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FROM CLASSROOM TO CONSTRUCTION SITE: THE ROLE OF MIXED MODE LEARNING IN ENGINEERING WORKFORCE PREPARATION

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Tiju Mathew Thomas

INTRODUCTION

A major barrier to STEM (Science, Technology, Engineering, and Mathematics) participation is the early disengagement of students in science and mathematics, leading to an underprepared workforce (Sanders, 2008). A critical challenge for tertiary institutions is bridging the gap between classroom learning and real-world applications. Engineering students often struggle to apply theoretical concepts to industry-relevant scenarios, necessitating a shift toward authentic learning models (Reeves et al., 2005). Recent reports and literature continue to highlight the increasing demand for skilled engineering graduates in New Zealand. The Hays 2025 Skills Report indicates that 85 percent of hiring managers encounter gaps in skills during the hiring process which affect performance, while 86 percent recognise that the professional skills required of graduates are evolving over time (Hays, 2025). Similarly, the ACE New Zealand and Consulting Surveyors New Zealand Members Remuneration Survey found that 80 percent of member organisations reported vacancies for professional engineers, averaging 5.5 unfilled positions per firm, while 66 percent faced shortages in graduate engineer roles (ACE New Zealand, 2024). These findings underscore not only a skills gap but also the urgent need to support learners from being students to becoming engineering professionals.

The engineering profession remains among the most in-demand fields in New Zealand. To thrive in an evolving technological landscape, engineering graduates must develop critical thinking, applied knowledge, and interdisciplinary competencies (Savage et al., 2011). Despite high demand, engineering attrition rates remain high, prompting research into the factors influencing student retention and success (Engineering New Zealand, 2025; Makgoba, 2010; Makina, 2010; Zhong et al., 2022). According to Engineers Australia (2023), New Zealand's engineering sector experiences lower attrition rates compared to other industries; however, the limited number of new graduates entering the field remains a concern. The report highlights that only 73 percent of engineering graduates pursue careers in the profession, underscoring the need for stronger retention strategies and workforce planning (Engineers Australia, 2023). Studies emphasise the need for contextual, interdisciplinary, and problem-driven learning to enhance engagement, and performance amongst students (Brown et al., 1989; Cobb & Bowers, 1999; Kleine et al., 2024; McLellan, 1996). Contextual and meaningful learning experiences underscore the development of a professional identity, fostering motivation, deeper understanding, and the ability to tackle real-world engineering challenges (Strobel et al., 2013).

Among the competencies required of engineers, critical thinking is considered of paramount significance (Cooney et al., 2008). To cultivate these skills, tertiary education must integrate structured learning models that blend theory with hands-on practical experience (Jackson & Wilton, 2024; Jenkins et al., 2019). Without this alignment, graduates are at risk of inhibiting their cross-disciplinary problem-solving skills.

A collaborative approach between academia and industry is crucial to address the skills shortage (The Academic Insights, 2024; Vummidi, 2025). Cadetship programmes, which integrate work-based learning with classroom education, are a promising strategy to enhance employability and practical expertise (Engineering e2e, n.d.). Such programmes not only support skills development but also foster the transition in identity from student to professional. These programmes provide students with financial incentives, mentorship, career progressions, and exposure to industry practices, bridging the divides between academic knowledge, relevant work experience, and workplace competency. A targeted approach and early interventions at the school level and industry-driven curriculum design can make engineering education relevant, meaningful, and engaging (Herrington et al., 2014; Treacy & O'Donoghue, 2014).

Recent research emphasises that the development of professional identity is a critical outcome of work-integrated and vocational education (Raelin, 2016; Trede et al., 2012). Learners not only acquire skills but undergo a transformation in how they see themselves in relation to the profession (Trede et al., 2012). Especially in engineering education, structured and planned workplace exposure has been found to accelerate the shift from learner identity to professional identity (Raelin, 2016).

This study positions cadetship and flexible learning models such as the mixed mode model to achieve identity transformation. This article explores how the mixed mode delivery model not only supports workforce readiness, but also professional identity development among learners. By examining student learning experiences and graduate survey data (2016–2021), this study assesses the effectiveness of this model's approach and its alignment with the needs of the industry. The insights gained from this study contribute to the ongoing discourse on engineering education reform and workforce development in New Zealand.

