



Undergraduate Student's Perceptions of Factors that Enable and Inhibit their Professional Skill Development

Keith Willey^a, David Lowe^a, Emanuela Tilley^b, Kate Roach^b, and Tania Mchet^c
The University of Sydney^a, University College London^b, University of Technology Sydney^c
keith.willey@sydney.edu.au

ABSTRACT

CONTEXT

The need for Engineering graduates who can balance strong technical competencies with broader professional and transversal capabilities is well recognised. In response to calls from industry and recognition by universities of underdeveloped professional skills in their students, there has been a move towards a more integrated approach to preparing undergraduate students for professional practice. This often involves the integration of professional skills development within the more traditional engineering science curricula.

PURPOSE OR GOAL

Engineering students tend to have diverse reactions to the teaching of these broader professional competencies with many students reacting negatively. This study explored the nature of these reactions and in particular aims to move past the common assumption that students' attitudes relate to students feeling like professional elements are not "real engineering". Understanding students' views on these competencies will enable universities to adapt their curriculum to maximise the quality of demonstrated learning related to professional skill development learning outcomes.

APPROACH OR METHODOLOGY/METHODS

As part of a broader survey on student reactions to the development of professional skills (with $N \approx 500$), we asked an open-ended question seeking the respondents' comments that "might be helpful to us in understanding your views and experiences?". After undertaking a survey that required students to reflect on and think about their views in regard to their professional learning and development, this question captured those aspects that students thought were the most important additional information. We identified the dominant themes that emerged from these comments using a thematic analysis.

OUTCOMES

A number of dominant and often interconnected themes were observed. These ranged from a perception that professional skills cannot be taught at university and must be learned through workplace practice, to the view that university-based professional skills development is not authentic or valued, is poorly focused and structured and often being taught by academics who have not worked in industry themselves.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The student responses suggest that to successfully develop students' professional skills within university curricula, it is not sufficient to have an integrated, targeted and embedded program, but the intentions and outcomes of such programs, need to be well scaffolded and articulated to both students and staff and to be valued and seen as an integral part of a university's culture and beliefs.

KEYWORDS

student perceptions; professional skills; integrated engineering.

subjects such as "Integrated 1,2,3 (4? haven't done it)" and "PEP" are in place to force this interaction between students, not so much for the student's development, but as a checkbox for the uni to say to employers "yes we put our students in positions to develop professional skills", hence my feelings that these approaches feel disingenuous. Whether or not this is the case, an underlying reason may be that the university does not understand the students' motivations for learning. In an environment filled with academia, where the pursuit of knowledge is its own reward, is the polar opposite of the beliefs expressed by many undergraduates (possibly enforced by a society where our self worth is dictated by what we bring to the table and thus we find the easiest way to do so), where we want our degree and a job as fast as possible and as easy as possible, so subjects like PEP and ENGGX111 do not feel valuable, as we expect to be taught technical skills in a higher education setting. **(Participant 4, male, 21-25 years old, domestic student, middle year undergraduate, 1 to 3 years in work, no work in a professional job)**

In my experience, most of the professional competencies are either inherent or just have to be learnt on the job. Technical competencies are best taught at university so that students can feel prepared for a job's requirements and feel adequately suitable for engineering roles when they go to apply for them. (Eg. just about anyone will apply for a job if it says "good team work" in the job description, but not everyone will feel comfortable applying for a job that mentions "experienced with C++ and Java".) **(Participant 2, female, 21-25 years old, international student, middle year undergraduate, three + years in work, three to 12 months in a professional job)**

When students are transferring from other universities or receiving advanced credit for other studies they have undertaken, undergraduate program directors often chosen to exempt them from Integrated Engineering 1 (the first year six credit point unit). This is interpreted by some students as an indication that the unit is not important or not value by the University.

In terms of improvements, I do admire the university's attempt to try to force students to develop professional skills on their own, however, its implementation requires some reworking. As an example, ENGG_111 (Will exempt ENGG1111 as it is a first-year subject) does not feel like a valuable subject **(Participant 4, male, 21-25 years old, domestic student, middle year undergraduate, 1 to 3 years in work, no work in a professional job)**

The following comment from a graduate student seem to suggest a view that professional skills should not be taught by engineering, calling for a more multidisciplinary approach to developing professional skills. The graduate student comments that even calling these core units Integrated Engineering, is sending the wrong message that they are about engineering and technical competencies are not professional skills. This is a particularly interesting perception as the units aim to integrate learning and development of professional skills with the application of the technical knowledge.

