE opportunities for future engineering students. PACE currently facilitates standard engineering work placements for engineering students in parallel with the EIPP, which mainly provides industry-based final year projects. However, in light of the information in the previous paragraphs and early indications of student experience in PACE, one must ask - "what does an engineering-industry placement offer in terms of professional development opportunities that other PACE activities do not?" As supported in the proceeding section, we believe that non-technical experiential activities can benefit engineering students greatly, and that any key differences can be made up through the curriculum, and exposure to professional practice through activities such as those outlined in the Engineers Australia accreditation guidelines, etc.

Preliminary indicators of PACE student experience and potential implications for engineering students

In order to assess the potential for broad experiential learning opportunities through PACE to foster professional development of engineering students, an audit of PACE student testimonials took place. Publicly accessible through the University's webpages (Macquarie University, 2013b), these testimonials, which stem from activities broader than standard technically-based engineering internships, offer preliminary indications of the impact of the program on student learning. Whilst feedback to date represents the experience of students outside of Macquarie's Engineering Program, latent content analysis reveals themes consistent with several intended benefits of work experience in an engineering workplace that are not directly articulated in the engineering accreditation guidelines, or elsewhere (Male and King, 2013):

"Specifically, industry engagement will assist students to:

- *a) develop more comprehensive and accurate understanding of engineering practice as a socio-technical activity;*
- *b) develop motivation for learning due to recognition of relevance of the engineering program and the value of engineering;*
- *c) improve learning through understanding context and connections;*
- *d) develop reflective practice skills to improve learning support lifelong learning;*
- *e) develop comprehensive socio-technical capabilities;*
- *f) develop a sense of belonging to the faculty and the profession;*
- *g) build networks."*

To the latter list could also be added "h) enhanced employability" as exposure to the workplace is regarded by both employers and students as enhancing employability. It is difficult to identify any item in the above list that does not have the potential to be addressed largely in a non-engineering workplace, though items (f) and (g) would be easiest to cultivate in an engineering environment, and/or through supervision and mentoring by an engineer. This is supported by the testimonials of Macquarie students (Macquarie University, 2013b):

"My [PACE] activity enabled me to learn how to use the knowledge and skills that I have gained in my university studies to solve real-life problems that are relevant to my academic field."

"I've discovered a lot about myself as a person and how I handle certain things in certain situations. I've learnt the importance of open and honest communication as well as how to be more tolerant and patient. I learnt about a whole new culture and way of life and most importantly have changed my perspective on the way I view life and become more open minded. The list goes on!"

"It [the PACE experience] stimulated me to apply the knowledge and skills gained throughout my degree to issues happening outside academia. In this way creating, in my opinion, an important 'bridge' between university, and the community[-] two spaces that should never be separated".

"I gained a range of skills and knowledge from my [PACE] activity that I can relate to my chosen discipline. One of the modules presented was on reflection. I found this module to be quite useful in showing me proper techniques to self-reflect on my own past experiences. I found that this module is essential in my own self-improvement."

"I feel as though I have learnt to multi task and how to manage myself in a stressful environment. I have also had to interact with many different kinds of people…"

As the PACE Initiative commenced in 2012, substantial evidence of impact on student learning, including that of engineering students in the PACE-accredited ENGG400, does not yet exist. Preliminary indicators, however, consistently point to important outcomes which would be equally valuable for future engineers. Interestingly, the testimonials detailed in this paper are from students of a unit based at the Faculty level (FOSC300: Participation and Community Engagement in Science) which is open to students of any degree program. The unit is aimed at helping all students to build a professional mindset, engage with the community, learn through participation, and develop their capabilities - creating a combination of skills that employers value. Activities to date undertaken by students in FOSC300 have included mining consultation; lab internships; animal, human, and environmental research; volunteer wildlife keeping; scientific and IT mentoring; and community development – in local, regional, and international locations.

Although early student feedback hints at the potential value of broad experiential learning, it is acknowledged that for the sake of fostering professional practice in future engineers, such non-technical experiences might present risks. Those include: i) a lack of direct engineering-based professional role modelling, and ii) reduced opportunity to learn technical and other skills specific to engineering industries. Regarding the first item, we have already noted the interest of accrediting bodies on having academics with industry experience to act as role models to students (though admittedly the academic environment is usually somewhat different to the engineering workplace). In the case of the second item, it must be recognised that this is not a priority for most employers; applying technical theory was rated lowest in priority of 11 generic engineering competencies (Male, 2011b).

Additionally, it should be noted that there are distinct benefits to having engineering students undertake practice-based experience in a non-engineering workplace. For example, such placements are more likely to provide opportunities to work in truly multidisciplinary teams, and/or to work in a wider variety of roles and in a wider variety of organisations, and hence to apply their generic and professional skills to a wider range of problems. These benefits are confirmed in a growing body of evidence documented by the PACE Initiative – student testimonials, partner feedback, research on various aspects of the student experience, and so on. We believe that such experiences are highly relevant for future engineers, especially if their career options are to extend beyond the historical roles of technical management and leadership and into a wider variety of public service rolesl, etc.