A BACKGROUND TO CADETSHIP PROGRAMMES IN NEW ZEALAND

Cadetship programmes provide school leavers and working professionals an opportunity to earn while studying part time, combining full-time employment with structured learning (Engineering and e2e, n.d.). Employers support cadets through diploma or degree qualifications, ensuring relevant training aligned to the industry. The Public Works Department initiated the first civil engineering cadetship in 1894, but the scheme declined in the late 1980s (WSP, n.d.). By the early 2000s, WSP-Opus had revived their cadetship programmes to address a shortage in engineering technicians and technologists in New Zealand.

Engineering technician graduates are trained to handle well-defined engineering problems, as opposed to technologists, who engage with broadly defined engineering problems (Engineering New Zealand, 2017). Engineering New Zealand (2017) categorises well-defined problems as those with systematic solutions, limited theoretical complexity, and well-defined adherence to industry standards with less complexity to address. These problems involve localised consequences, minimal conflicting constraints, and practical knowledge application, making them highly relevant to engineering cadetship programmes at a technician level. Well-defined engineering problems often align with standardised codes of practice and specifications, and workplace safety protocols, requiring technicians to apply technical expertise within controlled, industry-specific approved environments (Engineering Council, 2020). This structured approach ensures that graduates transition smoothly into the workforce, developing practical problem-solving abilities while working within clearly established professional guidelines.

Over the last 20 years, cadetship programmes have emerged as a structured pathway into the engineering workforce, bridging higher education with industry needs. By integrating the engineering technician level body of knowledge, hands-on learning, and industry mentorship, these programmes have enhanced workplace readiness, providing cadets with progressive career development opportunities while mitigating New Zealand's engineering skill shortage within the civil engineering construction sector.

CADETSHIP PROGRAMMES AS AUTHENTIC INTEGRATED LEARNING

Cadetship programmes provide an integrated learning pathway that bridges classroom learning with industry needs, equipping students with practical engineering skills as they earn a qualification while working. In New Zealand, these programs cater to individuals with National Certificate of Educational Achievement (NCEA) Level 2 qualifications, particularly those with mathematics and science subjects, who seek to gain engineering credentials while working on real-world construction projects (Engineering e2e, n.d.). A study by Cameron and Devitt (2016) indicates that students are most successful in cadetships when they are motivated, inquisitive, and willing to engage in independent research. Engineering is inherently connected to solving authentic problems in real-world engineering contexts (Strobel et al., 2013), and cadetship programmes underpin this by ensuring that knowledge provided is directly related and applied in engineering settings. This connection between academic learning and real-world application enhances motivation, engagement, and problem-solving abilities (Fouts, 2000).

Authentic learning environments, where students see the relevance of their academic learning in real-world applications, are essential for developing workforce-ready graduates (Treacy & O'Donoghue, 2014). Herrington et al. (2014) suggest that future pedagogical models must be built on authentic learning settings. However, researchers have identified challenges in presenting students with real-world authentic tasks (Barab et al., 2000; Gulikers et al., 2005; Petraglia, 1998). Herrington, Oliver, and Reeves (2002) emphasise that it is important for students to perceive the learning as meaningful for its authenticity to be effective. Cadetship programmes naturally address this issue by allowing students to engage in industry-based learning early on, ensuring their training in academic settings is relevant, applied, and practical.

THE QUALIFICATION

The New Zealand Diploma in Engineering (NZDE) is a two-year, full-time programme (16 courses, 240 credits) at Level 6 on the New Zealand Qualifications Framework. Students can specialise in Civil, Electrical, or Mechanical Engineering. The NZDE was developed in response to industry demand for a technician-level qualification that integrates practical skills with high-quality academic study aligned with national standards (NZDE, n.d., para 1). It is to be noted that graduates of the NZDE do not attain Chartered Professional Engineer status; the qualification is accredited for the graduate to have a professional identity appropriate to the role of engineering technician, which is formally recognised within New Zealand's engineering competency framework (Engineering New Zealand, 2017). The qualification ensures that graduates are equipped with applied engineering knowledge and problem-solving abilities, which are essential for workforce readiness.

The New Zealand Board of Engineering Diplomas (NZBED) oversees the NZDE to ensure its continued alignment with industry requirements. A key focus of the qualification is to provide students with both theoretical knowledge and hands-on learning opportunities that mirror real engineering workplace opportunities. Recognising the need for flexible education pathways, the industry and academic institutions have collaborated to make the qualification accessible to working professionals. The mixed mode delivery model, which will be discussed in the next section, has addressed this challenge by blending face-to-face learning with distance education, supporting engineering skillset development while accommodating workplace commitments.