The Integrated Engg units are a good step in the right direction, but you need to ask the Arts, Commerce and Law lecturers to teach these subjects because when you name it as such, people still think that these subjects are about Engineering and technical competencies, and not soft skills. They will think of it as peripheral to the educational experience and this is not what the intended outcome should be. In every semester, the student must take at least one of this subject to ensure that professional competencies are developed incrementally (as you cannot teach things overnight and certainly to teach that at postgraduate level is a bit too late). Good values are inculcated and indoctrinated over time and that has shaped my personality and my character as I have gone through the degree.

In order to effectively teach professional competencies, interdisciplinary degrees that include arts, commerce and law subjects should be offered as these subjects are not maths based, are about people and require writing arguments from a multitude of perspectives and at times with no right and wrong answers. Unfortunately, the STEM way of thinking and the Arts/Commerce/Law way of thinking is almost always mutually conflicting, and some people might end up hating it, but it must be taught, as much as it is a pain in the neck to think in two different ways. **(Participant 10, male, 21 to 25 years old, was international student, employed professional, 3 to 12 months in work, 3 to 12 months in professional job) (note: completed undergraduate degree after the introduction of Integrated Engineering but before the introduction of PEP).**

A number of students also commented on the Covid 19 pandemic, noting that having to interact with students in their class and teams via Zoom was problematic. However, one first-year student saw the pandemic as providing them an opportunity to develop professional skills that will be necessary in the future because of anticipated changes to the way we work.

Developing professional skills online has been quite a learning curve. Learning to communicate with people, ensuring each person gets a chance to speak and is on the same page is really challenging. However, I think these skills will be useful heading into the future where it will become easier to collaborate on an international level (Participant 12, female, under 20 years old, domestic student, first year undergraduate, 3 to 12 months in work, no work in a professional job)

Outcomes

A number of dominant and often interconnected themes were observed. In this paper we have focused on examining the themes of authenticity and value.

Comments attributed to the authenticity theme ranged from perceptions that professional skills cannot be taught at university and must be learned through workplace practice, to the view that university-based professional skills development is not authentic and/or being taught by academics who have not worked in industry themselves.

It is interesting to note that most participants had definite ideas about how professional skills should be learnt and what skills are required in the workplace even when they had little or no experience in a professional position. Furthermore, there is a belief by many students that problems with lack of professionalism, teamwork, poorly performing team members, motivation and conflicting priorities do not occur in the workplace, and their existence in university student learning and projects contributes to their perception that these activities are not authentic and do not reflect professional practice.

It would obviously be nonsensical to acknowledge that working in professional practice with other professionals and undertaking the associated activities and consequences would not be meaningful. However, many students do not seem to appreciate the opportunity their university studies provide to develop and receive feedback on their professional skills in a low-risk environment. It is interesting that many students appreciate that the technical knowledge they learn at university is regarded as preparation for professional practice and they expect to learn much more from experienced professionals when they have to apply this technical knowledge in practice. Yet many students do not view that they can develop their professional skills in the same way.

Comments coded to the *value* theme range from perceptions that the University does not value the teaching of professional skills, often as a consequence of the limited credit points attributed to the Integrated Engineering units. Students also felt the value of the Integrated Engineering units was diminished as they are often given as exemptions to transferring students and hence the University does not value them as much as technical units for which they perceive it is harder to obtain credit.

Some students felt the University's commitment to teaching of professional skills was more of an add-on, being poorly focused and structured and hence was not valued by the University. A number of students expressed their concern that the University should focus on developing their technical skills as, in their view, this is what employers wanted and what would enable them to successfully achieve a graduate engineering position. While other students believe that professional competencies are inherent and are learnt through working and everyday life.

Interestingly it was a graduate student who, after three years working professionally, suggested that the program should be expanded and have a wider interdisciplinary focus

where arts, commerce and law lecturers should be used to teach important professional skills and competencies as they felt the STEM way of thinking is more technical.

It should be noted that when the Integrated Engineering program was initially introduced at the University of Sydney there was resistance from some staff and students. This resistance was often associated with value, including concerns about the reduction of credit points focused on more highly valued technical content, and a dislike, particularly by students, of the more open-ended, complex and broad problem-based learning the Integrated Engineering units introduced. This required students to use judgement, manage competing demands, uncertainty and complexity. Unlike much of their more technical studies where problems often have a unique correct answer and their learning is “associated with absolutes, moving from the ‘knowable’ to the ‘known’ using predetermined rules, facts and analysis to manage encountered uncertainty” (Willey & Machet 2018, 2019).