Conclusions

Whilst integrated engineering industry work experiences may remain the 'gold standard' in the professional development of many engineering undergraduates, substantial changes in technology and work practices in recent decades, the associated changes in organisations and work places, and the changes in curricula by many universities to integrate some form of work experience for all students, such as the PACE initiative at Macquarie University, are opening a wider range of career development options for graduates of professional engineering degrees which extend well beyond their classical roles in technology development and management.

Based on this initial study, we contend that the range of practical and work experiences that engineering students can benefit from during tertiary education is now considerably broader than previously expected, and ideally future engineers should have experiences such as applying their engineering skills in multidisciplinary teams, working on projects with an international focus, and working on projects presenting significant nontechnical challenges (e.g. service projects with limited resources) – experiences that would benefit any student during their education, independent of their specialisation or major. Such opportunities make possible hands-on engagement with the Graduate Capabilities, the principles of which are consistent with the expectations of professional accrediting bodies. Initiatives such as the Professional and Community Engagement (PACE) program at Macquarie University, which can offer a breadth of experiences in learning through participation, will likely play a valuable role in preparing engineering students for professional practice in the 21st century.

To understand the long-term potential for such experiences and future engineers, this paper also proposes the establishment of additional research projects which enable a much more detailed examination, both in latitude and longitude. Further, it is acknowledged that while programs such as PACE instil important Graduate Capabilities such as 'lifelong learning', the nurturing of professional practice should not end upon graduation. In particular, it is important that future engineers have a sense of professional identity and responsibility, especially given the increasing levels of mobility of many engineering professionals during their careers. With this in mind, future research may therefore also reveal that there is an increasing need for engineers to engage in continuing professional development (CPD) and mentoring programs managed by professional associations. This paper represents the beginning of such enquiries.

References

ABET (2012). Criteria for Accrediting Engineering Programs, 2013 – 2014. http://abet.org/uploadedFiles/Accreditation/Accreditation_Step_by_Step/Accreditation_Documents/Current/2013_-_2014/eac-criteria-2013-2014.pdf Accessed on: 15/10/2013

ALTC (2010). Learning and Teaching Standards Project - Final Report. http://www.olt.gov.au/system/files/altc_standards.finalreport.pdf Accessed on: 15/10/2013.

Baker, M., Beale, A., Hammersley, L., Lloyd, K., Semple, A-L., White, K. (2012). Ethical practice in learning through participation: Showcasing and evaluating the PACE Ethical Practice Module. In *Asia-Pacific Journal of Cooperative Education*, 14(3), 195-207.

Barnett, R. (2000). *Realizing the University: In an age of super-complexity*. Buckingham: Society for Research into Higher Education and the Open University Press.

Billett, S. (2011). Curriculum and pedagogic bases for effectively integrating practice-based experiences. Final Report, ALTC Fellowship. http://www.olt.gov.au/system/files/resources/Billett C S Griffith NTF Final report 2011_0.pdf Accessed on: 15/10/2013

Brennan, S. (2013). How colleges should prepare students for the current economy', Business Insider Australia, February 14. http://www.businessinsider.com.au/colleges-need-to-prepare-students-for-the-current-economy-2013-2. Accessed on: 15/10/2013

Brew, A. (2013), Understanding the scope of undergraduate research: a framework for curricular and pedagogical decision-making, *Higher Education*. http://link.springer.com/content/pdf/10.1007%2Fs10734-013-9624-x.pdf Accessed on: 15/10.2013

Brown, N. (2010). WIL[ling] to share: an institutional conversation to guide policy and practice in work-integrated learning, *Higher Education Research & Development*, 29(5), 507-518.

Cooper, L., Orrell, J. and Brown, M. (2010). *Work integrated learning: A guide to effective practice*. Routledge Taylor & Francis: London & New York.

Dehing, A. J. M. (2012). *Preparing students for workplace learning in higher engineering education*. Eindhoven: Technische Universiteit Eindhoven.

Engineers Australia Accreditation Board (2008a). Document S02. Accreditation Criteria Summary. ACCREDITATION MANAGEMENT SYSTEM: EDUCATION PROGRAMS AT THE LEVEL OF PROFESSIONAL ENGINEER. http://www.engineersaustralia.org.au/sites/default/files/shado/Education/Program Accreditation/AMS Professional Engineer/S02 Accreditation Criteria Summary.pdf

Engineers Australia Accreditation Board (2008b). Document G02. Accreditation Criteria Guidelines. ACCREDITATION MANAGEMENT SYSTEM: EDUCATION PROGRAMS AT THE LEVEL OF PROFESSIONAL ENGINEER. http://www.engineersaustralia.org.au/sites/default/files/shado/Education/Program Accreditation/AMS Professional Engineer/G02 Accreditation Criteria Guidelines.pdf

Engineers Australia (2009). Continuing Professional Development Policy. http://www.engineersaustralia.org.au/sites/default/files/shado/About Us/Overview/Governance/Policies/CPD Policy.pdf

Gamble, N., Patrick C., and Peach, D. (2010). Internationalising work□integrated learning: creating global citizens to meet the economic crisis and the skills shortage, *Higher Education Research & Development,* 29(5), 535-546.

