Credentialing professional learning for university educators

A Literature Review

Project title: Investigating Learning and Teaching Frameworks and Credentialing for Professional Learning in Higher Education

Authors: Dinan-Thompson, M., Bajema, A., Cowden, G.

December 2021

Project Team: Professor Maree Dinan-Thompson, Professor Liz Johnson, Professor Shannon Johnston, Associate Professor Lisa Cary, Dr Ann Luzeckyj, Dr Andrea Lynch, Mrs Gina Saliba. CAULLT Liaison: Professor Simon Bedford.

Executive Summary

Micro-credentials are now widely accepted as short-form learning opportunities in higher education, both within Australia and globally. However, there is currently no standard framework, definition, or taxonomy for micro-credentials in Australian universities. This literature review provides insights into the benefits, challenges, design recommendations, and key considerations to inform the development of a micro-credentialing taxonomy for university educators' professional learning.

Flexibility and personalised learning experiences, including the implementation of varied pedagogical approaches, were identified as critical components for the design of micro-credentials. The literature established that micro-credentialing improves learner engagement and learning outcomes, however a credential must have quality content, and be engaging, authentic and relevant, and beneficial for the learner. Micro-credentials should also be verified and portable across institutions and into the workplace, with consistent processes for awarding credit/recognition towards an existing qualification or professional requirement.

Robust assessment and quality assurance are other key themes in the literature. The security and permanency of certification and credentials is identified as a considerable challenge, and blockchain may be a possible solution. The review explains how digitalised badges and certificates support and facilitate the use of micro-credentials. It also confirms that there are a number of platforms and providers available for credential design, delivery, and certification, each offering different strengths and limitations.

In summary, the following report draws together research in the field, and highlights both benefits and issues for universities operating in the micro-credentialing space, demonstrating the demand for formally recognised short units of learning combined with the need for consistency and portability across institutions.

Table of Contents

Glossary of terms

Blockchain

"Blockchain is an open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way. The ledger itself can also be programmed to trigger transactions automatically" (Iansiti & Lakhini, 2017, n.p.).

Digital badge

A digital badge is a visible, digital representation of achievement. "Created to acknowledge competency, skill or achievement they have been adopted for a variety of purposes including to motivate learners, recognise achievement and accredit learning" (Hartnett, 2021, p.104).

Gamification

Gamification is a learning and teaching approach that uses digitalised, game-like elements in course materials to engage and motivate learners (Commonwealth of Australia, Australian Curriculum, 2021).

Massive Open Online Courses (MOOCs)

MOOCs are individual units of learning offered online and completed by large numbers of people.[1] There are two major types of MOOC – the Connectivist MOOC (cMOOC), and the eXtended MOOC (xMOOC) (Mohamed & Hammond, 2017). MOOCs offer educational experiences at scale, and are usually free; however it is common for a fee to be charged for a certificate to formally recognise successful completion.

Micro-credential

There is no agreed definition or common standard for a micro-credential (Oliver, 2021; Organisation for Economic Co-operation and Development [OECD], 2021; Universities Australia, [UA], 2021). Oliver's 2019 paper proposes that that a micro-credential is "a certification of assessed learning that is additional, alternate, complementary to, or a formal component of, a formal qualification" (p. i). The New Zealand Qualifications Authority [NZQA], uses the following broad definition:

---

[1] The M in MOOC stands for massive, the first O is for open, the second O is for online, the C stands for course.

A micro-credential certifies achievement of a coherent set of skills and knowledge; and is specified by a statement of purpose, learning outcomes, and strong evidence of need by industry, employers, and/or the community. They are smaller than a qualification and focus on skill development opportunities not currently catered for in the regulated tertiary education system. (2021, a, n.p.)

The NZQA definition does not specifically include assessment, whereas others do so (such as the European Commission[2], 2020, and Oliver, 2021) – this is further discussed throughout the paper.

Platform

The term platform refers to tools and resources such as software or websites which can be used to design and/or offer a course/subject or micro-credential.

Unbundling and rebundling

Unbundling refers to the dismantling of larger university degrees into smaller components (Czerniewicz, 2018; Gallagher & Maxwell, 2019). Rebundling is "the reaggregation of those parts into new components and models" (Czerniewicz, 2018, p.12).

