

Use of online on-demand microcredentials to provide an alternative learning pathway for an engineering diploma program.

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Introduction

This paper sets out the methodology and results of a feasibility study and the following pilot project which were implemented to investigate the use of microcredentials as an alternative learning pathway for the civil option of the New Zealand Diploma of Engineering (NZDE) programme.

The NZDE is designed “to provide skilled and competent engineering technicians specialised in Civil, Electrical, Electronic, Mechanical or Fire Engineering for the New Zealand engineering sector” (NZBED, 2017). The NZDE (Civil) graduates fill a number of roles in the civil engineering industry including civil construction site engineers, infrastructure and structural designers and draftspeople, engineering surveyors and project managers for civil engineering projects (Wilson, 2014).

There is a need for more civil engineering diploma graduates if New Zealand is to continue to develop at its current rate (IPENZ, 2010) but current graduate numbers are decreasing (Engineering E2E, 2017). One possible approach to increase graduate numbers is to make the programme more accessible and attractive to working people.

Microcredentials are recognitions of small packages of learning. The learning and assessment resources required to undertake these small packages of learning may be presented on an online platform that allows learning to be undertaken at any time (i.e. on-demand learning). Mischewski (2017) suggests that this approach could provide a more flexible approach to learning which may allow easier access to education for working people. They may also provide a low-stakes entry for people who have been away from formal learning for significant periods of time.

The feasibility study was undertaken in 2018 with funding from the Engineering E2E programme. The Engineering E2E programme was set up and funded by the Ministry of Business, Innovation and Employment to address the current shortage of engineers in New Zealand. The Feasibility Study recommended that a pilot project be undertaken to develop a better understanding of how micro-credentials could be used in this context. The pilot project started in January 2019 and is ongoing (as of July 2019). It is being funded by the Tertiary Education Commission (TEC) which is the government organisation tasked with managing education provision in New Zealand.

This paper first examines what microcredentials are, how they are currently being used and what their advantages and disadvantages may be. The methodology and results of the feasibility study and the pilot project are then presented. Finally, the potential for online on-demand microcredentials and associated learning resources will be discussed.

Literature Review

Microcredentials

Berry & Cator (2016) and De Monte (2017) define a microcredential as recognition of the mastery of a specific competency while the NZQA (2018) use the term to describe credentials that certify the “achievement of a set of skills and knowledge”. There is a

significant difference in these two definitions. Competency based microcredentials typically involve much smaller packages of learning that may only take days or weeks to complete while the learning required to master a set of skills and knowledge could potentially take several months. For the purposes of this research the former definition was used.

There are a number of potential advantages that may result from these smaller packages of learning. Berry and Cator (2016), Finklestein, Knight & Manning (2013) and Grant (2014) note that the content can be ordered in a wide variety of configurations, known as “stacks”, which allow learners to access what they need to learn when they need to learn it. They add that this relevance can motivate learners to complete the learning process. Raine and Anderson (2017) add that this flexibility allows learners to learn at their own pace and structure the learning to fit in with their work and family commitments as well as making the learning process easier. Detsimas, Coffey, Sadiqi & Li (2016) and Svensson, Ellström and Åberg (2004) suggest that the learning process can be more efficient if the content relates to activities the learner is undertaking at work. Barry and Egan (2018) suggest that the flexibility enabled by microcredentials would allow learners to take control of their own learning which can provide further motivation for adult learners.

There are concerns about smaller packages of learning. Olneec (2015) and; Wheelahan (2007) suggest that breaking a topic down into smaller learning packages may result in learners not understanding how the discrete package of learning fits into the big picture or how it links to other packages of learning. This concern is also noted by Lewis & Lodge, (2016) but they suggest that this may not be such an issue in technical education, such as that provided by the NZDE (Civil) programme, as this type of education focuses on developing a series of discrete competencies related to the practice of civil engineering. They argue that the connections between competencies taught in technical education are more easily understood than the in-depth knowledge grounded in first principles which is the aim of degree and higher qualifications.

Working Learners

Adult learners, particularly those already working in the civil engineering and construction field, may be particularly useful in addressing the needs of industry. Finkelstein et al (2013) find that adult learners are often more motivated than younger full-time students as they are more likely to appreciate the importance of education. Fairchild (2003) finds that they tend to have a wider knowledge base both of the subjects being studied and of life in general which can help them better understand the course content and context. Detsimas, et al (2016) add that people working in construction industry have an additional advantage as they are also familiar with the practice of the subjects they are studying.

Working Learners also have additional challenges. Fairchild (2003) notes that many have family, work and social commitments which reduce the time they can devote to study and conflict with formal class times. Donavent (2009) finds that some may not have the academic skills required to keep up with formal education and require additional support which may not be as readily available with online learning.

The New Zealand government has identified the need for a vocational education system that gives working people the opportunity to engage in programmes such as the NZDE (Civil and also recognises that educational institutions need to provide programmes and approaches that are relevant to the needs of industry (Ministry of Education, 2019, p5). The current restructuring of the vocational education system acknowledges that alternative pathways for the delivery of education, such as the use of microcredentials, may be a means of achieving this.

