34th Australasian Association for Engineering Education Conference
3 - 6 December 2023 – Gold Coast, QLD

Incorporating work-integrated learning practices into existing degree level engineering delivery

Hana, Cadzow[a]; Sarah, Hexamer; James, Mackay:
Te Pūkenga – Otago Polytechnic[a]

ABSTRACT

CONTEXT

In response to industry demand and the need to re-invigorate the level 7 Bachelor of Engineering Technology (BEngTech) degree, Te Pūkenga – Otago Polytechnic has developed and piloted an engineering Degree Apprenticeship pathway, with a new infrastructure asset management specialisation available alongside existing pathways. Degree level apprenticeships are common internationally, particularly in the UK (Rowe *et al*., 2016) but this was the first time one has been delivered in New Zealand. Based on initial work by Goodyer and Frater (2015), learners in the pilot were able to combine workplace and classroom learning to replicate the success of similar models overseas.

PURPOSE OR GOAL

The main purpose of this paper is to reflect on the success and limitations of two methods for the incorporation of learning occurring in the workplace into an existing degree delivery. The details of the methods are provided along with discussion highlighting their impacts and effects on a range of stakeholders.

APPROACH OR METHODOLOGY/METHODS

The impact on learners, industry, and delivery staff was investigated using survey and semi-structured interview data combined with project implementation data including analysis of enrolments, online resources and the ways in which the project interacted with existing learner management systems.

ACTUAL OR ANTICIPATED OUTCOMES

The use of work-integrated learning has proved valuable to both learners and industry. Evidence from the pilot research project indicates that the ability to incorporate workplace and classroom learning into bespoke pathway is at least partially responsible for increases in key professional skills, improved career outcomes, and industry partners starting to enrol multiple apprentices. The outcomes for staff delivering the new model have been mixed, with some engaging strongly with the pilot and others feeling it is irrelevant to, or in conflict with their current roles. The flexibility provided by the pilot seems to have increased accessibility to degree level engineering study for some learners, particularly women.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The ability to integrate learning from workplace and classroom settings into a meaningful and robust individual path of study has had positive impacts for both learners and industry. Still, significant challenges remain around scaling the model across campuses and engineering disciplines. Careful consideration is needed as the Degree Apprenticeship programme embeds into the national delivery network moving forward.

Key Words

Degree Apprenticeship, Work-integrated learning

Introduction

The Bachelor of Engineering Technology (BEngTech) is a three year, L7 (New Zealand Qualifications Framework) Degree accredited internationally under the Sydney Accord. The BEngTech is delivered at multiple sites across Aotearoa–New Zealand under a single programme document. This was the case even prior to the advent of the combined national polytechnic Te Pūkenga, established in 2020, which has created an even greater focus on well considered national delivery (s 252, Education and Training Act, 2020).

In 2020 funding was provided by the Tertiary Education Commission (TEC) to pilot the use of a Degree Apprenticeship model of delivery to boost enrolment in the BEngTech as well as ensure delivery remained responsive to shifting industry needs and patterns. The first degree level apprenticeship to take place in Aotearoa-New Zealand, the project was conceived in response to a 2015 report by Goodyer and Frater, identifying degree level apprenticeships as a key opportunity for enhancing the national vocational education landscape. The decision to pilot a degree apprenticeship model using the existing BEngTech programme was due, in part, to the perceived opportunity to increase the numbers of trained asset management engineers (Mackay, Nyhof, and Cadzow, 2018).

Degree Apprenticeships are common overseas, particularly in the UK (Rowe, Perrin, and Wall, 2016), and typically designed using a “Trailblazer” approach. This approach usually begins with the creation of a Degree Standard, which outlines the skills, knowledge, and attributes necessary for an apprentice to successfully complete the programme and be considered ready for the professional environment. In the case of the BEngTech, the qualification was already well established and delivered nationally. This meant that during the early design of the apprenticeship pathway and delivery model most of the course structure remained un-altered. The addition of three new papers focussing specifically on asset management engineering was enough to create an asset management pathway in all three majors (Civil, Electrical and Mechanical) (Mackay and Cadzow, 2022).