THE MIXED MODE DELIVERY MODEL

Throughout this paper, the term "mixed mode delivery model" refers to a structured part-time study model built around intensive "study blocks." This teaching model implements a distance learning approach for delivering the New Zealand Diploma in Engineering (NZDE) through a structured study block format. The academic year consists of two semesters, each spanning approximately 18–20 weeks. Each semester is divided into two intense study blocks per course, each lasting two-and-a-half to three days, during which all face-to-face course content

is delivered. Apart from these two face-to-face blocks, the remainder of the semester is dedicated to self-directed student study time, assessment work, and any engagement through online modes. These blocks are strategically scheduled to accommodate the requirements of each course, including teaching hours, practical lab work, assessments, and tutorial hours, ensuring an optimal learning experience for students who are unable to attend conventional full-time programmes in their local region.

To facilitate a seamless learning process, all course content and resources are provided in advance. A gap of four to five weeks is typically allowed for between study blocks to engage students in self-directed learning, facilitating the reinforcement of their understanding of the previously taught course materials. Open-book assignments are completed independently outside block teaching hours, while closed-book assessments are conducted during the second or final study block. Tutors assess, mark, and provide feedback through an online platform, allowing students to track their progress and strategise their learning.

The programme is delivered at multiple venues across the country, enabling students to enrol and attend courses at a location convenient to them. This format allows part-time students to complete the NZDE qualification within five to six years. A final examination is held at the end of each semester at designated venues across New Zealand, ensuring all students can attend the nearest venue. The mixed mode delivery model is particularly beneficial for industry professionals, as it minimises time away from work, typically requiring only five days per semester for a single course. The expectation is that students engage in self-directed study outside the structured study blocks, supported by comprehensive course materials, resources, and tutor support offered to guide independent learning. It is worth noting that similar block models have existed for decades in jurisdictions such as the United Kingdom and South Africa, where apprenticeship pathways for technicians have traditionally combined structured work experience with part-time study (Trevelyan, 2012). However, adopting this delivery of the NZDE qualification through the integration of study blocks and cadetship offers a modern adaptation of this model particularly suited to New Zealand's civil engineering sector.

This paper examines the effectiveness of the mixed mode delivery model in preparing graduates for the civil engineering workforce, exploring its impact on student learning, industry engagement, and professional readiness.

METHODOLOGY

This paper relies on secondary data analysis; specifically graduate survey responses collected between the period of 2016–2021. These surveys were administered online to graduates who had completed the programme requirements. The surveys consisted of structured multiple-choice questions with provisions for collecting open-ended responses to capture deeper insights. While the survey was not originally developed for this study, its standardised format ensures consistency in data collection throughout the period of 2016–2021. Ethics approval for this study was granted by the Western Institute of Technology.

The quantitative data from multiple-choice responses were coded and visualised using descriptive statistics, allowing for pattern identification to understand graduates' experiences. The qualitative data were analysed using Braun and Clarke's (2006) thematic analysis approach, which involves six key phases: (1) familiarisation with the data; (2) generating initial codes; (3) searching themes; (4) reviewing themes; (5) defining and naming themes, and (6) producing the final report. The thematic analysis focused on semantic themes, ensuring the analysis remained within the explicit meanings of the gathered responses rather than interpreting underlying assumptions.

A key limitation of this study is that the findings are reported purely based on a single data source, the survey response, without triangulation from additional qualitative methods such as interviews or focus groups. This limitation is acknowledged and was mitigated by the inclusion of open-ended questions in the survey, which allowed respondents to provide detailed reflections, offering a more reflective understanding of their learning experience. The surveys also included optional comment sections, enabling graduates to elaborate on their responses, thereby enhancing the depth of qualitative insights.

The study aims to critique and evaluate the effectiveness of the mixed mode delivery model, particularly investigating how the model bridges the gap between academia and industry needs. By analysing graduate responses, the paper highlights the model's strengths, areas for improvement, and its potential scalability for broader industry application.

FINDINGS FROM THE SURVEYS

Graduate survey data from 2016–2021 reflects consistently strong alignment between the New Zealand Diploma in Engineering (NZDE) programme and the academic process of preparing learners for the engineering workforce. The majority of graduates were employed in engineering-related roles at the time of graduation, with many graduates already holding mid- to senior level positions within the civil engineering industry while studying. This real-time alignment of work and academic learning was considered a powerful catalyst in their professional growth and academic development, highlighting the NZDE qualification as a formative experience in becoming workforce ready at a technician level.

