

Use of stacked microcredentials for a diploma in structural detailing

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ABSTRACT

CONTEXT

Most qualifications recognise the competencies of a learner at the completion of their qualification which is usually several years after they start their studies. However, learners have different competencies at each stage of their studies and may be competent to undertake some roles in industry before they complete their qualification. There is a need to recognise when a learner is ready to enter an industry and to recognise their developing competencies as they learn while they work. Microcredentials offer the ability to break a larger qualification into parts that recognise the competencies of a learner as they progress through a larger qualification.

PURPOSE OR GOAL

A new diploma is required to recognise the competencies required to be a Structural Detailer. There was a need to develop this programme so that it fitted in with industry needs. This paper describes the process that was undertaken to identify these needs and final system that was developed.

APPROACH OR METHODOLOGY/METHODS

The new structure was developed the Waihanga Ara Rau (Construction and Infrastructure) Workforce Development Council under the guidance of a Technical Advisory Group comprising practitioners, industry group representatives and providers.

ACTUAL OR ANTICIPATED OUTCOMES

The Technical Advisory Group developed an innovative approach to meet the industry needs using three microcredentials to recognise the competencies required at each stage of a Structural Detailers learning journey and which also stack to form the diploma.

The Skills Standards and Microcredentials that make up the proposed system are presently being processed by the NZQA. Finding funding for the development and delivery of the new qualification is underway.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

This research sets out a system that can better meet industry needs and can provide the opportunity for people to quickly enter the steel detailing industry at minimal cost.

KEYWORDS

Microcredentials, Vocational Education, Detailing

Introduction

The engineering industry is often hamstrung by the shortage of skills in specific areas. Gaps in the skilled workforce can result in delays in projects, bottlenecks constraining productivity and increased costs. Finding and hiring local people with the required skills can be a long and costly process and may not be successful. Other options are to hire from overseas, use offshore resources or train new people. Training unskilled local people within the workplace is beneficial to the community but carries with it significant costs as it takes some time before the person becomes a productive member of the team. Traditional vocational education programmes provide suitably trained people but take time for learners to move through the education system.

While industry has an immediate need for skilled people, there are also large numbers of people who are looking to upskill to enable them to move into roles that offer professional and economic advancement. However, many mature workers have existing family and other responsibilities which mean that a prolonged study period is not financially viable. Younger people are also discouraged from entering tertiary education by the high costs and time required.

Programmes that allow people to quickly enter the workforce and then learn as they earn provide them with the opportunity to upskill with minimal cost. However, they need the competencies that make them a productive member of an engineering team if they are to get employed and ongoing education to become skilled workers within their industry.

The term 'skilled workers' often refers to people who have the competencies to undertake the full range of activities in an engineering team. However, an engineering team has variety of roles ranging from entry-level work, such as amending drawings, through to more complicated activities such as detailing complex structures. This spectrum of roles is recognised in industry but less obvious in education with diplomas and degrees covering a wide range of competencies rather than a narrow range required for specific entry-level roles.

Educational qualifications recognise the competencies of learners and provide potential employers with confidence that the graduate will be able to fulfil a specific role within their organisation. However this recognition is typically provided at the culmination of the learners' studies, which often spans several years. The delayed recognition of competencies that learners may acquire earlier in their educational journey may delay their entry into the workforce even though they may be able to effectively undertake some roles that are urgently required in the industry. As a result, there is a growing need for more timely and flexible recognition of skills and knowledge that learners develop progressively in the workplace (Oliver, 2019).

Micro-credentials have emerged as a solution to address this need by providing a means to break down larger qualifications into smaller, stackable components that recognise specific competencies as the person progresses through their learning journey (Hunt et al., 2020). By recognising competencies as they are acquired, micro-credentials facilitate continuous learning and immediate application of skills in the workplace, thereby enhancing both employability and workforce readiness (Oliver, 2019).

This paper describes the process undertaken to develop a programme that better meets industry requirements and allows unskilled people to quickly develop the competencies required to enter industry. This process was undertaken by a working group consisting of Workforce Development Council Educational Designers, industry representatives and vocational education providers who were tasked with developing a solution to the shortage of Structural Detailers in New Zealand. In a series of meetings extending over 18 months the group identified the technical and operational needs of industry, developed a structure that met these operational needs and then developed the skill standards and microcredentials to meet the technical requirements of the structural detailing role.