Without the creation of a bespoke degree programme it was necessary for the apprenticeship delivery model to be able to incorporate work-integrated learning practices into the existing courses and delivery. This paper discusses two different ways in which this has occurred during the pilot, and comments on the benefits and challenges of each. Consideration is given to how each method of assessing work-integrated learning impacts on a variety of stakeholders including learners, industry partners, and teaching staff. Recommendations around the scalability and sustainability of each method are also made.

Research Methodology

The data informing this paper is drawn from research carried out in conjunction with the BEngTech Degree Apprenticeship Pilot which ran from 2020-2023. This investigation was carried out using an action research model where improvements to programme design and delivery were identified and implemented iteratively throughout the pilot.

Data was collected using a range of qualitative and quantitative techniques including short-form questionnaires, feedback surveys, interviews, focus groups, and analysis of data extracted from the relevant Learner Management System (LMS). Ethics approval for this research was granted by the Otago Polytechnic Ethics Committee[1].

[1] Ethics approval code 889

Strategies for inclusion of work-integrated learning

The overall delivery model for the BEngTech apprenticeship pathway recognises the fact that learners come from a variety of contexts and require flexibility to move through different modes of learning to create the best opportunities for success (Mackay and Cadzow, 2023). In addition to this the pilot established that the wide variety of course content present in the BEngTech meant there was no single delivery template which suited all courses. Further complicating matters, the variety of jobs being undertaken by apprentice learners was wider than initially expected. While in some overseas contexts there exist bodies of learners from single employers, or closely aligned roles which are large enough to be considered a cohort, the same economies of scale do not appear to be preset in Aotearoa-New Zealand.

These factors combined resulted in the design of a “multi-modal” delivery model as shown in Figure 1. This model allows learners to move between modes of delivery as required by course content, workplace needs, or personal circumstance. The individual route through the programme, or path of study (POS), is overseen and supported by a specialised apprentice manager. Learners will typically use multiple modes throughout their learning journey, and in some cases within a single course.