While five years into the program this resistance has largely dissipated and student satisfaction with the two credit point units has been steadily increasing, the fact remains that the two credit point Integrated Engineering units are still perceived as being a bolt on, requiring students taking a standard program, to undertake five units in a semester. In response to the concerns, many of which are discussed in this paper, the program has recently been redesigned to consist of three, six credit point units which are now embedded into a student’s normal program. It is hoped that this will increase the perceived value and subsequent commitment to these units by both students and staff.

Recommendations

The student responses suggest that to successfully develop student’s professional skills within university curricula, it is not sufficient to have an integrated, targeted, well designed and embedded program. It is clear for success that the intentions and outcomes of such programs, need to be valued, well scaffolded, articulated and demonstrated to both students and staff and to be seen as both authentic learning and an integral and supported part of a university’s culture and beliefs.

References

- ABET. (2011). *Criteria for Accrediting Engineering Programs*.
http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Process/Accreditation_Documents/Current/eac-criteria-2012-2013.pdf
- Brookfield, S. (2017). *Becoming a critically reflective teacher*. San Francisco, CA: Jossey Bass.
- Engineers Australia. (2018). *Accreditation Management System: Accreditation Criteria User Guide – Higher Education (AMS-MAN-10)*.
- King, R. (2008), “Engineers for the Future,” Sydney, Aust.,. Accessed April 28, 2021 [Online]. Available: https://www.engineersaustralia.org.au/sites/default/files/content-files/ACED/engineers_for_the_future.pdf .
- Confederation of British Industry (2009), “Future Fit: Preparing Graduates for the World of Work,” Confederation of British Industry (Great Britain) (CBI), London, UK.
- Guest, G., MacQueen, K. M., & Namey, E. E. (2012). *Applied Thematic Analysis*. Sage Publications. [https://books.google.co.uk/books?hl=en&lr=&id=Hr11DwAAQBAJ&oi=fnd&pg=PP1&dq=validity+of+automatic+coding+for+thematic+analysis&ots=Xi4zyKwluH&sig=0aNyKVAInU3b6dRmv5ZtZiVw42Y&redir_esc=y#v=onepage&q=validity of automatic coding for thematic analysis&f=false](https://books.google.co.uk/books?hl=en&lr=&id=Hr11DwAAQBAJ&oi=fnd&pg=PP1&dq=validity+of+automatic+coding+for+thematic+analysis&ots=Xi4zyKwluH&sig=0aNyKVAInU3b6dRmv5ZtZiVw42Y&redir_esc=y#v=onepage&q=validity%20of%20automatic%20coding%20for%20thematic%20analysis&f=false)
- Lowe, D., & Goldfinch, T. (2021). Lessons from an Analysis of the Intended Learning Outcomes of Integrative Project Units within Engineering Programs. *IEEE Transaction on Education*. In Press
- National Academy of Engineering, (2004), “The engineer of 2020: Visions of engineering in the new century”, Washington, D.C.: National Academy of Engineering.

<https://www.voced.edu.au/content/ngv:63792>

Passow, H. J., & Passow, C. H. (2017). What Competencies Should Undergraduate Engineering Programs Emphasize? A Systematic Review. *Journal of Engineering Education*, 106(3).
<https://doi.org/10.1002/jee.20171>

Royal Academy of Engineering, (2007), "Educating Engineers for the 21st Century," London, UK.
Accessed April 28, 2021 [Online]. Available:
<https://www.raeng.org.uk/publications/reports/educating-engineers-21st-century>

Winberg, C., Winberg, S., Jacobs, C., Garraway, J., & Engel-Hills, P. (2016). 'I take engineering with me': epistemological transitions across an engineering curriculum.' *Teaching in Higher Education*. <https://doi.org/10.1080/13562517.2016.1160045>

Willey, K., Machet, T. (2018). Complexity makes me feel incompetent and it's your fault, In Proceedings of 29th Australasian Association for Engineering Education Conference 2018 Hamilton New Zealand

Willey, K., Machet, T. (2019). Assisting tutors to develop their student's competence when working with complexity. *8th Research in Engineering Education Symposium (REES 2019)*, Cape Town: Research in Engineering Education Network.

Copyright statement

Copyright © 2021 Keith Willey, David Lowe, Emanuela Tilley, Kate Roach and Tania Machet: The authors assign to the Research in Engineering Education Network (REEN) and the Australasian Association for Engineering Education (AAEE) and educational non-profit institutions a non-exclusive licence to use this document for personal use and in courses of instruction provided that the article is used in full and this copyright statement is reproduced. The authors also grant a non-exclusive licence to REEN and AAEE to publish this document in full on the World Wide Web (prime sites and mirrors), on Memory Sticks, and in printed form within the REEN AAEE 2021 proceedings. Any other usage is prohibited without the express permission of the authors.