The paper concludes with the description of a programme that uses microcredentials to recognise the varying competencies required in a Structural Detailing team. This enables people to enter the industry early with a formal qualification and attain additional qualifications recognising their capability to take on more advanced roles as they develop as a Detailer.

Background

One industry with a significant need for more workers is the structural detailing industry. This is the industry that takes the designs for structures and their components and produces the drawings required to fabricate the components and construct the structures, manages the fabrication of the components and manages delivery and erection of the components on site.

The main role in this industry is the Structural Detailer. A competent detailer will be able to apply engineering and construction knowledge to design information, produce accurate manufacturing and assembly instructions and drawings, know about the building regulatory system and compliance requirements, and contribute to quality standards in construction projects. These competencies require an understanding of structural systems and the industry, CAD and modelling software skills and good problem-solving abilities which are usually developed in practice.

There are no formal qualifications that recognise the specific competencies related to structural detailing. Many existing Structural Detailers have gravitated into detailing from engineering, architectural and construction roles and qualifications. This has meant that they have had to learn the specific competencies related to detailing while working.

The New Zealand Diploma in Engineering (NZDE) in civil engineering is the closest match for this industry. However, it takes 2 years to complete full time and covers the basics of the full range of civil engineering disciplines. The new qualification needs to take less time and focus the specific competencies related to structural detailing. Nevertheless, the new qualification has been designed so that parts of some NZDE courses can be cross-credited if graduates wish to pathway into the NZDE. It is also proposed to use teaching resources developed for some NZDE courses in the delivery of the new qualification.

The industry decided that a formal qualification focusing on structural detailing was required. They approached the Construction and Infrastructure Workforce Development Council who set up a Technical Advisory Group to develop the qualification.

Approach

The Structural Detailing Technical Advisory Group was established in January 2022. Development of industry driven qualifications requires collaboration with technically experienced subject matter advisors, so the membership was drawn from consultants and manufacturers from the light steel, structural steel, precast concrete and steel reinforcement industries and representatives from industry organisations such as Steel Construction NZ (SCNZ), National Association of Steel Framed Housing (NASH) and Concrete NZ. In addition, a representative from Vocational Engineering Education NZ (VEENZ) was later included to provide input from future providers of the programme and to enable the new qualification to link in with the NZDE.

The group had to address several issues including the following.

- There is a significant skills shortage in the detailing industry and there is an immediate need for new people. This issue will become more serious if the forecast increase in construction industry work occurs in 2025.
- Many existing structural detailers have no formal qualifications recognising their competencies which they have developed while working. In an informal online survey, over 60 existing Structural Detailers have indicated that they are keen to engage with a qualification that recognises their existing competencies and provides the pathway for them to progress in the industry. This means that the programme needs to allow experienced steel detailers to easily get their competencies recognised and enter the programme at an appropriate level.
- Many of the competencies (e.g. 3D modelling, structural concepts, construction industry organisation) required to enter the Steel Detailing Industry are not taught in secondary

education. This means that anyone entering the industry needs to learn a lot of new concepts and practices and are not immediately productive in a Steel Detailing Team.

- The nature of the role means that most competencies are best acquired while working so any programme needs to enable learners to enter the industry as soon as possible.
- Work-based learning produces the outputs that demonstrate the detailers competencies and so any programme needed to allow learners to submit their work as evidence of their competency. Associated with this is the fact that many outputs are produced by a team and so there is a need to have the ability to verify how much of the output the learner was responsible for.
- The programme needed to allow for separate specialisations in light steel, structural steel, precast concrete or reinforcing steel detailing with timber, glass and other specialisations also having the potential to use the programme. This meant that the programme needed to have flexibility to enable outputs from the full range of specifications to be used for assessments.
- Some detailing roles may not involve learners in producing outputs that could be used to demonstrate all the competencies associated with the programme. Therefore, the option of having set assessments also needed to be available.

The group considered that a Level 5 Diploma was required to properly recognise the full Structural Detailer role but also acknowledged that the diploma alone was too big and took too much time to enable the above considerations to be effectively addressed. It was realised that a group of smaller qualifications recognising the different competencies that a learner developed as they progressed were needed. The programme was being designed using Skill Standards, but these were too small and numerous to be useful as an industry qualification. The solution was to use three 40 credit Microcredentials that arranged sequentially to match the learning pathway of a Structural Detailer and stacked to form the diploma.

