

# Work-Integrated Learning (WIL) as a tool for enhancing engineering graduate outcomes

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## ABSTRACT

### CONTEXT

Work-Integrated Learning (WIL) is employed in a variety of ways across different teaching models and curriculum. In the vocational engineering education context within New Zealand, WIL approaches are already interwoven throughout the delivery of the Bachelor of Engineering Technology (BEngTech) and New Zealand Diploma in Engineering (NZDE) through a range of RPL processes, industry or workplace projects, and, most significantly, in the case of the BEngTech, the degree apprenticeship programme.

### PURPOSE OR GOAL

Evaluative research conducted on the BEngTech degree apprenticeship model indicates that the WIL approach used in the delivery, has an impact on graduate outcomes. The purpose of this paper is firstly to begin investigating the ways in which the model positively influences graduate outcomes, and secondly, to identify how we might most effectively develop and deploy relevant WIL approaches seen in the degree apprenticeship programme across other areas of vocational engineering education in order to benefit graduates and meet the needs of industry.

### APPROACH OR METHODOLOGY/METHODS

The research in this paper has been conducted using a qualitative methodology. Data was gathered through a series of surveys and interviews with learners and industry involved in the degree apprenticeship, as well as from an external evaluative report. Themes relating to graduate outcomes were identified and analysed during an action research process.

### ACTUAL OR ANTICIPATED OUTCOMES

WIL, as modelled in the BEngTech degree apprenticeship programme, appears to enhance graduate outcomes through a variety of methods including, supporting the development of key graduate attributes, reducing the need for learners to take on debt in order to study, and contributing to the retention and upwards mobility of learners within a workplace or industry sector.

### CONCLUSIONS/RECOMMENDATIONS/SUMMARY

WIL approaches can play a valuable role in improving graduate outcomes and meeting industry needs in the vocational education space. Lessons from the BEngTech degree apprenticeship can be applied to other areas, and adapted WIL practices could be deployed to see the benefits of that model emerge in other settings. Further research is needed to fully understand the ways in which graduate attributes are developed in comparison to the traditional taught pathway.

### KEYWORDS

Work-Integrated Learning, Graduate Outcomes, Vocational Engineering Education

## Introduction

Work-Integrated Learning (WIL) is employed in a variety of ways across different teaching models and curriculum. In the vocational engineering education context within New Zealand, WIL approaches are already interwoven throughout the delivery of the Bachelor of Engineering Technology (BEngTech) and New Zealand Diploma in Engineering (NZDE) through a range of Recognition of prior learning (RPL) processes, industry or workplace projects, and, most significantly, in the case of the BEngTech, the degree apprenticeship programme delivered by Otago Polytechnic. The BEngTech degree apprenticeship was first delivered as a three-year pilot, beginning in 2020. Various evaluative processes attached to this pilot indicated that the delivery model has had a positive effect on a variety of graduate outcomes, including the development of graduate attributes by learners, and a range of metric within an employment setting.

In this paper, we firstly unpack the ways in which the benefits seen in the degree apprenticeship delivery align, or not, with wider WIL and degree apprenticeship literature. In doing so we highlight areas for future research, as well as existing opportunities to deploy WIL thinking to improve graduate outcomes.

## Methodology

A qualitative approach using data gathered from a series of surveys and interviews with both learners and industry involved in the degree apprenticeship delivery was implemented. This was part of an ongoing evaluation of the new delivery model. The results drawn on primarily in this paper come from a survey of learners enrolled in the apprenticeship model conducted by the degree apprenticeship project team, as well as an independent external evaluation carried out by the degree apprenticeship team at Manchester Metropolitan University. Both were carried out in 2022. Participant types and numbers are show below in Table 1.