Methodology

The research discussed in this paper spans the processes undertaken from an initial feasibility study and a pilot project that followed it.

The Feasibility Study comprised of an online graduate survey followed by face-to-face interviews to determine typical graduate roles and associated competencies required to carry out those roles. An extensive mapping process was undertaken to determine the extent to which the competencies could be aligned to the NZDE syllabus.

Feasibility Study

Overview

The purpose of the Feasibility Study was to develop and assess a framework for a microcredential based system that:

- focuses on the competencies required for roles that NZDE (Civil) graduates are required to undertake in civil engineering industry;
- links into the NZDE (Civil) programme allowing each microcredential to be assessed as evidence of prior learning;
- allows working learners to learn what they need to learn when it is relevant; and
- is easy to access at all times.

The system was developed by first determining the competencies graduates actually use in practice. Learning packages and corresponding microcredentials were then scoped for each competency. These microcredentials were then mapped to the NZDE syllabus and the need for adjustments to the scope of some microcredentials and additional microcredentials was assessed.

Survey and Interviews

An online survey was sent to all graduates of the Unitec NZDE(Civil) and Bachelor of Engineering Technology (BEngTech) programmes who graduated between March 2016 and March 2017.

The survey asked graduates to provide details on the roles they undertook in the civil engineering industry and the skills required to carry out these roles. The survey was sent to 94 NZDE graduates with 30 responding giving a response rate of 32%. The survey was also undertaken by 70 BEngTech (Civil) graduates (out of 160 contacted). It was revealed that the NZDE and BEngTech graduates often undertook the same or similar roles in industry meaning that the data from the BEngTech graduate interviews was also relevant to this research.

After asking respondents to indicate whether they would be willing to be interviewed, the subsequent interviews aimed to develop a more complete description of the activities that were typically undertaken for each role. Interviews were undertaken with 6 NZDE(Civil) respondents and 11 BEngTech (Civil). The interviews were undertaken in a semi-structured face to face interview lasting 30 to 40 minutes. The discussion was recorded and analysed to determine common themes for each role.

This survey and the subsequent interviews provided an indication of the roles NZDE graduates played in the civil engineering industry and a detailed description of the activities undertaken in some of these roles.

Microcredential Development

The competencies required for each role were identified. There were many competencies, such as producing CAD drawings, basic surveying and project management, that crossed several roles but there were also competencies specific to each role. As will be discussed later, the competences for some roles were well defined while other roles need more research.

Microcredentials recognising each specific competency were then developed. This involved teasing apart some of the tasks that graduates undertook to identify specific microcredentials. For example, producing a subdivision design includes being able to calculate water, wastewater and stormwater flows, designing pipe systems to carry these flows and producing drawings to communicate the design – all of which are separate competencies. The output from this process was a series of short descriptions of the scope of the each microcredential. More detailed descriptions of the required learning resources and associated methods of demonstrating the competency would need to be developed.

Mapping

It was recognised that if microcredentials were to be used as a potential pathway into formal education to complete the NZDE (Civil), a formalised process for the assessment of prior learning (APL) would need to be developed. In addition, the microcredentials would need to be officially recognised by an institution as full or partial fulfilment of the requirements of the syllabus if the learner decided to undertake the NZDE (Civil) programme.

In the Feasibility Study, the microcredentials were aligned to the competencies identified as being required to carry out the identified industry roles. This meant that they did not always fulfil all of the learning outcomes and requirements of any of the courses within the NZDE programme and some additional microcredentials were needed to align with the NZDE course learning outcomes.

For the pilot project, the mapping of the microcredentials involved analysing the competencies for various roles in the industry and finding ways for them to more closely align with the learning outcomes in the courses within the NZ Diploma of Engineering (NZDE). Once there was alignment between the microcredentials and the NZDE courses it was easy to determine the APL process.

Pilot Project

The main objective of the Pilot Project was to develop and test a delivery platform and online resources that would enable learners to earn the microcredentials by learning the associated competencies. Other objectives were to develop suitable process by which learners could demonstrate their competencies, identify the time and cost requirements involved in developing the platforms and resources, determine industry interest in the approach and review how effective the online on-demand approach was in delivering the required learning.

The process involved in earning a microcredential consists of the following steps:

1. Learner determines which micro-credential they wish to earn and reviews the free online Submission Requirements which set out the competencies the micro-credential represents and how the competencies can be demonstrated.
2. Learner decides what learning (if any) that they need and use the free Online Learning Resources to develop those competencies. A separate Moodle site was developed and is being used as the Learning Management System (LMS) for the Pilot Project.
3. Alternatively, learners may find that they already have the required competencies from previous learning or experience and just need to demonstrate it.
4. The learner compiles a Demonstration of Competency using the Submission Requirements as a guide for their submission.