---

[2] cited in Brown et al., 2021

Introduction

Micro-credentials are a method of broadening reach to more learners. They are small learning packages or modules which target specific learning goals or outcomes. Micro-credentials have traditionally been competency-based and can be considered a more affordable, attainable, and flexible form of education than traditional university degrees. Micro-credentials "attest to skills acquired or learning undertaken in a short, discrete formats, distinct from longer traditional qualifications such as diplomas and degrees" (UA, 2021, p.4). A benefit is that they can provide evidence of very targeted skills, whereas a degree transcript contains only broad recognition.

Micro-credentials emerged from an array of different change agents such as the development and increasing availability of technology, the increasing cost of university degrees, changes to workforce demands, and reduced trust and value in university degrees from both employers and potential students (Oliver, 2019; Williams, 2019). Unbundling traditional degrees and introducing micro-credentials is having a gradually increasing impact on higher education in terms of flexibility and other challenges.

Indeed, the literature identified a number of challenges regarding the design and implementation of micro-credentials in a university setting. These include learner identity verification and security of assessment (Catalano & Doucet, 2013); how to provide support and feedback to learners (Conole, 2015; Czerniewicz, 2018); high drop-out rates and low completion rates (Anderson, 2013); ensuring the consistent quality of micro-credentials (Dawson et al., 2015; Gallagher & Maxwell, 2019; Oliver 2019); overcoming ethical challenges such as building trust and archiving (Willis et al., 2016); and ensuring the recognition of micro-credentials by other institutions and employers (Dawson et al., 2015; Oliver, 2021; UA, 2021). Many of these issues arise as micro-credentials in Australia are largely unregulated – for example, they are not part of the *Australian Qualifications Framework* (AQF) (UA, 2021). However, guidance is offered in the *Review of the Australian Qualifications Framework Final Report 2019* [the AQF Review], which indicates that the AQF could be broadened in the future to include micro-credentials (Australian Government, 2019).

It is not the purpose of this document to present a comprehensive report, rather it aims to synthesise relevant literature to inform the use of micro-credentialing for university educator's professional learning. The report was reviewed and updated in November 2021, and is based around the five key themes identified in a systemic literature review first conducted in 2019. Appendix A is a graphic illustrating the initial approach. The themes of this report are frameworks, consistency and quality, design, assessment, and platforms/delivery approaches.

Methodology

This project firstly used a systemic approach to identity key themes, and then expanded the literature review using a critical lens to assure depth and currency. The methods used are as follows:

Initial search strategies for the systemic review (2019)

1. Search relevant academic databases:

    a. Databases searched: ERIC: Education Resources Information Center (ProQuest); Informit A+ Education; Scopus.

    b. Micro-credentialing search terms: micro-credentialing, stacking, unbundling, competency-based education, badge.

    c. Higher education search terms: higher education, tertiary education, university.

2. Search relevant grey literature with search terms:

    a. Grey literature was sourced from university websites investigating/ implementing micro-credentialing, academic databases as listed previously, and government websites.

    b. Search terms: as listed previously.

3. Read abstracts of articles identified so far, and exclude irrelevant articles.

4. Read the full-text of relevant articles, and identify major themes within the literature.

Secondary approach (2021)

5. Critical review - further investigation of the major themes identified in the original literature, using a qualitative approach.

6. Expansion to include additional search terms: micro-credentials (and microcredentials); educators; quality; portability; professional development; digital badge; gamification; credential ecology.

7. A scan of commercial websites and industry updates to assure currency.

8. A review of relevant reports and policy documents published in 2021.

9. An expanded search of international frameworks.

Australian governance landscape

Australian educational frameworks and government policies and initiatives are briefly summarised in this section, and their relevance to micro-credentials is further expanded upon throughout this paper.

- The *Australian Qualifications Framework* is the national policy for regulated qualifications in Australian education and training. It incorporates the qualifications from each education and training sector into a single comprehensive national qualifications framework (AQF, 2013).

- The *Higher Education Standards Framework* (Threshold Standards) sets the standards that a provider must meet, and continue to meet, to be registered to operate as a higher education provider in Australia. The Threshold Standards underpin and provide assurance of quality and integrity in the delivery of Australian higher education (Commonwealth of Australia, 2021).