**Table 1: Sources of data drawn on in this paper.**

Source of data	Degree Apprenticeship Project Team Learner Survey (2022)	Independent External Evaluation (2022)
Learner Survey Responses	12	17
Learner Interviews		7
Staff Interviews (Management)		8
Staff Interviews (Teaching)		2
Industry Interviews		5

The learner survey consisted of a variety of questions which learners responded to using a five-point Likert scale, as well as more open form questions. From the survey responses and external report, data and themes relating to graduate outcomes were identified and analysed. In this paper, these results are contextualised with a short literature review focusing on relevant WIL literature. Ethics approval for the evaluation research project was granted by the Otago Polytechnic Research Ethics Committee in August 2021 (Approval number 889).

# Literature Review

## Benefits of WIL

Kolb (1984), describes a theory of experiential learning in which learners take their theory and learning from the classroom, and put it into practice in the workplace. Through a process of engaging in and reflecting on a variety of transformational experiences around this practice, learners are able to test, grow, and deepen their understanding of in class materials. This theory underpins much of the global WIL practice, and the values of experiential learning are seen across a wide variety of disciplines, and WIL approaches.

In their 2023 contribution to the Routledge International Handbook of Work-Integrated Learning Jackson and Cook reviewed 57 empirical studies exploring a range of WIL programmes, and in doing so identified significant benefits for learners engaged in WIL. These included many benefits relating to success in courses of study, including higher academic performance, the ability to link classroom learning and professional practice, improved learner experience, and improved retention rates. Significantly, many of the benefits include aspects which improve learner employability, and link closely with desirable graduate attributes. Notably, Jackson and Cook indicate the WIL supports the preparation of learners for work through growing capabilities in communication, teamwork, critical thinking, problem solving, adaptability, time-management, and technology related skills. All of these capabilities are considered crucial in terms of both general employability and the BEngTech Graduate Attributes. They also note that WIL programmes typically enhance employment outcomes and improve learner wellbeing.

## Benefits of degree apprenticeship models

Degree apprenticeship models are one example of WIL practice. While many WIL models rely on short-term projects or placements, degree apprenticeships typically feature learners who are working fulltime in industry for the length of their qualification. This means that while many modes of WIL focus on sending learners from the traditional classroom into the workplace, degree apprenticeships seek to draw learners in from work, without requiring them to stop work (Smith et al.,). Degree apprenticeships recognise the significant amount of learning occurring in the workplace and award this academic credit. This can be done through a variety of methods including the generation of genuine work-place evidence related to learning outcomes which is then assessed on a case-by-case basis, or through the creation of standardised assessment which requires learners to draw on their own workplace contexts (Cadzow et al.,2023).

There are a range of benefits for learners in degree apprenticeship programmes identified in the literature. These echo the more general WIL benefits described by Jackson and Cook, and additionally, these benefits are in many instances, linkable to engineering graduate attributes. Brinia et al., (2018), posit that degree apprenticeships in general support the development of skills which improve effectiveness and relationships in the workplace, noting in particular communications skills. Griffiths et al., (2018) write that there were notable benefits also to self-management and teamwork Nottingham (2019), suggests that degree apprenticeship programmes equip learners to learn and recognise learning, and in doing so create patterns of lifelong learning.

The development of skills is also seen to extend into more practical areas with Green et al.,(2022) noting that degree apprentice learners in radiology were more competent in all practical aspects relating to the job. Antcliff et al.,(2016), suggest that degree apprentice learners gain increased exposure to modern tools, for example through the use of specific software at work. This quick uptake of relevant skills and knowledge is viewed as a contributing factor for degree apprenticeship learners ability to make an immediate contribution in the workplace.