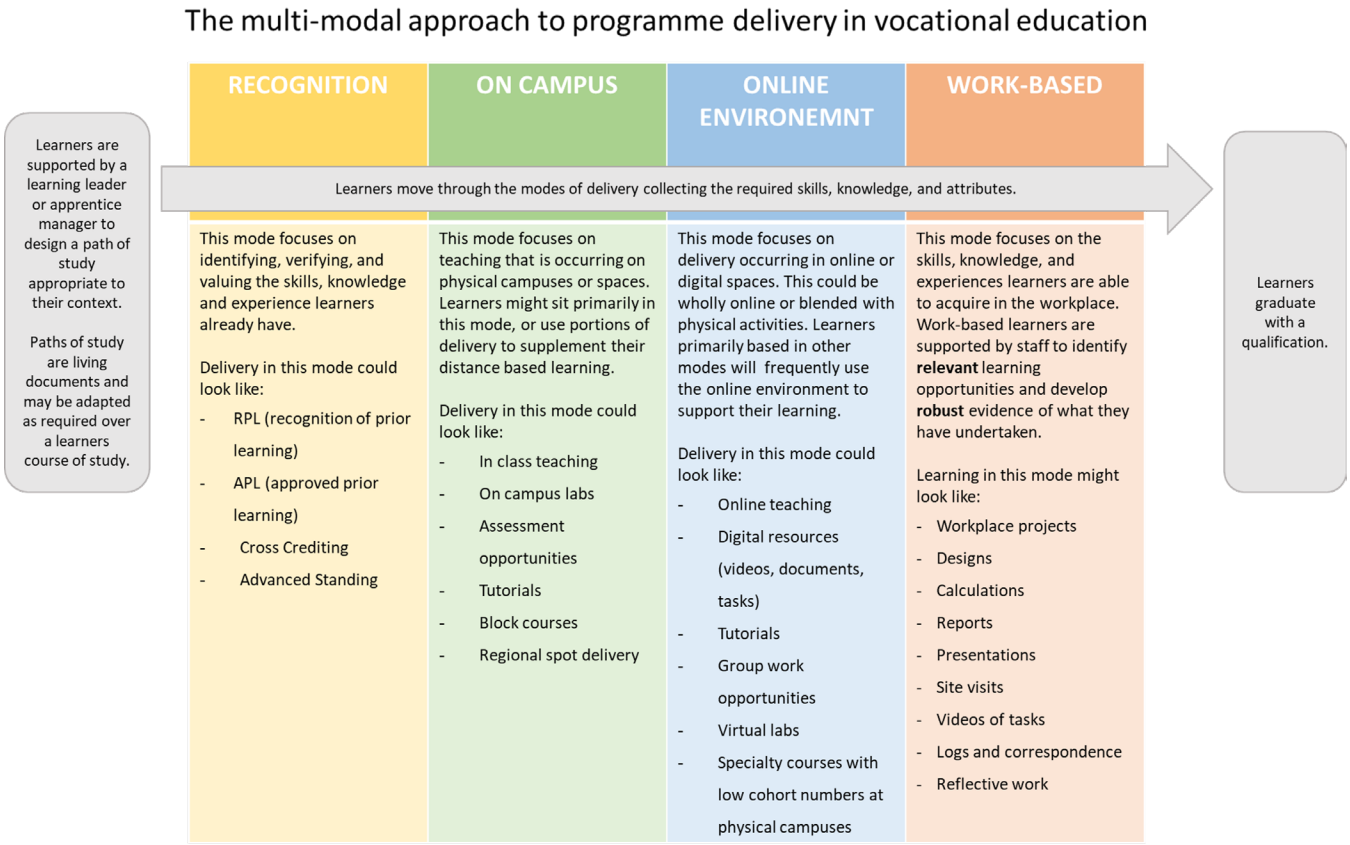

Figure 1: The multi-modal delivery model used in the BEngTech Degree Apprenticeship Pathway. (Source: Mackay and Cadzow, 2023)

The recognition and integration of learning from the workplace into assessment for courses where learners did not meet the requirements of the “recognition” mode (see Figure 1) was carried out using two broadly defined methods as described below. A summary of the two methods is provided in Table 1.

Delivery Method 1: Assessing “organic” workplace evidence

This strategy for incorporating workplace learning takes activities and tasks already occurring as the start point of learner activity. Learners work closely with apprentice managers and teaching staff, as well as their employeers, to identify activities, tasks, or experiences occurring, or scheduled to occur, within their workplace contexts which relate to the learning outcomes of specific courses. In instances where the learning has already taken place and appropriate evidence exists or can be generated without the need for additional content support from the delivering institute, a learner may be awarded with a recognition of prior learning (or equivalent) and be awarded the course credits. More frequently learners will require additional materials and supervision from the delivering institute, as well as from their workplace mentor(s) to build their capability as they undertake their work. In this scenario learners may access online materials, classes, tutorials, and one-on-one support as required. In course curriculum documentation, assessment carried out under this method will often be described as “Portfolio” and “Presentation”, where portfolio requires a collection and curation of evidence of workplace learning, and presentation involves the presenting and defence of said portfolio to the panel.

As learners are undertaking their paid work, they are guided by their apprentice manager as to what evidence they should be collecting. This may come in the form of documentation such as reports, designs, or calculations and is typically coupled with evidence of reflection showing how the evidence links to the relevant learning outcomes. To ensure the reliability and robustness of evidence, workplaces may be asked to submit attestations to verify what work the learner undertook on their own, with supervision, as part of team etc. Learners should also typically present their “portfolio” of evidence to an appropriate group of assessors who then have the opportunity to ask questions to determine the level of learner understanding. Assessor panels or groups will typically include a mix of industry representation and lecturing staff to ensure that the work being assessed is both suitable for industry standards and appropriate evidence of course Learning Outcomes. Assessment may be carried out in one panel presentation or spread out over time to meet the needs of learners and assessors.

