Full Paper

Abstract

Engineering employers continue to report dissatisfaction with the skills of new graduates at the same time as employment outcomes continue to fall. Work experience is generally considered the best way to develop employability, but there are too few work placements to meet demand. Non-placement authentic work integrated learning (WIL) is an alternative but there is very little research to show if learning outcomes are equivalent. This paper compares student outcomes from placement and non-placement authentic WIL.

The non-placement WIL module used a real project from a local engineering company, jointly scoped, developed, supervised and assessed by engineers from the company and the author. Students also participated in a series of skill based workshops developed and facilitated by the author.

At the start of semester non-placement students rated themselves significantly lower than their peers who had completed a 12 weeks of engineering work experience on a number of employability skills. The students also struggled to engage with the WIL project initially. However attendance, participation, and individual assignment submission rates improved with consistent implementation of classroom conditions that simulated the workplace. After completing the WIL module, the gap between non-placement and placement students had all but disappeared.

This paper shows that working closely with an industry partner to jointly design, supervise and assess students undertaking an authentic project is effective in increasing students' confidence in their work readiness, to a level similar to students who had work experience. The survey used to assess student perceptions of work readiness and graduate employability is a useful tool for curriculum development.

Background

Engineering employers continue to report dissatisfaction with the skills of new graduates (GCA 2015a, p.20), at the same time as employment outcomes continue to fall (GCA 2015b, p.7). Employment outcomes reflect availability of jobs and demand from employers, and is sometimes used as a proxy measure of employability (Bridgstock 2009), perhaps reflecting the difficulty associated with measuring 'employability' (Oliver 2011).

Graduate employability is a contested concept, but generally it is considered to encompass the discipline knowledge, skills and personal attributes that give an individual graduate the ability to gain and maintain work or employment (Hillage & Pollard, 1998). It is a narrower set of skills than covered by graduate attributes, which includes skills for employment and life (Barrie et al. 2009).

Although the concept is contested, there is broad consensus that work experience is the best way to develop employability (Orrell 2011; Male and King, 2013; Smith, Ferns, Russell and Cretchley, 2014). However there is insufficient provision of work placements to meet demand of the one million students in Australian universities (Australian Workforce and Productivity Agency 2013, Australian Education Network 2014).

An alternative to work placement is to bring authentic projects into the classroom in the guise of WIL (Orrell 2011). However, to date very little research has been done to compare the outcomes of placement and non-placement WIL. One study found that high-quality and above average placements were better than simulated non-placement WIL, but interestingly, sub-median and low-quality placements were not (Smith et al. 2014). In a study of stakeholder perceptions of employability, Jollands, Clarke, Grando, Hamilton, Smith, Xenos,

Carbone, Burton, Brodie and Pocknee (2015) found that students with work experience as well as students from programs with high levels of authentic project work demonstrated a more sophisticated understanding of employability than peers. This suggests that non-placement WIL can develop employability in graduates, but to what extent is unknown.

This paper discusses design of a non-placement authentic WIL module and compares student learning outcomes from placement with non-placement WIL.

Aims

The aims of this paper are to:

- Describe the design of a non-placement authentic WIL module
- Compare the effectiveness of placement and non-placement WIL in developing students' employability
- Recommend areas for improvement in context, approach, curriculum and assessment

Design of the non-placement WIL

A non-placement authentic WIL module was developed and run at RMIT in 2015. The WIL module was designed to cover a broad range of skills and attitudes identified by Australian employers (GCA 2015a, Jollands et al 2015). These were categorised using the CareerEDGE framework (Dacre Pool and Sewell, 2007). Employers identified that current graduates have gaps in employability across a wide range of employability categories.

A reflection model was used to enhance student learning as reflection has been identified as the key to learning from experience (Moore 1999). Students discussed their experiences in workshops, as well as submitting reflections on critical incidents from their week. The aim was to develop the habit of reflecting on their experience and learning from their peers. An overview of the semester structure is given in Table 1.

Table 1: Non-placement WIL semester overview

Wk	Guest speakers	Focus for the week	Assessment
1	Meet the staff	*Self awareness*	Self assessment (Pre-skills survey), Skills card, Letter to self
2	No class	*Career planning*	Cover letter/CV/5 companies
3	Library	*Research*	Reflective journal
4	**Industry Partner**	*Scoping*	Project scope
5	Alumni	*Team work*	Reflective journal
6	Careers, graduate coach	*Career Planning*	Group project statement of work
7	**Industry Partner**	*Managing self and others*	Reflective journal
8	Alumni	*Leadership*	Mid semester peer feedback
9	**Industry Partner**	*Communication*	Reflective journal
10	No class	*Experience*	Video of roleplay interview
11	**Industry Partner**	*Work readiness*	Self assessment (Post-skills survey)
12	**Industry Partner**	*Communication*	Group project presentation
13		*Communication*	Group project final report, Final peer review

This non-placement WIL module is part of a core chemical engineering final year course, PROC2114 Research Project. PROC2114 is a 24 CP course that runs for 12 weeks with 3 hours of classes and 9 hours of self-directed learning per week. At RMIT University there are two semesters per year and students take 48 to 60 CP of courses per semester. Students with industry work experience of 12 weeks or more are 'accredited' and do not need to undertake the WIL module to pass the course. The cohort of accredited students formed the 'control' group in this study.