- *Job-ready Graduates* is a publication by the Australian Government (2020). It promises a "dedicated funding stream for universities to carry out the vital functions of engagement with industry, development of industry-relevant course material, optimisation of course mix for local economies, and provision of work-integrated learning opportunities for students" (Higher Education Reform Package, 2020, p.24).

- The Microcredentials Marketplace is an initiative from the Australian Government (2020). It is a $4.3 million fund to build and operate an online micro-credentials marketplace, and is described as a platform which will allow a comparison of short courses and help learners to understand how they can be stacked and used for credit towards a complete qualification (Tehan & Cash, 2020). In July 2021, the Universities Admissions Centre announced that it would be building the Microcredentials Marketplace, and consultation had occurred.

- The Heads of Agreement for Skills Reform, known as the National Skills Agreement, was announced by the Australian Government in August 2020, and one of its goals is to develop and fund nationally accredited micro-credentials in the VET sector in 2022 (Department of the Prime Minister and Cabinet, 2020).

Frameworks

Micro-credential frameworks and educators

The review of literature found that a number of micro-credentialing frameworks have been developed specifically for the professional development (PD) of teaching staff, in both primary/secondary education and in higher education (Bartz & Kritsonis, 2019; Brauer & Siklander, 2017; Copenhaver & Pritchard, 2017; Dyjur & Lindstrom, 2017; Gamrat, et al., 2014; Powell, et al., 2018). A successful framework allows for learning to be recognised towards formal qualifications, and be portable across national and international boundaries.

In the UK, the Higher Education Academy (HEA) *Professional Standards Framework* (PSF) underpins the Educational Fellowship Scheme (EFS). The EFS awards fellowships that broadly reflect current practice, ongoing professional development, and contribution to student learning. It has descriptors which align to career development stages and the associated HEA recognition – Associate Fellow, Fellow, Senior Fellow, Principal Fellow (HEA, 2011). The PSF aims to:

- promote the professionalisation of teaching and learning support within the HE sector;
- foster creative and innovative approaches to teaching and learning;
- enable HE staff to gain recognition and reward for developing their capabilities as teachers and supporters of learning;
- facilitate and support the design and delivery of initial and continuing education development programmes and activities;
- demonstrate to students and other stakeholders the professionalism that staff and institutions bring to teaching and support for student learning; and
- support senior staff seeking to:
  - develop policies and systems for the recognition and reward of teaching and learning support staff
  - promote a strong culture of teaching and learning support (HEA, n.d., p.2).

In Australia, Chalmers and Gardiner (2015) investigated university educators' PD outcomes and evaluation, and a key research finding was around the newly derived position of academic developer, with the authors noting that "academic developers require a relevant, rigorous, yet flexible framework, to guide their collection and analysis of data which can be used to demonstrate effectiveness and inform future practice" (p.82). The resulting *Academic Professional Development Effectiveness Framework* was trialled by nine Australian

universities, using both qualitative and quantitative data over the short and long term to assure evaluation of a PD program's effectiveness over time. Aspects of this research and framework are further discussed later in this paper, and consideration is given to the expansion of the framework to encompass all university educator roles.

The Australian Universities' Provision of Professional Learning: Environmental Scan (CAULLT, 2019), summarised the findings from a survey of 38 Australian tertiary institutions, and noted a wide range of frameworks and provisions for PD. The report made six proposals for consideration, which included consensus on a national Australian teaching standards framework to underpin quality teaching (wherein the framework was contextualised with reference to Aboriginal and Torres Strait Islander peoples), transparency around PD for teaching staff, and nationally recognised PD which would be accepted across all universities and governed by a national learning and teaching body (CAULLT, 2019).

Industry frameworks

One of the identified benefits of micro-credentials is they can provide the opportunity for greater integration between providers, employers, and industry (Oliver, 2019). More specifically, micro-credentials allow for targeted learning of specific skills required for different roles, and also provide an accessible and feasible approach for continuing professional development (CPD) and learning (Milligan & Kennedy, 2017; Oliver, 2019).