The key feature of this inclusion strategy is that teaching staff are not assessing evidence of learning against the criteria embedded in assessment from traditional deliveries, but rather directly against the learning outcomes of a particular course. This requires flexibility from teaching staff as well as careful documentation and review processes to ensure appropriate and consistent awarding of credit. In this method learners enrolled in the same course may satisfy the learning outcomes of the course using very different workplace evidence. The key consideration is that evidence provided by learners is equivalent, demonstrating the same overall level of achievement against the learning outcomes, rather than consistent, demonstrating the same route to attain the learning.

A particular challenge of this method is the knowledge flexibility required from lecturers to assess the wide range of possible evidence. There is also a significant time investment required from apprentice managers and lecturers to support learners and their mentors in identifying and capturing workplace based learning opportunities which are directly relevant to course Learning Outcomes. Conversations to facilitate this can typically take 4-7 hours per learner, per course. Assessment of bespoke evidence can also take slightly longer than for a “common assessment”. In theory, the time it takes to identify, document and assess workplace based evidence can be streamlined by having dedicated staff per course to do this work and gains in efficiency are anticipated to some extend as part of the maturation of the programme. Additionally, the development of learner management systems which are inclusive of apprentice learners will also streamline some of the documentation and moderation of this process.

Delivery Method 2: Development of course assessment to capture workplace contexts

The second method for assessing workplace learning is to develop assessment which captures workplace contexts. Using this method lecturers write assessment which deliberately asks learners to carry out activities, analysis, reporting, reflection etc, on projects they are undertaking within their work environment. This form of assessment is usually best suited for use in papers where the content is less technical or calculation based and more centred on a range of interpretive, analytical, or project management-based skills.

Assessment designed for this sort of use typically provides learners with the required output, for example an Assessment of Environmental Effects, or Asset Management Register, without specifying the exact content required in the output. Good assessments will also be supported by a robust marking rubric, indicating to learners the critical skills and thinking they need to show evidence of, but again not necessarily outlining specific "correct" answers. This allows for flexibility in the projects or examples learners draw from in completing the assessment.

In contrast to the first method, described above, lecturers using this form of assessment can expect to receive a more uniform version of assessment to review and mark. This saves time both in marking and in learner support as the workload to ensure learners are using appropriate projects with regards to a defined assessment is typically smaller than that of reviewing a whole programme of work to link to learning outcomes.

Limitations to this method include the fact that learners may have to tailor what they are doing in the workplace to meet assessment requirements. Additionally, some workplace activities may be relevant to the learning outcomes of the course but not the specific details of the assessment. In some instances, not all workplace learners will have appropriate examples or projects to draw from to complete the assessment. When this occurs additional case study or project material may need to be provided.

Table 1: Summary of impacts of each method of assessing learning occurring in the workplace.

Considerations	Method 1: Assessing "organic" workplace evidence	Method 2: Development of course assessment to capture workplace contexts
Relevance to learner	Content of assessment is highly relevant to the learner and their work context. Method is most suited to learners with significant existing experience.	Content of assessment can be highly relevant to the learner and their work context but overlap will vary. Method is most suited to learners who have significant learning to do in the course and need support in structuring this.
Workload for learner	Learner can potentially utilise a large volume of learning from the workplace, reducing additional assignment work required. Some additional work required to complete reflective and presentation tasks to accompany portfolio submission.	Learner workload varies depending on extent of alignment between assessment and workplace activities.
Workload for delivering staff.	Workload can increase significantly per learner as each POS is bespoke and evidence needs to be assessed from scratch. Time savings are made where leaners come from familiar work environments or are undertaking familiar activities in the workplace. Relationship management and expectation setting is time intense in this model.	Initial assessment design may require significant processing time. Assignment support and grading may take longer than more "uniform" assessment but is less intensive than model 1.
Effect on industry	Employees able to complete study with less time away from genuine work tasks. Learners are supported to learn while they work, potentially improving outcomes of work activities.	Learners may require more time away from genuine work tasks to complete assessment which is not closely aligned. Learner's focus may be more split between work and assessment.

