Virtual work integrated learning to support engineering student transitions

Sally Male
School of Electrical, Electronic and Computer Engineering, The University of Western Australia

Abstract

An important part of engineering education is learning about engineering practice. For engineering programs to be accredited by Engineers Australia, students must be exposed to practice. The most common way that this criterion is met is through compulsory engineering-related employment - traditionally 12 weeks. Due to increasing student numbers, a downturn in employment, and changes in engineering employment practices, it can be difficult for students to secure placements. We are currently developing a suite of work integrated learning modules in which engineering students across Australia will gain exposure to practice through virtual rather than real placements. Engineers, university staff members, and engineering students participated in planning forums in three cities early in 2016. Based on participants' reviews of hypothetical modules and consultation with other stakeholders, requirements for the modules were identified. This paper reports on the planning phase and how the modules will support student transitions.

Introduction

Employers have persistently indicated that engineering graduates have skill gaps in communication, leadership and social skills (Male, 2010). Studies on employability skills for engineers frequently feature: communication and teamwork; professionalism and attitudes such as integrity and commitment; ability to learn; management; a customer focus; business skills; leadership; sourcing and analysing information; and an interdisciplinary approach (Male, 2010). These are consistent with those stipulated in engineering program accreditation criteria by Engineers Australia (EA) (2011), and desirable skills identified by employers (Hamilton, Carbone, Gonsalvez, & Jollands, 2015).

Engineering students in three focus groups at universities in Australia reported that industry placements helped them develop the employability skills identified above (Male & King, 2014). This is consistent with findings of the OLT project, *The impact of work-integrated learning on student work-readiness* (Smith, Ferns, Russell, & Cretchley, 2014) and evidence that the most important strategy to improve graduate employability is participation in well-managed work experience, internships, and placements (Kinash & Crane, 2015).

In 2014, all but one of the 34 Australian institutions that offered formative professional engineering programs required students to complete a period of engineering-related employment. However, it has become difficult for students to obtain placements. In a 2014 survey of engineering students at 11 Australian universities, 29% of 215 students in their final year of their bachelor or masters degrees reported that they had not completed 12 weeks of vacation employment or an internship (Male & King, 2014).

Recent Australian research found that the importance to engineering students of obtaining a placement coupled with limited opportunities was forcing students into vulnerable positions (Male, 2015b). Additionally, some students were unable to graduate, despite completing coursework, because they had not obtained workplace experience. Therefore, opportunities are needed for engineering students to gain the benefits of a placement without a real placement.

Smith et al. (2014) recommended future research into simulated work integrated learning (WIL). Virtual WIL has been implemented in law (Patrick et al., 2009). In this project a suite of modules is being developed to complement opportunities for students to be exposed to engineering practice for students from universities across Australia, without real placements in workplaces.

This paper introduces the vision, the theoretical framework, and the planning phase in which requirements and learning outcomes for the modules were refined. The suite of modules under development, future research, and how the modules will support student transitions are outlined. Finally, questions are posed to conference delegates.

Vision

We are designing learning modules in which students will complete authentic engineering activities by:

- visiting an immersive learning environment that simulates an engineering site or workplace
- working remotely with students from their own or other universities
- receiving feedback from industry-based engineers and
- reflecting individually and with others.

Learning and assessment will be aligned with accreditation requirements. Students will spend much of their time interacting with each other and with real engineers because engineering practice demands social skills in technical contexts.

Expected advantages of virtual WIL over traditional placements are increased student access, better reliability, exposure to more diverse industries and roles, and the opportunity to structure exposure to practice from the first to the final year of the engineering program.

Virtual WIL modules will support students to transition from engineering students focused on passing studies to student engineers focused on studying for a future. This will be achieved by exposing students to possible future engineering roles, known to be necessary and motivating for students (Bennett & Male, 2016). Modules will additionally support students in the transition to professional engineer by developing career literacy, knowledge of engineering practice, and capabilities for engineering practice.

Theoretical framework for the design

The design of the learning modules fits the framework in Figure 1 for effective exposure to engineering practice, which was informed by literature on work integrated learning and engineering education (Male & King, 2014).