The non-placement WIL module was run on the university campus using a real project from a local engineering company run by their engineers. The author and the company's senior process engineer worked together to develop the project scope, group assessments, supervision and marking of the group work. The author also developed a series of skill based workshops in selected areas with individual student assessments. Three of the company engineers visited campus regularly to supervise the students, and made one visit to assess group presentations.

To simulate a work environment special classroom conditions were implemented. High expectations for attendance and behaviour were set and enforced. Students were expected to attend all classes and to participate (as in a workplace). If they could not attend they had to email the lecturer prior to class and explain why. Attendance was encouraged by use of a signed attendance sheet, and the consequence of non-attendance was that the lecturer followed up immediately with any student who failed to attend or email an apology, with a request for an explanation. Participation was encouraged by using a facilitated workshop format, with short lectures interspersed with self-reflection or group exercises. Students were asked to report back on group exercises on a voluntary basis. Later they were asked by name (from the attendance sheet) to report back on self-reflection exercises.

Special conditions for quality and timeliness of assignment submissions were also implemented. Electronic submission and feedback in Blackboard was used to manage the multiple assignments efficiently. Every assignment was a hurdle, so students had to pass every assignment to pass the course. The aim was to ensure every piece of work achieved a high standard, as in a workplace. Students were allowed to resubmit up to two times, within strict time-frames.

The first activity in Week 1 was undertaken by all students in the course. Each student completed a survey of their perceived employability skills, and indicated on their survey if they had done engineering work experience or not (discussed in more detail in *Evaluation methodology*). This survey was then used to separate the students into the group who needed to do the non-placement WIL module (28 students), and those in the placement (control) group (35 students). The non-placement WIL students also completed the same survey again at the end of semester.

The initial survey results of the two students groups (placement and non-placement) were compared. The differences were used to inform the content of skills workshops. For example, an additional focus on professional learning opportunities was added to workshops.

Workshops were developed by the author on career planning, experience, generic skills (communication, critical analysis, leadership, life long learning, networking, research, team work) and emotional intelligence (self awareness, managing self and others). These categories reflect the CareerEDGE framework (Table 2). Those workshop topics were selected by reviewing which skills are ranked most highly by Australian engineering employers as well as where current graduates have the biggest skill gap (GCA 2015a). These were compared with the skills the non-placement cohort identified as significantly weaker than the placement cohort. Any that were missing were then included in the curriculum.

Table 2: CareerEDGE framework (Dacre Pool and Sewell, 2007)

Category	Sub-categories
Career development learning	career decisions, knowledge of job market, networking, passion and interests, recruitment processes and preparation
Experience (E) – work and life	*none provided*
Degree subject knowledge, understanding and skills (D)	grades
Generic skills (G)	adaptability, communication, critical thinking, entrepreneurship, imagination & creativity, lifelong learning, managing others, numeracy, planning, problem solving, teamwork, time management, using ICT, work ethic, working under pressure
Emotional intelligence (E)	self-awareness, self-management, awareness of others, managing others, motivation (Goleman 1998)

Workshops on employability topics were developed using the following format:

- Review key outcomes from previous workshops
- Locate the new topic within the overarching framework of employers' desired skills and attitudes.
- Review professional media resources on the topic.
- Discuss where students develop this skill and use it.
- Self-evaluation of current skill level.
- Group discussion on strategies to develop the skill.

Lastly, reflection was built into the semester at a number of points, following the approach of Moore (1999) and Eyler (2001). First, students reflected on their strengths and weaknesses. Then they submitted fortnightly reflection assessments that analysed a critical incident of the previous week and identified areas where the student made choices that could brought about good outcomes or could bring about better outcomes in future (Eyler 2001). Finally, they reflected on their contribution to their group report and what they had learned from the WIL project. Reflection promotes learning from experience, promoting development of the generic skills of critical analysis as well as lifelong learning.

Discussion

The use of a real project and supervision by practicing engineers – including one who had worked on the project – made a very significant contribution to the students' perception of the authenticity of the project. The students had access to a very large volume of genuine documents, including site phots, P&IDS, plot plans, piping isometrics. They experienced the genuine challenge of how to deal with the huge sheer volume of documents, as well as real errors and omissions in the documents. They faced the need to make assumptions to run flow simulation packages. All groups produced passable quality reports, with feasible designs.