The approach of having industry, educational designers and providers developing the programme has meant that the content is closely aligned to industry needs and organised to enable more efficient delivery. Sargent et al. (2023) note that there can be a tension between a microcredential that allows learners to study what is relevant to their practice and a microcredential that demonstrates compliance with an industry body professional accreditation. However, in this case, the course was developed by practicing detailers to focus on the actual competencies that are required. Also, the qualification will be the professional accreditation for the professional body so there is no tension because the programme is developed from the workforce.

Microcredentials

A microcredential is a small, stand-alone award with set learning outcomes. They recognise learners' skills, experience or knowledge, while meeting demand from employers, industry and communities. They are listed on the New Zealand Qualifications and Credentials Framework (NZQCF); are 5 to 40 credits in size, taught at all levels of the NZQCF, delivered by accredited education providers and developed because there's evidence they're needed. A programme that includes micro-credentials can offer learners a meaningful learning pathway for accumulating relevant and necessary skills, the opportunity to gain valuable skills in a shorter time and the opportunity to check interest and aptitude before committing to a whole programme. (NZQA, 2024).

Microcredentials can provide several benefits including -

- allowing learning to be broken down into smaller packages than diplomas or degrees. that can take place over a shorter period of time (de Monte, 2017).
- stacking to provide a more flexible learning pathway with micro-credentials providing a coherent record of what the learner has learnt (Finkelstein et al., 2013).
- alignment of formal learning with workplace activities which is a more effective method of learning. (Detsimas et al., 2016).

- verification of a learner's competencies and hence ability to undertake specific roles in industry (Ferguson & Whitlock, 2024).
- earlier recognition of competencies where workers who are working and studying part time could use micro-credentials to gain the credentials, they need to gain promotion while they are still studying rather than only having their competencies recognised at the end of a program with the award of a diploma or degree (Mills et al., 2012).
- more granular record of what a learner can do (Ferguson & Whitlock, 2024; Finkelstein et al., 2013).

All of these benefits apply to the use in the structural detailing diploma. Breaking the diploma into smaller parts means that the learner's competencies at each stage of their development can be recognised. This means they can enter the industry sooner and, when they are working, they can be promoted to more demanding (and higher paid) roles when they are able rather than when they finish the diploma. Enabling the learner to enter industry sooner means that they learn about what they are working on which provides a more effective learning process and enables them to progress their learning and professional development at the same time.

Microcredentials are already being used to recognise professional competencies and are proving to be a good option for this use. Hunt et al. (2020) note that microcredentials offer professional development that is "personalised, competency-based, flexible and collaborative". Marra et al. (2022) surveyed pharmacy students doing postgraduate studies as part of their professional development while working. It determined that most (88%) preferred the use of a series of microcredentials rather than the traditional Postgraduate Diploma. The reasons given were convenience, flexibility and cost commitment.

The pedagogy behind the Diploma, and many other microcredentials, is competency-based learning where the focus is on the learner's ability to demonstrate their mastery of specific skills and knowledge which can be acquired from experience or formal study (Maytin et al., 2023). The output is the demonstration of these specific competencies which can be a set assessment or work the learner has produced. Microcredentials provide the flexibility to allow a range of outputs to be used to demonstrate the required competency. to be formally recognised. The microcredentials can also be written to recognise the learners own approach to the competency. In this case each learners will produce different outputs demonstrating the same broad competency.

Developed System

Figure 1 illustrates the potential learners, basic structure of the qualification and the competencies at each stage. The three microcredentials are stacked to provide a system for recognition of the Diploma in Detailing (Structural) The microcredentials recognise competencies that align with each stage of a detailers development from basic roles through to leading a team. Each microcredential is composed of 4 to 8 Skills Standards each focused on the specific skills and knowledge that make up the complete set of competencies required at each level as determined by the Technical Advisory Group.

