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Work ready engineering graduates through WIL processes

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ABSTRACT

CONTEXT

Work Integrated Learning (WIL) requires an engagement approach that incorporates workplace partners, universities and students. Effective collaboration between students, universities and workplaces provides an enhanced engagement experience and enables students' to graduate with work-ready skills. CQU's Bachelor of Engineering (Honours) and Diploma of Professional Practice (Co-op) students participate in two 6-month WIL placements over the course of their university studies. As part of practice assessment, industry partners provide an evaluation of our students' performance against the Engineers Australia (EA) Stage 1 Competency Standard for Professional Engineers.

PURPOSE OR GOAL

A WIL student engagement framework was developed and adopted. This paper investigates the effectiveness of the WIL program to make CQU graduates work ready as compared to the Quality Indicators for Learning & Teaching (QILT)national survey data.

APPROACH OR METHODOLOGY/METHODS

A CQU formatted template of student capability against the Engineers Australia (EA) Stage 1 Competency Standard for Professional Engineers is sent to the employers to assess our graduates. These data sets indicate that the level our graduating students work abilities are at the national average or higher on a 5 Likert scale where 3.0/5.0 is the average level. On the other hand, the work readiness capabilities of current CQU engineering students and new graduates are then compared against the QILT national survey data to identify the graduates' standings on various descriptors such as overall student reaction, their skill development, rated teaching practices positively, interaction with staff and students, facilities and resources, positive support services, skill developments, starting salary etc.

ACTUAL OR ANTICIPATED OUTCOMES

The student assessment data from 2012-2019 indicated that the EA competency standard trend for CQU students was consistently above the average (3.0/5.0 on the Likert scale) of a graduate engineer. The QILT data suggest that, in some of the descriptors, the performance of CQU students and new graduates is comparable to that of the national standard.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The CQU WIL program students are consistently evaluated as work-ready, as they are rated above the average performance expected for a graduate engineer. They perform better than the average in some areas. Overall, CQU engineering graduates are work-ready compared to the national standard managed by the QILT. In order to further assess the impact of WIL-based programs on graduate outcomes, we suggest that more specific post-graduate surveys could further establish a causal link between WIL education, employer assessments, and graduate outcomes.

KEYWORDS

Work Integrated Learning; work readiness; industry engagement; collaboration, national standing.

Introduction

The previous studies on WIL focussed on many factors of WIL engagement with workplace employers, universities and students. These factors include challenges and barriers of WIL processes, benefits and engagement styles of WIL to produce engineering work ready graduates. A thorough literature search is carried out to illustrate all these aspects.

The challenges and barriers faced during the WIL processes are evident. Some studies articulated an examination of employers' understanding of WIL, reasons for participation in the WIL placements (Ferns, Russell & Kay, 2016: Jackson et al., 2017). Jackson et al. (2017) indicated that the relationship between university and industries was in the form of 'placement to engineering workplaces' and 'non-placement to engineering workplaces'. Engineering students achieved a real-world work experience in the placement to engineering workplaces option. The development of work-related skills was achieved through engineering workplaces-based projects and simulations. Ferns, Russell and Kay (2016) pointed out that WIL employed real-world learning options into the curriculum and assisted engineering graduates to face the challenges of real-world problems. Ferns et al. (2016) also presented some challenges and barriers that the employers were facing including support for mentoring students, insufficient resources, cost, and the complexity of collaboration with universities. Walker and Rossi (2021) articulated that students experienced coping issues, self-belief doubts, and mental stress. It was not known which personal qualities the student should bring to their WIL journey to succeed during WIL placements and future employments. Student stress problems are significant in some WIL placements (Warren-James et al., 2021). The above literature suggested a few more challenges in WIL processes including an effective engagement on WIL, barriers of hosting students in workplaces, embedding real-world learning into the curriculum, evaluating WIL assessment, identifying suitable projects and tasks to assign to the students, sourcing of quality students, and maintaining quality of student performance.