	Learners able to fully investigate and become familiar with the projects of a particular work context.	Learners still able to utilise and explore genuine workplace contexts.
Quality considerations	High levels of variation make internal and external moderation challenging. Systems may need to look more closely at individual learner results rather than relying on more traditional sampling methods.	Existing moderation systems likely to appropriately evaluate delivery.
Scalability	Difficult. The time and knowledge required to assess a learner in this manner is unlikely to decrease significantly as scale increases due to bespoke nature of POS. Scalability increases as learner activities and contexts become more similar.	Possible. Single assessment task is able to be easily communicated to cohorts at a variety of scales. Increase in cohort increases grading.

Discussion

The introduction of the apprenticeship pathway to the existing BEngTech has facilitated an increase in enrolments and industry engagement while also strengthening and expanding, rather than competing with, an already well considered programme delivery. Analysing project implementation data indicated that at the end of 2022 there were 71 learners engaged in the apprenticeship delivery model. The ability of lecturers to incorporate mixed assessment methods into courses in a flexible manner is critical in order to utilise the learning happening in learner's workplaces. This flexibility has been well received by learners and industry alike. At the end of the pilot in 2022 there were 51 employers interested in or already hosting apprentices. Of those nine had multiple apprentices enrolled in the programme (Mackay and Cadzow, 2023).

During the piloting of the apprenticeship pathway from 2020-2022 student, staff, and employeer surveys were undertaken as part of a parallel research project monitoring the outcomes of the new model. Results from student feedback surveys showed that 76% of responses indicated a positive learning experience. In those responses flexibility of the learning environment was the most cited reason for this. The flexibility of the offering may also be contributing to the increased enrolments from women. 19% of the work-based apprenticeship pathway learners are women, compared with around 8% of the cohort in the traditional delivery mode. Further research is needed to fully establish the factors driving these higher enrolment rates.

Recognising, and supporting workplace learning as a valid pathway has also benefited learners. The ability to link what they are doing in the workplace and what they are doing in class has increased the learning and workplace confidence of 78% of survey respondents. 36% also reported some workplace mobility, including promotions, new roles, and pay increases, which they attributed to being on the programme. This is an indication that industry may be able to use this delivery model as a way of retaining skilled staff who wish to undertake upskilling or professional development opportunities, without "losing" them for a significant period to a programme of study.

While the benefits of incorporating workplace learning into assessment and delivery are clear, the optimal way(s) in which this should happen is less defined. As discussed above different contexts, course content, and learners all have an impact on how delivery and assessment occur. The two methods described in this paper represent examples of using workplace learning without having to rewrite an existing programme or begin anew using the Trailblazer approach. This saves time and development money and avoids the establishment of parallel qualifications in a marketplace which may not be able to support competing deliveries. Methods like these may be able to be utilised by any programmes which have sufficient focus on industry projects and connectivity written into their programme documents, without the need for substantial changes.

The challenge with using workplace learning in this way, is ensuring the consistency and robustness of assessment decisions and associated documentation. The greater the diversity in the evidence presented, the more challenging it is for lecturers to ensure that learners achieving the course have a similar enough skill and knowledge set that they can reasonably be compared

to one another. The first method of incorporation, assessing evidence from work tasks occurring independently of the course, is particularly prone to this difficulty.

There is an underlying tension between the needs of workplaces to have their staff trained specifically in what their role involves, and the needs of a programme to produce graduates with a consistent and broad skill set that can be used across industry roles. This tension is highlighted in the case of apprentice learners more so than in traditional delivery pathways. Clear expectation setting and documentation is important in managing the relationship between workplaces, apprentices, and delivering institutes in order to strike the correct balance between these sometimes competing needs.

While the experiences of learners and industry have been largely positive, delivery staff have had a mixed experience during the pilot process. For some staff there has been a reluctance to engage with the model due to the perception that it is in competition with existing recruitment and teaching. This has decreased during the pilot as it has become clearer that workplace learning opportunities vary significantly between learners. This requires deliverers to have a variety of taught delivery options available across the programme. The multi-modal model described in Figure 1 is responsive to this and situates the different delivery modes as complementary, rather than competitive. Furthermore, learners typically enrolling in the apprenticeship programme are unlikely to have enrolled in more traditional BEngTech deliveries due to the fact that they already have significant work and personal commitments. This means that the addition of a workplace focused delivery expands the pot of potential learners, rather than splitting existing cohorts into smaller, less sustainable groupings.