Industry-based CPD requirements are designed to reflect specific needs and skill sets. Industry CPD frameworks typically require a certain number of CPD hours to be logged over a set period of time. One particular challenge of CPD training is gaining recognition from higher education providers. Additionally, large employers are offering their own competency-based micro-credentials, for example IBM offers open badges (discussed later in this paper), Google has an IT certificate, and Amazon has in-house training[3] (Oliver, 2019). However, non-educational organisations (such as Google) offering micro-credentials can negatively impact on quality assurance (Oliver, 2021).

The Australian Professional Standards for Teachers (AITSL) is an important framework for ongoing PD for all levels of school teachers. The Standards "make explicit elements of high-quality, effective teaching" and encompass four career stages and three domains of teaching: professional knowledge, professional practice, and professional engagement (AITSL, 2021, n.p.). The New South Wales Education Standards Authority (NESA) outlines ways

---

[3] Also see the section in this paper called <u>Platforms and partnerships</u>

universities can be part of assuring teaching requirements in its *Professional Experience Framework*, and has an accreditation process for different teacher career stages. Of particular relevance to this paper is that a higher education provider can apply to have an undergraduate or postgraduate course (or part of) assessed and then registered with NESA; this counts towards ongoing PD and maintaining teacher accreditation (NESA, 2021).

Other examples of industry CPD frameworks and requirements can be found for accountants (CPA Australia, 2019), engineers (Engineers Australia, 2019), and a range of health professions (Australian Health Practitioner Regulation Agency, 2019).

Frameworks for lifelong learning

This section highlights broad frameworks for lifelong learning and is not specific to micro-credentials. Of particular relevance to this review is the OECD *Learning Framework 2030*, which cites the need for a shared language, clear visions and goals for education systems, and a broad set of knowledge, skills, attitudes, and values in action (OECD, 2018). The associated framework (under development) is the OECD *Teaching Framework 2030*, which specifically examines the teacher competencies required to support future students.

The *European Qualifications Framework for lifelong learning* (the EQF) "supports the cross-border mobility of learners and workers, and promotes lifelong learning and professional development across Europe" (EQF, 2018, p. 7). It includes formal, non-formal, and informal learning in its scope.

The World Health Organisation's (WHO) *Global Recognition of Learning Achievement Framework*, is being developed to promote lifelong learning in world-wide through the use of a standardised and systematic approach to awarding credentials in healthcare (WHO, 2021).

Frameworks specifically for micro-credentials

An ongoing topic of debate is the extent to which higher education programmes leading to micro-credentials are, or should be, classified as formal education…The development of coherent micro-credential frameworks could therefore provide a means of organising and orienting existing non-formal education programs across higher education systems by providing a basis for their classification and comparison. (OECD, 2021, p. 7)

Australia

There is currently no national framework or definition for micro-credentials. Universities Australia (2021) recommends alignment of its three recommended standards for micro-credentials with the *Higher Education Standards Framework* (HESF), as the HESF is "used

nationally and is well understood" (UA, p.6). The UA's principle-based standards are discussed later in this paper.

In July 2020, the Open University in Australia published its OpenCreds[4] micro-credentialing framework, which describes "how the Australian education ecosystem can provide a market-leading lifelong learning experience for all Australians" (2020, p.3). It may be used by all education providers in Australia. Types of OpenCreds are:

1. Pathway. This is aligned to a formal qualification level to provide learners and employers with a clear understanding of their level of achievement; and/or successful completion leads to an offer of admission to a formal qualification.

2. Credit-bearing, where successful completion earns credit for learning in a formal qualification, or component part of the body of a course that is part of a qualification. Credit bearing micro-credentials can be stand-alone or stacked.

3. Formal Professional Development. This is recognised by an industry association or accrediting body as meeting the needs towards maintenance of continuing professional development requirements (OpenCreds, 2020, p.5).

Canada

Canada's *National framework for microcredentials* (2021) was recently developed and has seven guiding principles, as follows:

1. Microcredentials can be a complement to traditional credentials (certificate, diploma, degree or post-graduate certificate) or stand alone.

2. Microcredentials are subject to a robust and rigorous quality assurance process.

3. Microcredentials should represent competencies identified by employers/industry sectors to meet employer needs.

4. Microcredentials may provide clear and seamless pathways across different credentials (both non-credit and credit) and may be stackable.