It is interesting to note that the central theme emerging across the surveys was the integration of classroom theory and industrial practice. Many graduates emphasised how the block course or the mixed mode delivery format allowed them to immediately apply engineering concepts at their workplace. As one graduate from 2017 survey noted, “Related to my work, [I] could see the application of what I was learning. To free up time after work, [I] can now go home and relax instead of study.” Another graduate from 2020 wrote of “the benefit of the information and putting it into practice at work,” referring to the part-time nature of the block courses. Another respondent from 2021 survey noted: “Very practical and relatable to my job.” This direct connection between learning and doing not only improves comprehension, but also builds confidence, technical fluency with direct application, and workplace identity.

The motivational drivers for completing the qualification consistently pointed to personal and professional transformation. Many respondents undertook and completed the qualification as a means of gaining industrial credibility, advance opportunities, and personal growth. For example, they made statements like “completing my study to gain better employment and become a more desirable employee.” Another graduate noted:

One key driver has been the potential progression within Downer once I have completed the NZDE (Civil).

Another driver has been my employer covering the cost of my studies so I can focus more on my papers and the time management involved with the studies. (2017 graduate survey)

These statements reflect a clear appreciation of the professional trajectory the qualification offers. Another respondent from the 2021 graduate survey said their motivations were the “increase in potential earnings over [my] career and increase[d] likelihood of employment.” These comments clearly demonstrate that the students had a clear understanding of the value of the diploma as a stepping stone in their engineering identity.

A significant number of graduates highlighted the role of the employer in supporting their academic journey. Many graduates were engineering cadets or sponsored by their employers receiving financial support, study leave, and workplace mentoring. These provisions provided more than convenience: they modelled the collaborative, supportive environments graduates will continue to experience in professional practice. Employer engagement assisted not only in validating their learning experience, but embedded them within the work culture and expectations of the industry.

The flexibility and accessibility the mixed mode delivery model offered emerged as another crucial factor in qualification completion and developing workforce readiness. Respondents appreciated the opportunity to study part time while working full time. The ability to compartmentalise learning into focused blocks allowed students to spend less time attending classes and to remain productive in their professional roles while progressing towards

the qualification. One graduate from 2020 shared, “Block courses worked well for me. To the point, no fluffing around.” Another graduate from 2018 noted: “Block courses, I prefer that format to full time study. This also allows the compartmentalisation of the work which makes it easier to learn.”

Other graduates highlighted the accessibility of regional delivery centres, well-prepared course materials, and assessments that better reflected industrial practices and professional engineering practices.

While the feedback was mostly positive, some offered areas for improvement, particularly around the relevance of the curriculum. A few respondents noted misalignment between a particular course’s theoretical components and industrial practice, pointing to outdated technologies, excessive focus on rote learning, and limited attention to soft skills like relationship management and planning embedded within the programme. One graduate remarked, “There is too much focus on outdated materials ... and not enough on real-world case studies or construction methodologies.” Another 2019 graduate noted: “Unfortunately most of the course didn’t cater well for engineering consulting type material ... you could get more students from this part of the industry if you changed a few things up.” These comments suggest that while the NZDE prepares learners for many technical tasks, broader professional competencies could be further strengthened through the programme and reflected in the course content.

The graduate survey data reinforces the programme’s effectiveness in building key engineering attributes. High percentages of respondents rated themselves as well-prepared to apply engineering theory, to perform technical operations, and work within teams to perform core competencies expected of engineering technicians. Additionally, responses to open-ended questions frequently referenced increased confidence, self-directed learning, and the ability to problem-solve in workplace environments, all indicators that respondents were developing necessary skills and attributes expected of graduates of the NZDE qualification.

The surveys also demonstrated that many learners improved in their ability to critically reflect, a key skill underpinning the transition from students to experienced practitioners. Several graduates commented on the self-discipline and motivation required by the block course’s structure and the self-efficacy involved in completing the qualification while balancing full-time work and family commitments. As one 2021 graduate noted, “What kept me focused was the opportunities that would open to me once I qualified, and my genuine interest in what I was learning.” Another respondent noted, “Striving for constant personal growth and improvement. Salary improvement.” This shows a developing sense of personal growth, purposeful engagement, and identity within the engineering field.

Finally, in answer to the question “would you recommend studying the NZDE with [the provider]”, the recommendation rate was consistently over 80 percent, suggesting a strong perception of value amongst the graduates and industry. Their willingness to recommend the qualification through the mixed mode delivery model reflects both satisfaction with the programme’s outcomes and the delivery model, as well as a belief in its transformative potential for other learners on similar academic journeys.