There is strong evidence that both WIL in general, and degree apprenticeships specifically, improve employment outcomes for learners. This happens in a variety of ways including improved rates of employment after graduation (Irons, 2017, and Crawford-Lee, 2016) higher

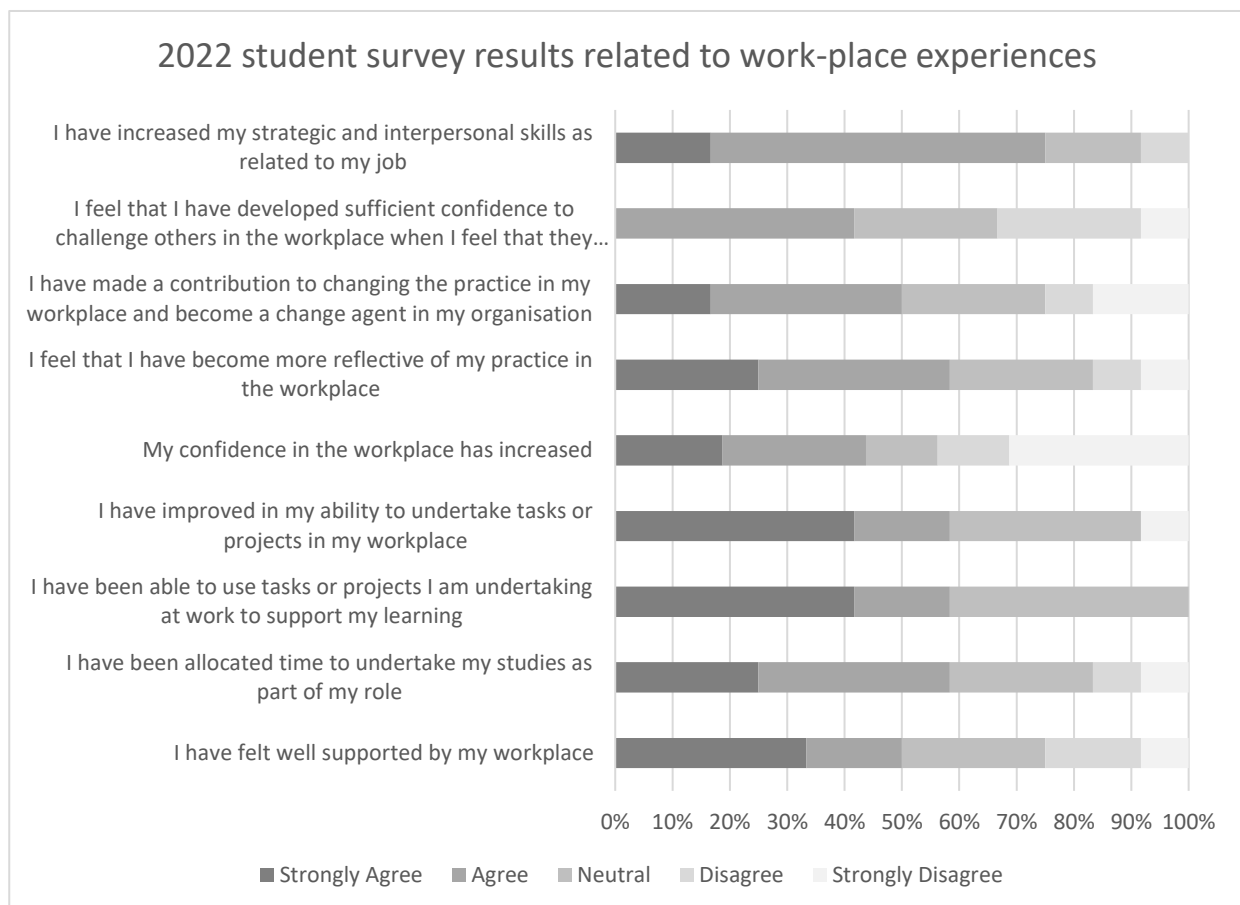
retention (Jones et al., 2022, Sevens et al., 2022, Antcliff, 2016, Green, 2022, and Higgs, 2021), and higher salaries coupled with decreased debt (Kirkham 2015, and Hakimian, 2022).

There are, of course, also challenges associated with degree apprenticeships. The most prominent of these is the need for learners to manage a complex work-life balance. Literature reports challenges in consistently being able to set aside days, or time, for working on study (Smith et al., 2023, and Minton & Lowe, 2019). The dual identity of being a full-time worker and full-time learner is also identified as a challenge for some learners and their managers (Quew-Jones & Brook, 2019).