It is important that staff loading is adjusted to reflect the extra work required in supporting apprentice learners, particularly those primarily undertaking assessment using method 1 (see Table 1). Currently, the type of online resources being created for delivery to apprentice learners indicate that staff tend to be more comfortable delivering courses in a blended/online model which still relies on fully “provider delivered” content, rather than drawing on workplace contexts as content. It is important for providers to ensure there are resources to support all content delivery, as each workplace will provide different content and experiences. There also needs to be an acknowledgement that some courses are much more likely than others to have content naturally occurring in the workplace and plan resources accordingly. However, currently a large driving factor towards uniform online delivery (as opposed to mixed online/workplace) appears to be time constraints on delivery staff. The time constraints apply also to the ability of staff to engage with and train for implementation of the new apprenticeship model overall.

Conclusion

The BEngTech apprenticeship pilot has shown a range of benefits for stakeholders. The incorporation of workplace based learning into the delivery and assessment of existing degree programmes has the potential to revitalise qualifications without the need to carry out more significant structural changes or design new qualifications. Apprenticeship models have proven benefits for learners and industry, as well as increasing enrolment numbers. Deliverers can benefit from closer relationships with industry and increased level of up-to-date examples from a variety of contexts being examined in their classrooms.

The methods presented in this paper allow for learners to draw on their workplace contexts for assessment purposes and can be implemented by induvial staff where programme documents allow for it. Adoption of these, or other, methods across whole programmes will likely provide the most benefit in terms of consistent learner experience and engagement. When applied at scale these methods should be supported by robust administrative and moderation systems, as well as suitable training and workload balancing for staff involved.

Different methods of incorporating work-integrated learning into delivery and assessment are appropriate for different learners. The creation of assessment which can be given to whole cohort and populated with individual workplace activities or learning is generally easier to manage from a delivery perspective in terms of both staff time and quality assurance processes. The presentation and evaluation of bespoke workplace evidence against learning outcomes is likely to have the most impact for learners already have significant experience and are able to carry out reflective tasks based on this.

Overall, a variety of delivery and assessment tools working together can create an environment where learners are able to engage in study in a manner which best meets their needs, even as those requirements change. The adoption of this multi-modal framework, alongside appropriate allowances for staffing, and robust learner management systems, can increase the overall enrolment numbers for a programme as well as boosting learner success and relationships with industry.

References

Goodyer, J. E., & Frater, T. G. (2015). *Stepping into one another's world: Apprenticeships-transforming engineering technologist education in Aotearoa NZ*. Tertiary Education Commission. Retrieved from https://engineeringe2e.org.nz/assets/e2e/discoveriespdfs/13b1e323d9/Stepping-into-one-anothers-world.pdf

Mackay, J., Nyhof, R., & Cadzow, H. (2018) Developing a transformative degree apprenticeship in engineering in New Zealand. EDULEARN18(10th annual International Conference on Education and New Learning Technologies), Palma de Mallorca, Spain. ISBN: 978-84-09-02709-5

Mackay, J. & Cadzow, H. (2022) Developing an Engineering Degree Apprenticeship with a Pathway in Infrastructure Asset Management. In Chan, S. & Huntington, N. (Eds.), Reshaping Vocational Education and Training in Aotearoa New Zealand. ISBN 978-3-031-12167-8

Mackay, J. & Cadzow, H. (2023) The Village Raising the Engineer: Report on the Degree Apprenticeship BEngTech (Asset Management) Pilot. Commissioned report for Tertiary Education Commission.

Rowe, L., Perrin, D., & Wall, T. (2016). The chartered manager degree apprenticeship: Trials and tribulations. *Higher Education, Skills and Work-Based Learning, 6*(4), 357–369. https://doi.org/10.1108/HESWBL-05-2016-0034

Acknowledgements

Bachelor of Engineering Technologies degree apprenticeship pathway pilot (2020-2022) generously funded by the Tertiary Education Commission NZ.

Copyright statement