There are some significant benefits of WIL placements to prepare work ready engineering graduates. Kaider (2017) suggested that WIL was an important engagement approach in increasing students' employability. He urged that the integration of theory and engineering practices of workplaces was key to the development of graduate employability. Blicblau et al. (2016), on the other hand, illustrated in their study that relevant work-experience improved the academic grades for engineering students. In some instances, a few engineering students were offered further full-time employment at the same place at the conclusion of their work placements. The studies of Male (2010), Male et al. (2011) and Jackson (2014) supported this point. Jackson et al. (2017) argued that WIL placements were the main vehicle to increase students' employability. Trevelyan (2019) also commented that curriculum reforms focussing on workplace skills and graduate attributes had not been attributed to significant employment opportunities. A structured work experience model, on the other hand, could improve the student employability (Edwards et al., 2015).

A broader benefit among universities, students and workplace employers through WIL is also evident. Ferns (2016) mentioned that the workplaces partners were interested in contributing to authentic learning through engineering workplace-focused resources. Agwa-Ejon and Pradhan (2017) and Glavas and Schuster (2020) explained that WIL enabled engagement of university academics and engineering workplace engineers for their mutual benefit. The authors articulated the potential of students' employability and impact of WIL on workplace organisations. They also reported that there was a lack of collaboration in terms of university assistance and lecturers' visits during the WIL period in selected industries. Therefore, a non-placement type WIL can be effective in many applications (Reedy et al., 2020).

The workplace dynamics are very important in WIL workplaces. Fleming and Pretti (2019) and Lu et al. (2018) carried out research to find whether a WIL student in the workplace community changed the workplace dynamics. They urged pre-placement preparation of

students regarding workplace relationships and scenarios. It was also necessary to support for student wellbeing during their WIL experience.

The above literature pointed out that a structured WIL program could be an effective learning method in developing work-ready engineering graduates. The main focus on the WIL processes is on activities such as assessments, pre-placement preparation, employer engagement and barriers to effective outcomes. It is also necessary to focus on student work readiness for employment by ranking or benchmarking against employers' evaluations of student capability to judge employability through mapping against the Engineers Australia Stage 1 Competency Standard. There is limited study reported in this direction. Therefore, comparison of CQU engineering graduates data with the national survey on engineering graduate employability (QILT, 2020) data helps in this direction.

Methodology

At the 2019 Australasian Engineering Education Conference, a framework on the WIL process was presented (Mandal & Edwards, 2019). It focused on four stages: Stage 1: Relationship Formation, Stage 2: Recruitment and Selection, Stage 3: Industry Placement and Stage 4: Capability Assessment. As part of Stage 4 of this process, data was collected on student work readiness capability via assessments conducted by employers of students' performance compared to the Engineers Australia Stage 1 Competency Standard. Graduate Outcome Survey (GOS) indicators were obtained from QILT (2020 which provides data from graduates of Australian higher education institutions approximately four to six months after finishing their studies. The GOS measures short-term employment outcomes including skills utilisation, further study activities, and graduate satisfaction.

In order to provide the basis for evaluation of a structured WIL program on student work readiness, the WIL employer work readiness assessments were compiled, along with student satisfaction surveys of the relevant WIL unit. GOS indicators for the Co-operative Education Program (CEP) students were then filtered and presented in tabular format, along with the national averages for all engineering students. The following steps represent the steps undertaken to collect and manage the student data set (Figure 1) for trend analysis through the MS Excel graph and tabular forms. These stages are further discussed in detail below.