In conclusion, the survey data reveals that the NZDE programme delivered through the mixed mode delivery model supports learners not just in retaining employment, but in becoming engineers, through authentic learning, industry integration, self-motivation, and reflective practices. The qualification acts as a bridge between academia and the evolving expectations of the engineering profession, helping learners to navigate this transition with confidence.

DISCUSSION

The findings from this study align with both interpretive and critical theory paradigms. The interpretive paradigm, as described by Sarantakos (2005), focuses on the “views, opinions, and perceptions of people as they are experienced and expressed by everyday life” (p. 40). In this research, graduates articulate their subjective experiences with the mixed mode delivery model and academic learning, providing insights into their learning journey accumulated over a period of five to seven years. Meanwhile, the critical paradigm allows for a reflective critique of the current educational practices, assessing the effectiveness of the mixed mode delivery model in preparing industry graduates for workforce readiness.

The mixed mode delivery model was established to support engineering cadets in full-time employment by offering a flexible, part-time learning option. Graduate survey data from 2016–2021 confirms that most students were employed in the relevant industry while studying and found this structure highly effective in helping them relate fieldwork and workplace practices with academic learning. Many students were positive about the learning experience and expressed how it was relevant to their role, allowing them to apply acquired knowledge directly at their workplace.

According to Reeves, Herrington, and Oliver (2005), authentic learning situates educational tasks in real-world contexts, which increases motivation and enhances learning. Reddy and Bruyns (2016) and Strobel et al. (2013) agree that students are more likely to succeed when their learning is authentic, meaningful and mirrors real practice. In this context, cadetship experiences not only enhance technical competence but also progressively shape students' professional engineering roles. Given that cadets often work on multidisciplinary engineering problems at their workplace (Petroski, 1996), aligning academic education with industrial practices is essential to sustain motivation.

Support from employers was another significant influence on student success. Graduates frequently identified such support, which included financial, logistical, and motivational assistance, as a reason for pursuing and completing their academic journey. These findings support Tahir et al. (2014), who emphasise the role of training employees in enhancing both personal and organisational performance. Supporting employees to pursue academic qualifications and training facilitates career progression and builds workforce capability. Many respondents viewed the NZDE programme not as an end point, but as a pathway to a better life, promotions and increased responsibility, and more substantial contributions to their employers. Encouragement from employers further strengthens the learner's sense of belonging within the professional community to create a professional identity.

Tutors have a critical role within the mixed mode delivery model. Graduates valued qualified and knowledgeable tutors, particularly those with on-the-ground experience with projects. Vansteenkiste et al. (2004) underscore the importance of educators framing and presenting learning tasks, which strongly influences learner motivation. Done and Willmot (2015) found that students who could apply their learning in real contexts before graduation were more motivated to enter the workforce and retained applied concepts better. This was echoed by graduates in the survey who appreciated the practical engagement, contextualisation of learning, and real engineering examples delivered by practicing professionals. Institutions should prioritise recruiting tutors who can bring relevant field experience into the classroom.

The model's success also relies on a robust academic support ecosystem within the tertiary education provider. Survey respondents praised the quality of academic and administrative support they received throughout their study period, noting that it extended beyond course content to include timely feedback, tutor availability, and employer engagement. This aligns with Tinto's (1975) theory that academic integration and support increase the likelihood of persistence, and with Thomas (2012), who stresses fostering the feeling of belonging and engagement to improve student retention.

In conclusion, the mixed mode delivery model not only helps full-time employees complete a qualification through a part-time format, but more importantly, contributes to the learner's becoming workforce ready.

RECOMMENDATIONS

This article makes a few recommendations, designed to strengthen pathways of professional transformation, ensuring that learners not only complete qualifications but also transition effectively into confident, work-ready, and holistic engineering professionals. Firstly, providers should utilise existing staff with local experience from the industry for cadetship schemes and to actively support the needs of part-time learners from the industry. A structured approach to delivering the qualification to part-time learners should be considered, along with the motivational factors (as perceived by the learners in this study) including their integration into the academic life through active learning and case-based and meaningful educational experiences. Engaging learners from the industry could inspire them to work through hands-on learning with frequent opportunities to put engineering theory into practice. While their cadets are learning knowledge and skills in an academic setting, employers could complement this with training in specific skills or processes required in their relevant industry. Further, engaging with established international models such as UK and European apprenticeship frameworks could offer valuable insights into how similar programmes achieve stronger alignment, shorter durations, or broader mobility of graduates. This benchmarking activity would enable the refinement of the New Zealand model in ways that maintain its flexibility while lifting its responsiveness to the engineering industry needs.

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