The learners entering the Introduction to Detailing Microcredential would have NCEA Level 2 literacy and numeracy skills. These learners could be -

- High School students doing the microcredential in addition to their NCEA studies to enable them to enter the detailing industry directly or those who plan to move into further engineering or architectural studies.
- High School leavers doing the first microcredential after they have finished their secondary school studies so that they can start working as soon as possible.
- Career Changers who are outside of the industry but want a quick way of entering it.
- Workers presently working in the fabrication or construction industries who wish to move into detailing.

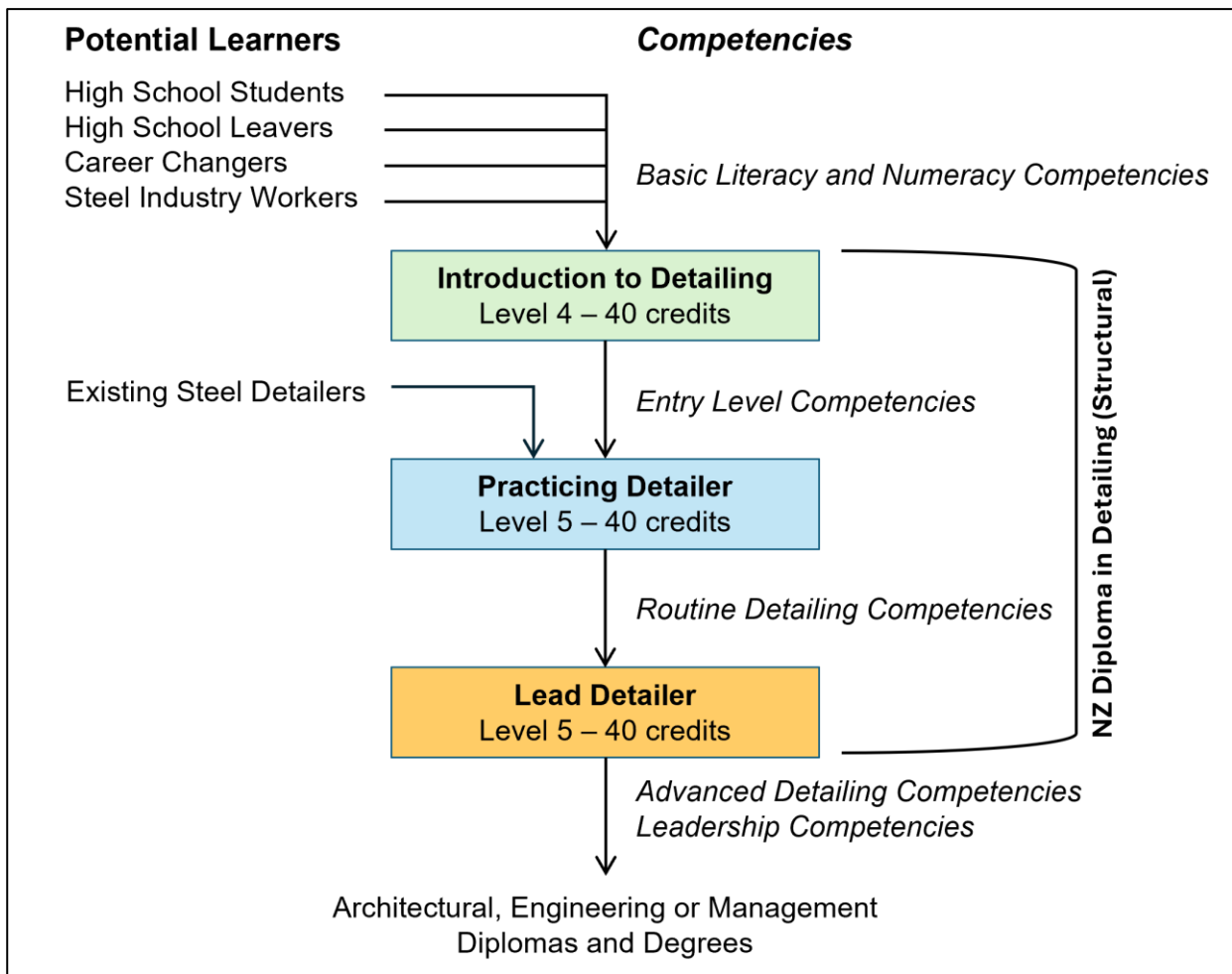


Figure 1: Qualification Structure, Potential learners and Competencies

The Introduction to Detailing Microcredential would be delivered in an online or blended format with tutorials provided online or face to face. It consists of 8 courses that can be delivered as a 15 week full time course delivery or part time over a longer period of time. The content of the microcredential provides learners with a basic understanding of measurements, structural concepts, technical drawing, 3D modelling and industry practice.