## Findings

### Workplace Experiences

Key results from the 2022 learner survey are presented below in Figure 1 and Figure 2. The results have been split into those results related to workplace experiences and those related to learning experiences.



**Figure 1: 2022 learner survey results related to work-place experiences**

Figure 1, above, shows learner survey results relating to workplace experience. Significant results from this portion of the survey include the fact that around half of the learners felt well supported by their workplace, and slightly more than half had been allocated time to undertake their studies.

*“My company understand the academic pressure and quite helpful by allotting time if I needed.”* Source: response to 2022 student survey

This suggests that the concerns raised in literature around the balance of work and study are true for around half of the learners in this programme.

*“My work is happy to fund my degree and sign the paperwork. However, I found it difficult last semester to balance work demands and study.”* Source: response to 2022 student survey

*“I will say that the work life balance does go out a little bit, which is a bit of a pain... but I guess that's in a way that's a good thing too, because you have to learn to manage this. So that is valuable in its own way. It can be a bit stressful at times and sometimes it does feel like you have no time. But I think at the end of the day, overall, it's definitely worth it.”*  
Source: Learner comment, 2022 External Evaluation

Despite the difficulties in balancing work and study, a key finding in the External Evaluation concluded that learners felt they benefited from the ability to stay in work while studying, particularly as this meant income was still coming in, and debt was minimised (Gorb & Lawson, 2022).

*“Having money coming in as well as being able to study was a big plus. Living is expensive and being able to do my class work at work was great”* Source: Learner comment, 2022 External Evaluation

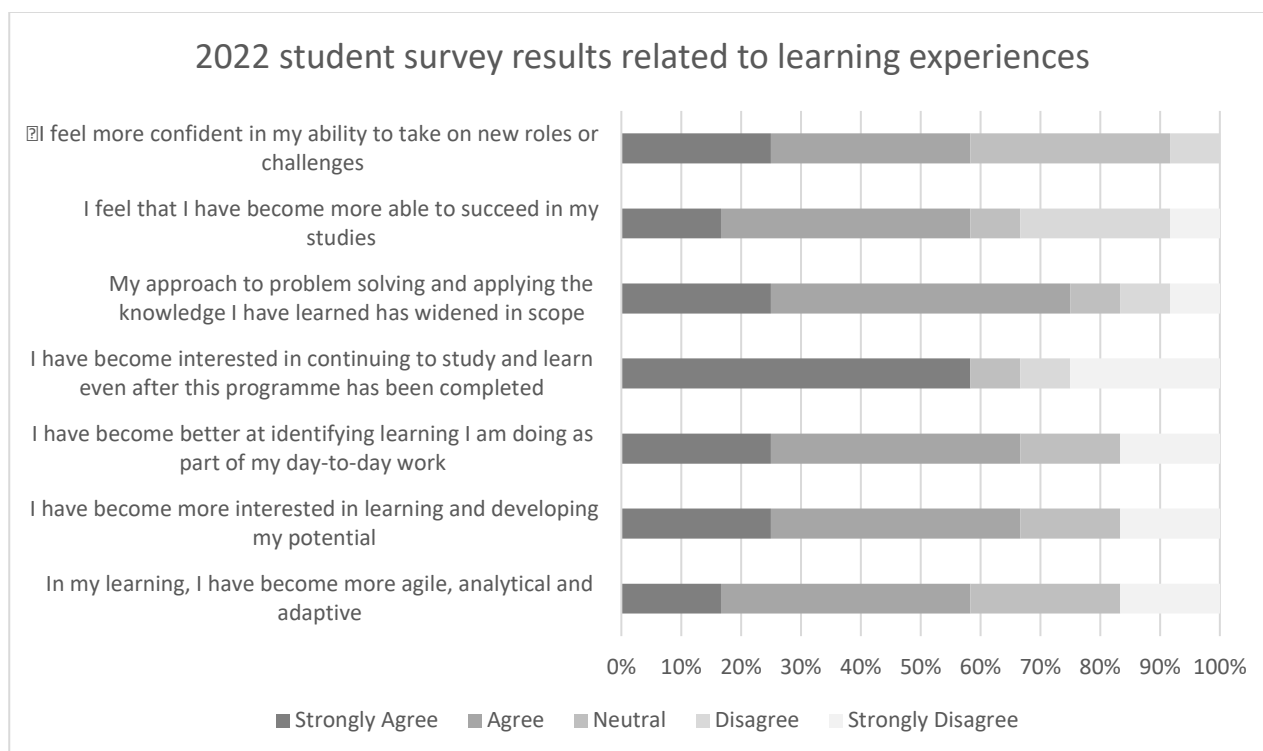
More positively, around 75% of learners reported an increase in their interpersonal skills, over 60% had developed confidence, and nearly 60% felt they had improved their ability to undertake projects or tasks. Five survey respondents reported either a pay increase, job promotion, or formal commendation (or combination of these) in relation or response to their studies. This indicates improvements in the BEngTech Graduate Attributes relating to engineering knowledge and application (GAs1-5), but also individual and teamwork (GA 9), and Project Management (GA 10). The full list of BEngTech Graduate Attributes are shown in Figure 3.