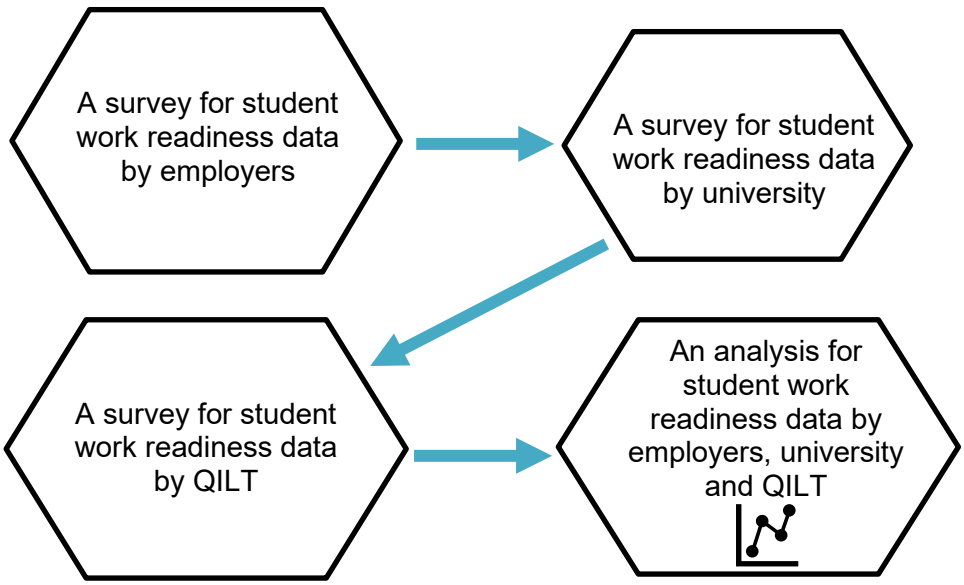

Figure 1: The proposed steps for collecting and managing student data set

Stage 1: a survey of the student work readiness is carried out by participating WIL employers on standard forms prepared by the university mapped to the Engineers Australia Stage 1 Competency Standard, via a WIL unit called Industry Practice 2. Employer assessments are undertaken independently by the student's direct supervisor.

Stage 2: A student survey through the Industry Practice 2 unit is offered to students by the university Moodle system on various descriptors to judge their satisfaction in the placement unit. This is a standard practice applied to all units across the university's offered units, and completed by students toward completion of the relevant term.

Stage 3: The results of the national graduate outcome survey (GOS) of engineering graduate data carried out by QILT (2020) are compared with that for the recent CQU engineering graduates. As indicated above, this data includes graduate employment outcomes and graduate assessment of course satisfaction.

Stage 4: An Excel spreadsheet is used to compile all data results and present the analysis via figures and tabular forms.

Results and Discussions

As stated in the methodology section, the student evaluation survey data on work readiness rated by the employers were recorded and processed by the MS Excel. The data showed a comparison of student work performance as a newly graduated engineer against the Competency Standard categories of knowledge base, engineering ability and professional attributes using a 5-point Likert scale. To evaluate work placement value to employers, we analysed the past seven years of employer evaluation assessments. These assessments were undertaken by organisations within Construction, Electricity, Gas and Water Supply, Manufacturing, Mining, Local Government, Professional, Scientific and Technical Services. The data for CQU students shown in Figure 2 are classified using the three EA Stage 1 Competency Standard categories. As indicated, each competency is rated at a level well above the average graduate rating of 3.0 out of 5.0. We note that the professional attributes competency is consistently rated higher than engineering knowledge and ability. Further analysis of the data indicates some supervisors do not rate students in every element of competency, as the position scope has not afforded students the opportunity to exercise all competencies. Recent data indicates this situation applies to competencies PE 2.4 Proficiency in engineering design, and PE 3.3 Capacity for creativity and innovation (Engineers Australian, 2019). Finally, in response to the re-employment question, employers answered in the affirmative for 100% of evaluations.