5. The assessor reviews the submission to determine whether it demonstrates mastery of the required competencies.
6. The assessor and Learner discuss the submission to provide verification that the submission is the learners own work, that they understand what they have submitted and that they have mastered the required competencies.
7. The assessor issues the micro-credential. For the pilot these badges are being issued through the project LMS. They do not contain the metadata that open badges provide although this facility could be added if a full micro-credential system is developed.

Results and Discussion

Graduate Roles and Competencies

The survey identified the roles that the graduates undertook. Over a quarter of the graduates work as Site Engineers where they manage civil construction sites. About 20% work as infrastructure engineers doing the design and drawing production for subdivision and other infrastructure work. Another 20% were identified as working in the structural field although whether they were working mainly as draftspeople or also doing design was not able to be determined. There was also a significant number of graduates working full time as engineering surveyors filling gaps in the industry caused by a lack of surveying graduates. There were one or two graduates in other roles such as Project Manager, Lab Technician and Maintenance Manager.

The following interviews allowed the competencies required by the Site Engineers and the Infrastructure Engineers to be clearly identified. There was only one Structural Engineer and one Surveyor interviewed and so the competencies required for these roles had to be estimated from other sources such as previous informal discussions with industry and the experience of the author in the industry. The competencies required for the Project Manager, Maintenance Manager and Laboratory Technician roles had to be assessed from interviews with the BEngTech graduates as well as industry discussions and experience.

Microcredential System

The mapping of the microcredentials to the NZDE (Civil) syllabus allowed the competencies required in specific roles in the industry to be aligned to the equivalent learning outcomes in the NZDE syllabus. This process revealed that 10 to 12 courses covered the most common competencies used by graduates in their work.

The learning was structured into 3 credit microcredentials, equating to about 30 hours of learning which is roughly 3 to 4 weeks of part time study. The microcredentials were designed to be stacked into groups of five, adding up to a total of 15 credits, covering all of the learning outcomes of the relevant NZDE (Civil) course.

The mapping process also reviewed the competencies that learners would require to be successful in an online learning environment and the level of support these learners would need. In addition, the delivery and assessment were rigorously aligned to NZQA standards to ensure that the microcredentials were being taught and assessed at the right level. To this end, detailed rubrics and marking schedules were developed to meet these requirements.

As the industry roles and NZDE (Civil) syllabus did not align exactly, an additional 4 or 5 microcredentials are needed to cover some learning outcomes. The process identified areas in the NZDE (Civil) syllabus where some essential competencies were not included or required update and a strong case can be made to review the syllabus.

Pilot Project

The pilot project is ongoing at the time of writing (August 2019). Even after extensive consultation and advertising, only seven learners enrolled in the project and, of those, only three or four of these learners are actively participating and completing microcredentials. It is considered that this is more a reflection of the difficulties of introducing something new rather than a lack of interest from industry. Informal discussions with industry have shown interest in the concept but committing to a significant amount of study time for people in full-time employment is a challenge.

It has already been observed that while the content is readily accessible and easily understood, in addition to a lack of time, the difficulty of remaining motivated when working independently has also been an obstacle. While most of the learners participating in the pilot project were conversant with accessing the material online and had no trouble surfing the internet or using an email client, it quickly became apparent that they lacked many of the basic skills required for online study such as the use of text editors or the creation of spreadsheets (e.g. Microsoft Word, Excel).

Despite the lack of engagement by some of the participants, the project has produced a better understanding of the process required to set up and operate an online delivery platform, the associated learning resources and assessment processes. Moodle has provided an effective and easily used Learning Management System, requiring less than a month to set up. The use of Snagit to record learning videos and YouTube to deliver them has allowed the videos to be effectively recorded, edited and delivered at a reasonable cost.

Some difficulties were also encountered. Obtaining illustrations and photos to illustrate the videos has been problematic as non-copyrighted material was required. Consequently, a significant amount of time was spent in producing photos and illustrations specifically for the learning resources. Significant time was also invested to ensure that correct terminology was used throughout and that the information presented was correct. In this project, only one person was preparing the material. It is our opinion that a team of people with specialist skills would have been more efficient.

The project will finish at the end of 2019 and a more definite conclusion will be drawn then. It is anticipated that interviews and analysis at the completion of the project will enable the issues involved on both sides of the online delivery and assessment to be better understood.

Conclusion

While it is still early in the process, early impressions indicate that the use of microcredentials is a step in the right direction, especially for those wishing to progress in the workplace. While time remains an issue with learners, it is expected that a wider uptake in industry could resolve many of the problems faced.

Indications are that, should microcredentials be adopted as a pathway to retrain, upskill or preparing for study towards the NZDE, attention must also be given to the foundation skills required to study in an online environment and that the formation of an online community would be beneficial to maintain learner enthusiasm.

The efficiency in developing the resources and assessments could be further improved by adopting an “online-first” approach of any new resources. These could, in turn, be used as classroom resources, significantly reducing the time and cost of development.

The use of microcredentials as part of the wider educational context also aligns with the current government review of vocational education (ROVE). This would indicate that a more in-depth study of their use would be beneficial.

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