Graduates of the Introduction to Detailing Microcredential would have the competencies to be a useful member of a detailing team. This addresses the issue that industry have with employing unskilled people who are a cost to the organisation while they are learning the basic skills. It is anticipated that this microcredential would encourage industry to provide cadetships or other opportunities for the local people rather than having to use an offshore workforce. The microcredential would allow learners to quickly develop useful competencies and get into paying work.

The last two microcredentials recognise the learners development of skills while working in the industry. The Practicing Detailer Microcredential allows the people in the industry to develop the full range of competencies required to do routine detailing work. The Lead Detailer Microcredential enables learners to develop and demonstrate their competencies in advance detailing and leadership of detailing teams. These microcredentials will require learners to be working in the industry.

The requirement to be employed in the industry is necessary as the highly specialised software and knowledge required for learners is only available within industry. In addition, there are a wide range of specialised roles with their own specific software and knowledge within the Structural

Detailing Industry which would not be adequately addressed in a formal class. Instead, the programme needs to allow learners to demonstrate their competencies using the outputs they produce at work. However, there may be additional assessments set for learners whose role does not allow for them to demonstrate some of the learning outcomes in the curriculum.

It is recognised that learners who were not in industry would not be able to complete the full diploma. One advantage of having microcredentials is that they would still have recognition of their competencies through the Introduction to Detailing Microcredential. This may be useful in cross-crediting or as prerequisites for other more general qualifications, such as the NZDE, or in other civil engineering industry roles such as the Timber Detailer or Structural Design CAD Operator roles.

Each paper in the last two microcredentials will typically be assessed by the learners submitting one portfolio demonstrating their competency in the learning outcomes for that paper. The work in the portfolios would be mostly outputs they have produced at work although additional projects may need to be done if their roles does not cover a specific learning outcome. The portfolios would be reviewed by a panel including academic and industry people to ensure that the educational standards are met and technical capabilities of the learner are verified. The panel will also interview the learner to verify that the work is theirs and that they do have the knowledge and skills set out in the learning outcomes. The interview will also discourage learners from using other people or AI to do their work.

The time required for these last two microcredentials will depend on the learners but it is anticipated that each would take about a year of study and portfolio development to reach the required standards

The qualification structure also offers the opportunity for existing detailers who have developed the required competencies while working to get a formal qualification. Most existing structural detailers already have the competencies required for the first microcredential, and some may also have the second microcredential competencies. They would be credited part or all of the relevant microcredential upon submission of a portfolio of their work and passing an interview to verify their competencies. They would then be able to either do the Skills Standards required to complete a microcredential or start directly on the next microcredential.

Current Situation

The skills standards underlying the first microcredential and the microcredential itself have been processed by the NZQA. The structures and objectives of the last two microcredentials have been developed and the relevant skills standards are being finalised before submission to the NZQA.

It is planned to start delivery of the first microcredential in early to mid-2025 with the other two microcredentials becoming available soon after. Funding for the delivery is yet to be acquired and developing a viable business case in the existing construction industry slump is problematic. However, there may be a significant and rapid increase in the need for Structural Detailers when new construction projects come online in 2025 and the industry has expressed the need to start delivery to enable them to keep up with the anticipated need.

Conclusion

This paper presents an innovative new structure for a diploma that uses three microcredentials to recognise the diploma requirements. Each microcredential has a specific function, with the first recognising entry level competencies, the second recognising the development of routine detailing competencies and the last recognising advanced technical and managerial competencies. This provides a more focused view of the learner's suitability for specific roles within the structural detailing industry and enables new people to develop the competencies required to quickly enter the industry.

The structure was developed to meet the needs of the structural detailing industry for more people and to provide a formal qualification for existing detailers. The group worked with the Construction and Infrastructure Workforce Development Council and included practitioners, representatives of industry organisations and educational providers. This enabled the needs of the industry and related issues to be clearly identified which in turn meant that the developed solution aligns well with industry practice.

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