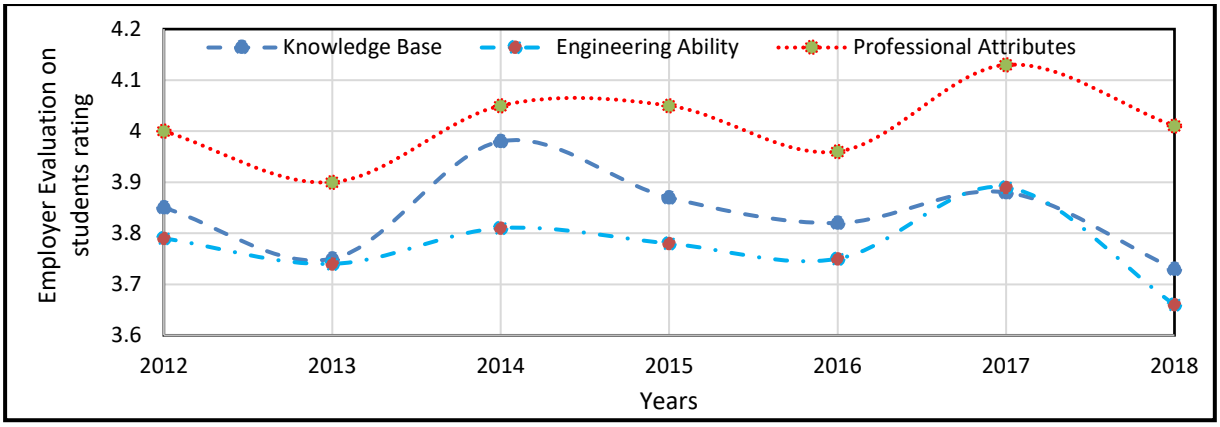

Figure 2: Employer evaluation on CQU student rating against EA Stage 1 Competency Standard: Knowledge Base, Engineering Ability and Professional Attributes.

In addition to employer ratings of CQU engineering graduates, the CQU engineering graduates themselves are providing their reactions and evaluations of the WIL learning and teaching (L&T) processes and practices in relation to their development as engineering work ready

graduates through anonymous responses to a CQU survey tool. They allocate ratings on a 5-likert scale with 5 indicating strongly agree, 4 agree, 3 neutral, 2 disagree and 1 strongly disagree. CQU sets a student satisfaction level of 4 on this scale as a corporate target. Examining the student data in the WIL unit of Engineering Practice 2 (Figure 3), the student overall unit satisfaction average (far left of figure) is currently over the corporate target in the recent years. For the other descriptors, the WIL unit has also been performing well in recent years.

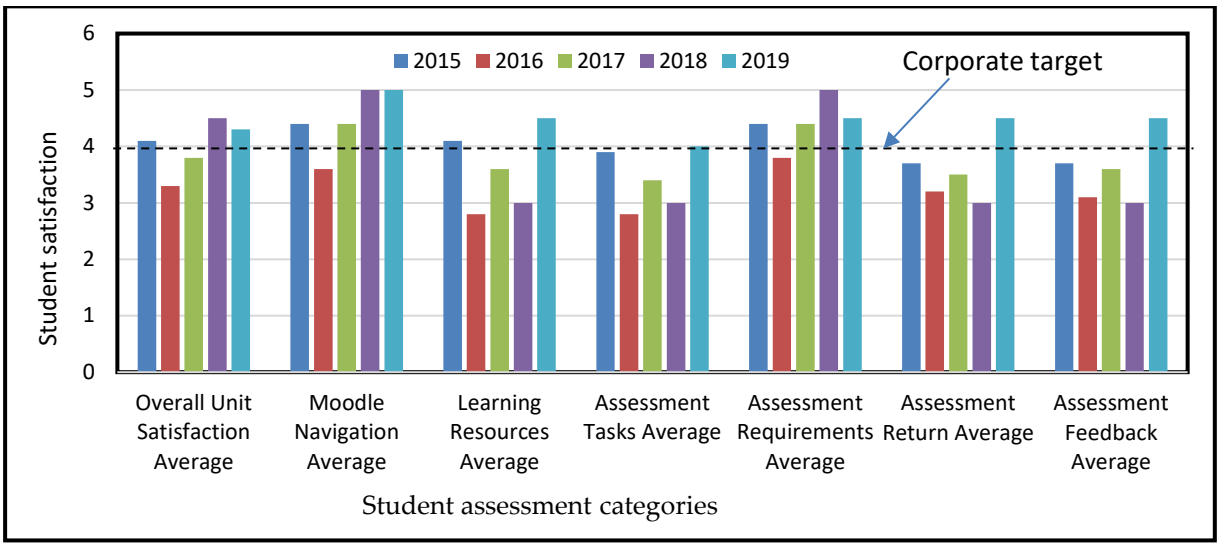

Figure 3: CQU student satisfaction data of engineering practice unit 2 on various descriptors.