5. Microcredentials are based on assessed proficiency of a competency, not on time spent learning.

6. Microcredentials are secure, trackable, portable and competency is documented in students' academic records.

7. Microcredentials are to follow institutional approval processes (CICan, 2021, p.3).

---

[4] The time allocation for a micro-credential in the OpenCred framework can vary between 2.5 and 150 hours.

Europe

The UK Open University and the digital education platform FutureLearn are two of the partners in the *Common Microcredential Framework* (CMF). The CMF's focus is on short-form micro-credentials and it supports the *European Qualification Framework for lifelong learning* (and other European national qualification frameworks). The CMF has a network of over 400 higher education providers and offers over 3000 MOOCs and short learning programs (EMC, 2019; FutureLearn, 2021). A requirement of the CMF is that learners receive academic credit when a credential is successfully completed. Additionally, the European Union (EU) has a micro-credentials roadmap initiative in progress which aligns EU's stated flexible, transparent and lifelong approach to learning with its legal requirements for a coordinated strategy to promote a skilled, trained and adaptable workforce within micro-credential frameworks and initiatives (EU, 2021).

New Zealand

In July 2021, the New Zealand Qualifications Authority introduced a nationwide micro-credentials framework and register, called the *New Zealand Quality Framework.* The themes of the framework are consistent with those in this review of literature, and include quality assurance, assessment, and credit recognition and transfer (NZQA, 2020, b).

United States

In the US, the National Education Association (NEA) has a list of available credentials for educators, but there is no national supporting framework. The Center for Teaching Quality's *Micro-credential Strategy Framework* supports professional development for educators and can be used for decisions and tasks associated with planning, launching, and implementing a micro-credential pilot or initiative with a group of educators (CTQ, 2021).

Quality assurance

Quality assurance of micro-credentials is identified as a major consideration (Catalano & Doucet, 2013; Gallagher & Maxwell, 2019; Oliver, 2019), particularly for higher education providers. Ralston (2020), claims that micro-credentials "undermine higher education's traditional mission" (p.2), while other literature is specifically concerned about fragmentation and lack of cohesion. For example, the *Australian Qualifications Framework Review Report 2019*, [AQF Review] recognised an increase in demand for micro-credentials, but also noted the concern about consistency in the way micro-credentials are offered (Australian Government, 2019). A lack of consistency between micro-credential offerings is a specific issue (Oliver, 2019; OECD, 2021), with Oliver (2019) noting that providers need clear policies and procedures to ensure arms-length quality assurance. As an example, one of the standards in Canada's national framework for micro-credentials requires that micro-credentials are subject to a robust and rigorous quality assurance process (CICan, 2021).

Brown et al., (2021) note that agreement on the definition of a micro-credential is "essential to establish standards" (p. 233). This is supported by a draft report commissioned by UNESCO, which suggests that a micro-credential "includes assessment based on clearly defined standards and is awarded by a trusted provider" (Oliver, 2021, p. 4). The European Commission's description (2020) states, "a micro-credential is a proof of the learning outcomes that a learner has acquired after a short learning experience, these learning outcomes have been assessed against transparent standards" (cited in Brown et al., 2021, p. 233). The critical quality assurance measure in these definitions is that the learning is assessed.

Currently in Australia there is no universal process, but rather a number of proposed credentialing approaches. Just some of the differences between these approaches include rewarding the amount of effort required to earn credit, the relative 'size' of the credential,[5] and the security practices involved when awarding credits (e.g., identity verification). In line with Canada's framework, Oliver (2019) confirms that a consistent approach to credentialing can be achieved by applying a set of standards. Indeed, standards, levels of trust, and integrity feature in the UA report (2021), which discusses the importance and value of a credential earned from a trusted provider and associated future implications for ongoing recognition and portability. UA (2021), supports alignment with Australia's *Higher Education Standards Framework* (Commonwealth of Australia, 2021), and recommends three standards, as follows:

1. Micro-credentials have clear evidence of achievement or learning outcome.

---

[5] For example, a micro-credential could be worth between 0.25 and one credit point towards a university subject depending on the time commitment/difficulty/ level/volume of learning

2. Micro-credentials have an understandable unit of exchange.
3. Micro-credentials are quality-assured and verifiable, with sufficient, relevant metadata (UA, 2021, p.6).