*“I have been given more responsibility specifically around the asset management space where I have been appointed a work package manager for a package of work we are doing for a local council.”* Source: response to 2022 student survey

Around 60% of learners reported having work tasks allocated to them which meaningfully connected to their studies. Comments in the survey indicated that the linking between work and learning was seen as a significant benefit by learners.

*“Workplace colleagues and managers have been very supportive of my studies and actively looking for projects to help with/count towards studies”* Source: response to 2022 student survey

## Learning experiences



**Figure 2: 2022 learner survey results related to learning experiences**

Results from the student survey related to learning experiences are shown in Figure 2. Overall learner survey results indicate that learners felt positively about the learning they were doing. Significant findings include that nearly 70% of learners felt they were better at identifying learning they were doing day-to-day, and the same number have become more interested in learning and developing their potential. These statements link strong to BEngTech Graduate Attribute number 12. Lifelong Learning. It is often difficult to gauge to what extent learners have become lifelong learners at the point of graduation, but these results indicate that establishing that attribute may be an outcome of the degree apprenticeship model. Evidence from the evaluation report also suggests the degree apprenticeship model supports and embeds interaction between industry staff and learning and teaching roles going forwards.

*“The idea of the alumni coming back and teaching is fantastic. I mean, we’ve had alumni come back and do guest lecture type stuff and talk about their experience.”* - Source: employer comment, 2022 External Evaluation

Over 70% of learners reported feeling that their approach to problem solving and applying the knowledge they have learned widened in scope as a result of the degree apprenticeship, while just under 60% reported becoming more agile, analytical, and adaptive in their learning. These outcomes link closely with Graduate Attribute 2: problem solving, 3: design/development of solutions, and 4: investigation.

## Discussion

### Development of Graduate Attributes

Throughout both the wider WIL literature and the results highlighted in this paper, there is evidence that degree apprenticeship models help with the development of Graduate Attributes. The 12 Graduate Attributes attached to the BEngTech are shown below in Figure 3. These Attributes are considered essential for graduate engineers to meaningfully participate in the

workplace. The extended time in a workplace context appears to lead to an acquisition of so called “soft skills”, which can be directly mapped to Graduate Attributes 9 and 10.