The impact of the influential WIL processes on L&T student engagement practices and learning is also supported by the QILT (2020) national higher education survey data (funded by the Australian Government Department of Education, Skills and Employment) relating to CQU undergraduate engineering on current student experience, recent graduate satisfaction and recent graduate employment and salary. These data put into context how CQU's L&T practices employing WIL are linked to the engineering student experience at CQU (Figure 4). It shows that, in all areas of student skills development, teaching practices, engagement with students and resources and facilities, the CQU undergraduate engineering students are rating those positively at well over national averages. In relation to recent CQU engineering graduates, 85.8% of them were satisfied with how their skills improved compared to the national average (NA) of 83.3% (Figure 5), and 89.1% of them found full-time employment just after their compared to the NA of 82.4% with a median graduate salary of $70,400 (NA of $65,000) (Table 1).

Further, adding the employers' perceptions on graduate ability indicates the benefits of student WIL engagement. The 2019 employer satisfaction survey by QILT confirmed that supervisors rated Australian graduates highly; their overall satisfaction was 84%. The ‘overall satisfaction’ means that the proportion of those employers are likely or very likely to consider hiring another graduate from the same institution and course if a position is created. This satisfaction is based on five graduate attributes: foundation skills (general literacy, numeracy, communication, investigation and the ability to integrate knowledge), adaptive skills (the ability to apply and adapt skills and knowledge and work independently), collaborative skills (interpersonal and teamwork), technical skills (application of technical and professional knowledge and Australian Standards) and employability (ability to perform and innovate in the workplace). In engineering, the employers’ overall satisfaction on Australian graduate capability is 89.9% (QILT, 2020), slightly higher than the general national average data for all professions. These national engineering results can be linked to the CQU engineering data relating to the WIL processes stated before and CQU results are competitive and 100% of employers involved with WIL respond positively to the re-employment of the CQU graduates.

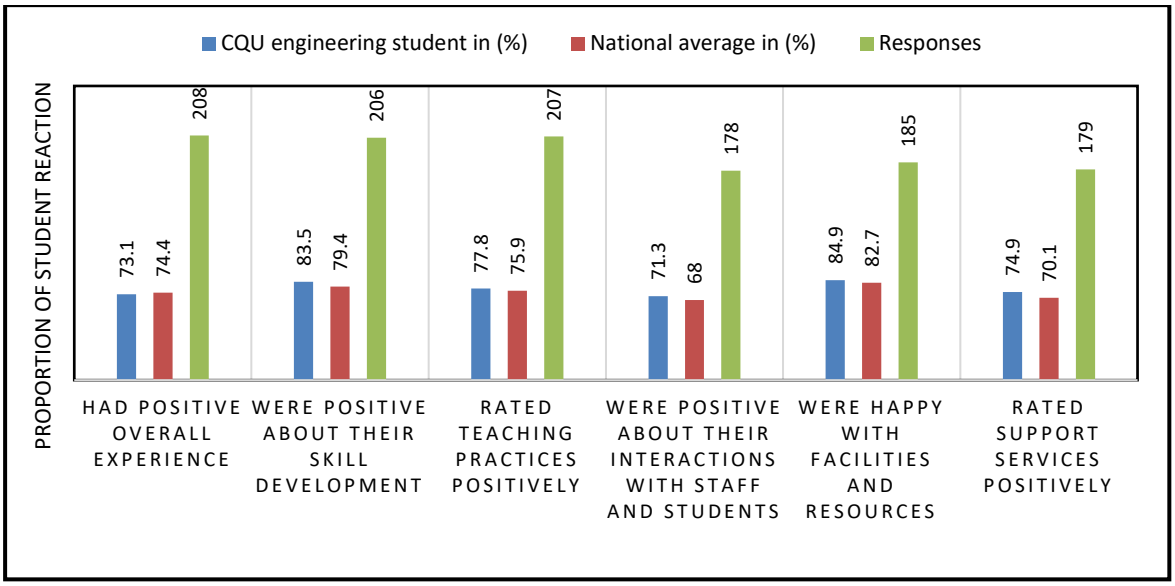

Figure 4: Current CQU engineering student experience survey (2017 - 2018) by QILT (2020).