Grandin, J. M. (2006). Preparing for the Engineering Workplace, *Online Journal of Global Engineering Education,* 1(1).

Harris, L., Jones, M., and Coutts, S. (2010). Partnerships and learning communities in work-integrated learning: designing a community services student placement program, *Higher Education Research & Development,* 29(5), 547-559.

King, R., (2008). Engineers for the Future. Australian Council of Engineering Deans. https://www.engineersaustralia.org.au/sites/default/files/shado/ACED/Engineers for the Future.pdf Accessed on: 15/10/2013

Lamanusca, J. S., Zatas, J. L., Soyster, A. L., and Luenymorell, J. J. (2008).The Learning Factory: Industry-Partnered Active Learning, *Journal of Engineering Education*, 5-11.

Light, B., and Hartmann, E. (2011). Integrating Innovation, Work, and Learning in Higher Education – The Case of Work Based Learning Frameworks, in Jeschke,S. et al. (Eds.), *Enabling Innovation*, Springer-Verlag Berlin: Heidelberg.

Litchfield, A., Frawley,. and Nettleton, S. (2010). Contextualising and integrating into the curriculum the learning and teaching of work□ready professional graduate attributes, *Higher Education Research & Development*, 29(5), 519-534.

Macquarie University (2008). Review of Academic Programs, White Paper, http://staff.mq.edu.au/public/download.jsp?id=97830 Accessed on: 11/05/2012

Macquarie University (2013a). PACE website http://www.mq.edu.au/about_us/offices_and_units/professional_and_community_engagement/ Accessed on: 12/09/2013

Macquarie University (2013b). FOSC300 testimonials, http://web.science.mq.edu.au/for/business_and_community/pace/testimonials/fosc300/ Accessed on: 13/10/2013

Mackaway, J., Winchester-Seeto, T., Coulson, D., & Harvey, M. (2011). Practical and pedagogical aspects of learning through participation: the LTP design assessment framework, *Journal of University Teaching and Learning Practice*, 8 (3), Article 5, pp.1-18.

McGill, D., and Town, G. E., (2008). *Developing an Industry Partnership Program,* Proceedings of the 2008 AaeE Conference, paper 13, Yeppoon, 7-11th December.

McKenzie, A., Morgan, C., Cochrane, K., Watson, G., and Roberts, D. (2002). *Authentic learning: What is it, and what are the ideal curriculum conditions to cultivate it in?* Proceedings, HERDSA Conference, 426-433.

Male, S. M. (2011a). Understanding Generic Engineering Competencies: A Review and Modelling Approach, *Australasian Journal of Engineering Education*, 17(3), 147-156.

Male, S. A., Bush, M. B., and Chapman, E. S. (2011b). An Australian study of generic competencies required by engineers. *European Journal of Engineering Education*, 36(2), 151-163.

Male, S. and King, R. (2013*). Best practice guidelines for effective industry engagement in Australian engineering degrees*: *Draft guidelines*. Australian Council of Engineering Deans. http://arneia.edu.au/_asset/doc//_file/Draft-Industry-Engagement-Guidelines-Ver-4-12-Sept-2013.pdf Accessed on 15/10/2013.

Peach, D. & Gamble, N. (2011). Scoping Work-Integrated Learning Purposes, Practices and Issues. In Billett et al, (Eds.) *Developing Learning Professionals : Integrating Experiences in University and Practice Settings.* Springer, Dordrecht, The Netherlands.

Smith, C. (2012). Evaluating the quality of work-integrated learning curricula: a comprehensive framework, *Higher Education Research & Development*, 31(2), 247-262.

Universities Australia, (2008). A National Internship Scheme. Position Paper No.3/08. Deakin, ACT. http://www.universitiesaustralia.edu.au/resources/360/87 Accessed on: 15/10/2013

UTS Engineering, (2012). Engineering Practice Program Student Guide. https://my.feit.uts.edu.au/pages/course/undergraduate/engineering_practice_program/processes_administration Accessed on: 15/10/2013

Watson, D., Hollister, R., Stround, S. and Babcock, E. (2011). *The engaged university: international perspectives on civic engagement*, Routledge: New York.

World Council and Assembly on Cooperative Education, http://www.waceinc.org/ Accessed on: 13/10/2013

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