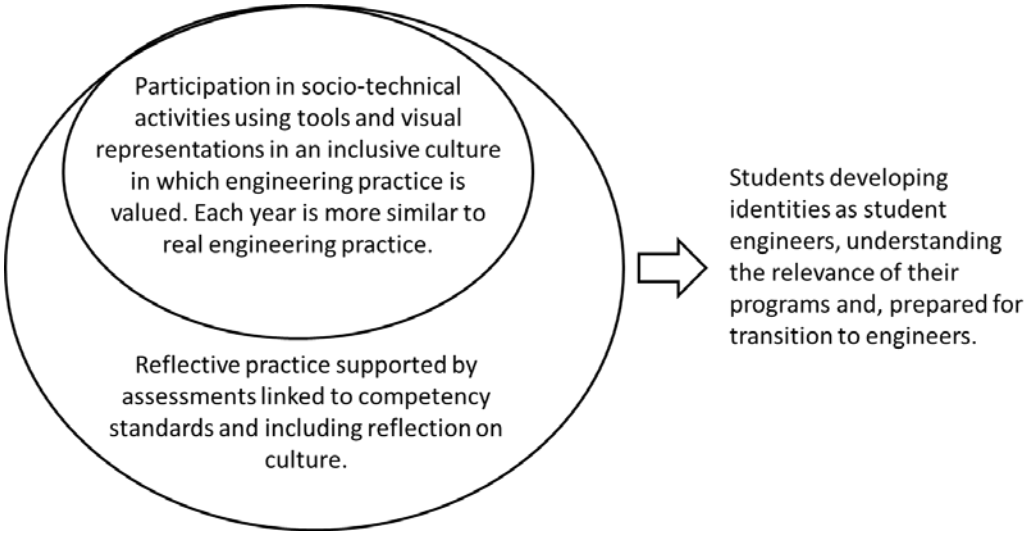

Figure 1. Model of effective exposure to practice in an engineering degree (Male & King, 2014, p. 3)

Planning phase

A planning phase was undertaken during the first six months of 2016. Discussions were held at meetings of the Australian Council of Deans of Information and Communication Technology, the Australian Council of Engineering Deans, and the Australian Associate Deans Teaching & Learning in Engineering. Three planning forums (N = 43) were held. Participants included engineers, students, academics, professional staff members, and an expert in work integrated learning.

At an engineering education conference workshop in December 2016, 25 academics reviewed the planned modules for whether and how they would use them. They sought flexibility for embedding modules in units or offering them independently of units.

Learning outcomes

The intended student outcomes for the modules were identified as:

- development contributing to achievement of Stage 1 Competencies
- understanding of engineering roles and value of engineering
- motivation towards engineering studies
- self-efficacy for working as an engineer
- development of an identity as a student engineer
- ownership of responsibility for learning
- improved capability to secure or create engineering work
- understanding of the employment market in the student's discipline
- capability to plan navigation of the employment market and
- an expanded engineering network.

Future research

Modules are being developed for piloting late in 2017 and during 2018. Modules for students in first, second, and third year are on engineering career literacy, conflict resolution in

engineering teams, and communication in engineering practice. Modules for third, fourth and fifth year are on self-management for engineering, safety hazard identification, preparing tenders, evaluating tenders, maintenance, and safety root cause analysis.

Planned Impact and Relevance to STARS

Students

Including domestic and international students, approximately 10,000 students complete engineering programs annually in Australia (Kaspura, 2017). As noted above, many of these students have not graduated with their cohorts because they had not completed the engineering-related employment required for their degree program when they completed their coursework. Most engineering students do not complete their engineering-related employment until they have completed at least three years of coursework. This project will complement opportunities for students to be exposed to practice from first year.

Transition into university

Engineering students need exposure to practice from early in their degrees to improve their transition into engineering. This project will embed understanding of engineering roles into first year. Understanding roles of engineering has been identified as a threshold for students' readiness to study engineering (Male, 2012). Unless engineering students have relatives who are engineers, they are unlikely to be aware of engineering roles. By learning about roles of engineers, students can be motivated by perceiving appealing and achievable possible selves and recognising the relevance of their education to their futures (Bennett & Male, 2016).

Engineering-related employment has been found to further motivate engineering students by supporting them to 'recognise a fit between their engineering education or engineering practice and applying learning in the workplace', 'receive affirmation from their co-workers including peers, colleagues and supervisors'; and 'recognise that they have experienced professional growth' (Male, 2015a, p. 4). This project is designed to provide these motivational experiences without real engineering-related employment.

Transition into practice

Due to the strong emphasis on engineering science, engineering students have been found to develop a less realistic perception of engineering practice as they progress through their studies (Trevelyan, 2011). The resulting misperception that engineering is purely technical can lead to identity crises when graduates enter the workplace (Faulkner, 2007). This project aims to support students to develop realistic perceptions of practice, easing their transition to engineering practice.

Questions to delegates

We would be interested to know whether conference delegates are aware of similar modules in other disciplines, and whether delegates can see a need and feasibility for modules such as we plan, in their institutions.

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