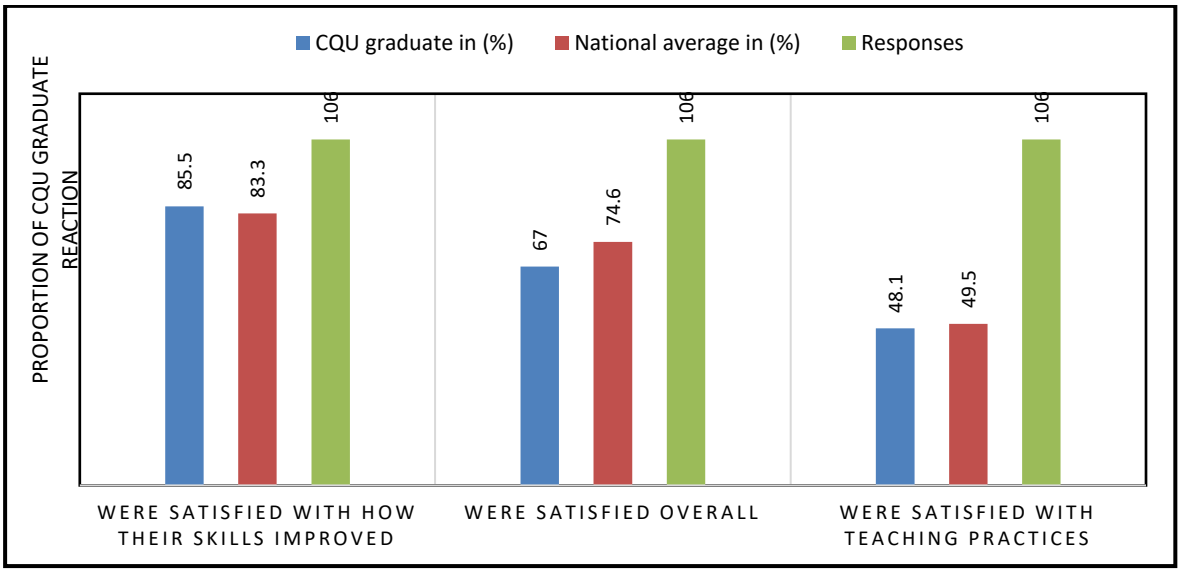

Figure 5: Recent CQU engineering graduate satisfaction survey (2018 – 2019) by QILT (2020).

Table 1: Recent graduate employment and salary survey 2017 – 2019 by QILT (2020)

Graduate outcomes	Proportion of CQU students	National average	CQU Responses	Confidence interval
Found full time employment	89.10%	82.40%	165	85.2% - 91.7%
Found employment	91.60%	87.70%	167	88.1% - 93.8%
Continuing to study full-time	3.20%	14.00%	157	1.9% - 6.0%
Median salary	$70,400	$65,000	105	$65,400 - $75,400

Whilst the analysis suggests potential benefits of WIL engagement, some limitations in the analysis are evident. Firstly, the employer work readiness surveys are carried out on a subset of the students included in the QILT survey data. The influence of WIL practices is difficult to correlate to the graduate survey data, as QILT data does not distinguish students by course, and hence is reflective of both non-WIL and WIL-based education programs. Secondly, the unit survey data focusses on one unit of the program, whereas the QILT survey is a broader program-wide survey tool and is similarly influenced by the inclusion of non-WIL graduate data.

Conclusions

As an assessment of work placement value to employers, we analysed the past seven years of employer work placement evaluations, whereby engineering workplace supervisors rate students against the Engineers Australia Stage 1 Competency Standard along with the self-evaluations by current CQU students and recent graduates of their learning through the QILT survey. Based on the data available, the following conclusions can be made:

- CQU engineering students are consistently rated above the average performance expected for a graduate engineer by their engineering workplace employers.
- They perform better than the average in all areas, however the highest rated competency is Professional and Personal Attributes.
- CQU engineering graduates are work-ready compared to the national standard, however more specific post-graduate surveys could further establish a causal link between WIL education, employer assessments, and graduate outcomes.

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