The students had lower attendance early on in semester, and submission rates and quality of weekly individual assignments were initially lower than later. Attendance improved markedly with consistent implementation of 'work-like' classroom conditions and consequences, with

attendance of around 85% for the final 6 weeks of semester. Timeliness of submission of the weekly assignment improved to around 95%, after an initial poor rate of around 75%. Each late assignment received a prompt fail grade with feedback that it was late, and would need to be resubmitted within a strict time limit and with justification. Quality of some submitted work was initially poor. The author grabbed student attention from the outset as one of the first assignments had a 20% failure rate. Some students found it very difficult to follow the directive to format their resume according to Careers department guidelines. Their focus increased when they received a series of NX grades. Each submission received feedback similar to the following:

> You have failed this assessment task because your resume has poor formatting and misses several important sections and has too much detail in others. You need to use the RMIT Toolkit advice on how to write a resume, what to include, what order, how to format, what font to use etc etc. Please use that resource and resubmit by [date] for another opportunity to get a PX grade for this assessment.

Students readily participated in group and class discussion, quizzes and activities. Self-reflection quiz hand-outs were a useful resource. Students responded well to being each asked to contribute individually, and listened attentively to each other. It may be important to encourage participation of introverted or minority students by giving them permission to speak.

The student reflections showed increasing quality in their increasingly mature analysis on how to handle critical incidents, as well as increasing length of submissions beyond the minimum requirement of 300 words. A sample of lecturer feedback on a reflection that received a fail grade was:

> The incident is relevant to research. You describe the incident logically and succinctly. You link evidence with processes and events, organizational structure and work group practices. You show some links with larger issues. However I am unclear on what strategies you plan to bring about a better outcome next time. Please add some reflection on that - it will all happen again otherwise. Please resubmit by [date] for another opportunity for a PX grade.

The feedback from the local company was very positive. The process manager wrote:

> In our initial conversations I understood the intent of the course was to replicate the experience the students would receive from an industry placement. Personally I think this course has given the students much more that will benefit them both in the completion of their degree and gaining their first role in industry. This is an interesting incident but lacks reflection on the origin of the problem, so please submit again by Thurs 2 April 5 pm for another opportunity for a PX grade.

Anonymous feedback from the students was too scarce to be representative. Students are surveyed on every teacher in every course every semester at RMIT University. Unfortunately, this leads to extreme survey fatigue, and survey participation rates are corresponding very low (2 respondents out of 28 for this module).

Evaluation methodology

An employability survey was developed, based on that of Smith and coworkers (2014), who used it to survey 3282 students from multiple disciplines. Self-reporting tools tend to have self-interest bias, but this tool was validated by cross-checking with employer studies and alumni interviews so is considered to have adequate reliability.

The survey measured students' self-reported perceived sense of employability against a range of employability dimensions using a quasi-experimental pre-test and post-test design. Pre- and post-testing is common in education research (Dugard & Todman 1995).

The perceptions of the two cohorts of students (placement and non-placement) were compared. Significant differences were identified using a one tailed T test.

The non-placement WIL students completed the survey twice, first at the beginning (a pre-test) and then again at the end of semester (a post-test). A statistical analysis was carried out to determine if there were significant changes in perceptions of the students ($p < 0.05$). The survey validity is acceptable as the sample size was adequate (>20) and participation rate was high (>70%)

Comparison of effectiveness of placement versus non-placement WIL

Initially, non-placement students rated themselves lower on many employability questions compared to the placement (control) cohort:

- Overall I am confident I am work ready.

- I am able to obtain work relevant to studies.

- I weigh up risks, evaluate alternatives, make predictions from data and apply evaluation criteria to options.

- I seek out opportunities for further learning to develop my workplace or professional skills and/or knowledge.

- I identify the standards of performance or practice expected in the workplace / my profession.

- I apply knowledge and skills gained in my studies to the workplace.

After completing the module, the gap between the two cohorts had all but disappeared. By the end of semester the non-placement students rated themselves equally work ready, and no longer rated themselves significantly lower on any of the targeted skills areas. In addition, pleasingly, they now rated themselves significantly higher than placement students on the following four questions:

- I recognise the "politics" of a workplace environment.

- I interact effectively and respectfully with people from other cultures.

- I learn from and collaborate with people representing diverse backgrounds or viewpoints.

- I listen empathetically, sympathetically and with compassion to colleagues in the workplace.

These questions reflect student learning on communication and teamwork through workshops, group work and reflection.

Interestingly there were <u>no</u> significant changes in answers to two questions:

- I am able to obtain work relevant to studies.

- I develop a personal code of values and ethics.

No change was expected in these questions unless there were confounding factors (impact of learning outside the module). So this supports the validity of the survey results.

Recommendations and conclusions

This paper shows that working closely with an industry partner to jointly design, supervise and assess students undertaking an authentic project is effective in increasing confidence in work readiness to a level similar to students who had work experience. The students' perceptions of their employability was assessed with a survey instrument that can be used to scope curriculum development to enhance student employability.

The overall structure of the project and type of project will be retained. Some changes are planned as follows:

- The local company engineers will play the team leader (rather than client)

- They local company will provide examples of workplace standards for reports of different types (scope, plan, report to client).

- An EA pilot work standards framework will be trialled.

- Program advisory committee members from industry will be used to form an interview panel to lend authenticity to the students' interviews.

A longitudinal research study is planned to compare student conceptions and perceptions of graduate employability and their self-reported employability skills with employment outcomes. Unfortunately there is a considerable lag in employment outcome data: this will be available for this cohort around March 2017.

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