Quality assurance is further considered as part of the following Design considerations and Assessment sections of this paper.

Design considerations

The 2019 OECD series, *Trends Shaping Education* highlights how the changing patterns of life and work – accelerated by a growing digital economy – are negatively impacting the uptake of longer and expensive formal education courses and qualifications. Research from Wiley Education Services in the US (2020) found that the issue of affordability and the versatile nature of micro-credentials made them an attractive alternative to committing to enrolling in a full degree. To offer learners speed and flexibility, micro-credentials can be designed as small chunks of learning; they may be developed as a stand-alone module, or modules that are stacked; design using the stacking approach enables micro-credentials offered by universities to form part of a larger, and more recognisable credential (Orr et al., 2020; Ralston, 2020). Stacking is the approach taken in the AQF whereby a Graduate Certificate can articulate into a Masters' Degree, for example. However, not all micro-credentials count towards a parent qualification. Czerniewicz (2018), and Wheelahan and Moodie, (2021) note that *not* having a clear pathway can contribute to fragmentation and undermine the coherence of the curriculum.

The literature noted a number of recommendations for designing and implementing micro-credentials, as follows:

1. Have a clear goal for the micro-credential with structured learning outcomes (Acree, 2016; Brown et al., 2021; Conole, 2015; Oliver, 2019; Wright & Beese, 2016).
2. Consider who will be completing the micro-credential and how this might influence design (Conole, 2015; Newby et al., 2016).
3. Explicitly design into the program mechanisms for motivating participants (Rosenberger, 2019).
4. Allow for personalisation and flexibility in learning (Coleman, 2018; Oliver, 2019).
5. Take advantage of local opportunities and local expertise (Hudak & Camilleri, 2018).
6. Ensure the usefulness of the micro-credential is clear in terms of learning outcomes and applicability to skills and competencies (Coleman, 2018).
7. Use iterative design methods with the use of participant feedback and piloting (Rosenberger, 2019).
8. Evaluate the success of a micro-credential according to individual goals (Stracke, 2017).
9. Include stakeholders in the design process (Brown et al., (2021)

Including stakeholders in the development process has featured as a common theme in the recent literature, for example, the OECD (2020) recommends granting teacher agency in

the development process, and Brown et al., (2021) suggest that employers and professional bodies should be part of the development process for micro-credentials.

While not specific to micro-credentials, the work of Chalmers and Gardiner (2015) is also relevant to the design section of this report, as their paper focussed on PD programs for university educators. The authors found that evaluation should be embedded in the design process. Further, they found that a standard framework for PD can be adapted across different institutions and used as a basis for reflective practice, as well as to develop a narrative, to support curriculum design, to review institutional context, and for benchmarking.

Different pedagogical approaches are evident when designing delivery for large groups of learners in an online context. For example, Dawson et al., (2015), and Anderson (2013), found that cMOOCs[6] use pedagogical concepts such as learner autonomy and learning networks to achieve learning in an online and social media environment. In contrast, xMOOCs[7] apply cognitive-behavioural pedagogies where learning occurs through accessing content and completing assessments, as opposed to connectivist learning through social interactions.

Digital badges are now widely used for recognition and certification, and are employed as pedagogical tools when linked to specific learning outcomes (Hartnett, 2021). When considering badging in a design context, a consideration is that digital badging may encourage students to be more motivated by extrinsic factors, rather than an internal desire for lifelong learning (Gibson et al., 2016). A study by Chou and He (2017) examined students' use of digital badges in enhancing online course participation and interaction, concluding "that there are no intrinsically effective badges; what matters is how they are integrated into the learning activities designed with sound pedagogy" (p. 1113). The study also noted possible issues around the workload of issuing digital badges. Achievement of digital badges is an interactive and goal-orientated approach that can act as a motivator for improving student performance - they promote competitiveness in learning and gamify learning, and can also be designed as an approach to education using technology (Copenhaver & Pritchard, 2017; Gibson et al., 2013; James, 2018; Willis et al., 2016).