NZ Engineering Technologist Graduate Attributes	Description
1. Engineering Knowledge	Apply knowledge of mathematics, natural science, engineering fundamentals and an engineering to defined and applied engineering procedures, processes, systems or methodologies.
2. Problem Solving	Identify, formulate, research literature and analyse broadly defined engineering problems reaching substantiated conclusions using analytical tools appropriate to the discipline or areas of specialization.
3. Design/Development of solutions	Design solutions for broadly-defined engineering technology problems and contribute to the design of systems, components or processes to meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. Investigation	Conduct investigations of broadly-defined problems; locate, search and select relevant data from codes, databases and literature, design and conduct experiments to provide valid conclusions.
5. Modern Tool Usage	Select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to broadly-defined engineering problems, with an understanding of the limitations.
6. The Engineer and Society	Demonstrate understanding of the societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to engineering technology practice and solutions to broadly defined engineering problems.
7. Environment and Sustainability	Understand and evaluate the sustainability and impact of engineering technology work in the solution of broadly defined engineering problems in societal and engineering contexts.
8. Ethics	Understand and commit to professional ethics and responsibilities and norms of engineering technology practice.
9. Individual and Team Work	Function effectively as an individual, and as a member or leader in diverse teams.
10. Communication	Communicate effectively on broadly-defined engineering activities with the engineering community and with society at large, by being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. Project Management and Finance	Demonstrate knowledge and understanding of engineering management principles and apply these to one's own work, as a member or leader in a team and to manage projects in multidisciplinary environments
12. Lifelong Learning	Recognize the need for, and have the ability to engage in independent and life-long learning in specialist technologies.

**Figure 3: Bachelor of Engineering Technology Graduate Attributes**

The degree apprenticeship model also supports the development of skills, attitudes, and behaviours relating to Graduate Attribute 12: Lifelong learning. This is traditionally thought of as a difficult attribute to deliver and assess evidence in a campus setting. As well as developing skills to wrap around core engineering activities, the results here indicate that degree apprentice learners are also gaining a range of technical, analytical, and practice-based skills which are indicators of a wide range of other Graduate Attributes, including 1-5. These appear to be developed as a result of both exposure to genuine workplace engineering projects, and the ongoing opportunity to be exposed to a variety of workplace settings.

What is not clear is the extent to which individual Graduate Attributes, as well as the overall Graduate Attribute portfolio, are developed in degree apprenticeships or WIL deliveries in comparison to a traditional taught model. Further research comparing Graduate Attribute attainment over time for apprentice and non-apprentice cohorts would be beneficial.

### Employment Outcomes

As claimed in the literature, there have been a range of positive employment outcomes associated with the degree apprenticeship delivery. Results in this paper have shown examples of staff receiving increases in salary, and promotion into new roles as a result of their studies. This suggests that employers are happy with performance and are using the degree apprenticeship as a mechanism for both professional development and staff retention. The results in Figure 1 indicate an improvement in key areas of work performance, further improving outcomes for both the learner, and employer.

“I do see myself conversing with a lot more seasoned engineers and project engineers and being able to hold my own.” Source: Learner comment, 2022 External Evaluation

The ability of degree apprentices to genuinely connect their work and study plays a role in the development of graduate attributes and contributes to the overall employability of learners. The fact that study can be undertaken without having to pause work is also a significant benefit as learners are able to gain work experience, build professional networks, and reduce the burden of learner debt while still drawing a salary.

## Conclusion and Recommendations

The results drawn from the evaluation of the degree apprenticeship delivery of the BEngTech are consistent with key themes in the WIL literature. There are clear benefits to graduate outcomes for degree apprenticeship learners, in particular the development of programme graduate attributes, and in workplace outcomes including salary increases, promotions, and increased confidence in professional practice.

Studies directly comparing the development of graduate attributes, and workplace outcomes of learners in a degree apprenticeship and taught version of the same programme are very limited. The research team believe that a longitudinal study investigating these factors in this setting would be a valuable contribution to the field moving forward.

The nature of being an active member of a workforce, as is the case for learners in degree apprenticeships, has been shown to provide learning opportunities and experiences which are not always available to those in traditional taught deliveries. This suggests that, where possible providing opportunities for WIL in traditional deliveries through the use of, for example, industry projects, is likely to be beneficial to graduate outcomes related to attribute development and employment. Overall, traditionally taught engineering programmes should not be afraid to let learning move outside of the classroom, and into the workplace.

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