Gamification is a learning and teaching approach that uses game-like elements in course materials to engage and motivate learners (Commonwealth of Australia, Australian Curriculum, 2021). Proponents of gamification suggest it may be a powerful pedagogical tool to enrich and extend learning and increase student engagement (Coleman, 2018; Gordon, 2014; James, 2018). Copenhaver and Pritchard (2017) found that employing the principles of

---

[6] The original type of MOOC - groups of people learning together and contributing to the course
[7] xMOOCs have a more traditional structure, centred around the lecturer delivering instruction to students

gamification through micro-credentialing overcame many of the challenges (e.g., time and place) within traditional professional development programs. Furthermore, they found the depth of content delivered increased when learners could self-direct their training and assessment based on their individual needs and progress. Gordon (2014) also identified the use of gamification as a way to support new pedagogic approaches.

The research around design considerations is vast and evolving, although micro-credential design research targeted for university educators is scarce. A backward design approach was mentioned in the literature both for curriculum design, and as a way to position an individual micro-credential in a stack/bundle or larger group of credentials. Other findings are that design should sit within a transferable framework, it should be collaborative, and curriculum content and assessment should be engaging, personalised, and flexible. Assessment is further discussed in the following section.

Assessment

There are different approaches and considerations when designing and implementing assessment for micro-credentials. This is due, in part, to the conflicting definitions of micro-credentials, centered on the inclusion (or exclusion) of assessment. Employers, stakeholders, and learners must be able to trust that learning outcomes can be assessed after a *short*[8] learning experience (Brown et al., 2021; EMC, 2019). Evidence of the achievement of learning outcomes is not only vital to establish and maintain standards, but also critical for recognition and the portability of micro-credentials (Brown et al., 2021; Oliver, 2019; UA 2021).

In Australia, assessment in higher education is aligned with AQF levels and criteria, with each level having prescribed standards and goals, and learning measured against specific criteria. However, there is currently no governing framework for micro-credentials in Australia. In Europe, microcredentials need to demonstrate that a reliable form of assessment was undertaken to be considered for inclusion in the *European Qualifications Framework for lifelong learning* (Hudak & Camilleri, 2018). Assessment of a micro-credential acknowledges achievement in particular and specific elements of a competency, skill or knowledge.

Much of the recent literature refers to competency-based assessment approaches, due to the nature of micro-credentials and the changing expectations of leaners and employers. For example, a qualitative study of competency-based hiring in the US found that "microcredentials offer merit to an applicant's transcript while highlighting skills gained in an authentic setting. This validation provides employers with a clear understanding of a candidate's abilities before extending an employment offer" (Gauthier, 2020, p. 5). The Organisation for Economic Co-operation and Development's (OECD) position paper also linked changing educational needs with the concept of competency, noting that competency "implies more than just the acquisition of knowledge and skills; it involves the mobilisation of knowledge, skills, attitudes and values to meet complex demands" (2018, p. 5).

Personalisation and flexibility are features of assessment in micro-credentials. The Australian Federal Government's Higher Education Reform Package (2020), advocates for "an education system that supports innovative forms of learning and features flexible approaches to education and training that provide tailored learning solutions" (p.8). This aligns with the literature, which supports an approach where micro-credential pedagogies accommodate the flexible and personalised nature of learning (for example: Bartz & Kritsonis, 2019; French & Berry 2017; Gordon 2014; Oliver 2019).

---

[8] Also see Volume of learning

Various approaches can be adopted provided that they assure quality and authenticity. Peer-assessment, industry assessment, e-portfolios, capstone assessment, and self-assessment are all mentioned in the literature. For example, Brown et al., (2021) noted that "portfolio-based assessment drawing on evidence and critical reflections gathered over time through professional practice should be able to contribute to a micro-credential" (p.249). When considering peer-assessment, Oliver (2019) observed the need for supervision, stating that "peer-assessment is frequently used in micro-credentials, but if it is the only method of assessment, learners may feel unsatisfied – and employers sceptical – when assessment does not have expert oversight" (p. 22). When developing Canada's framework, researchers noted that assessment of micro-credentials could take place as a capstone task in a similar way to a capstone subject in a degree program. The capstone is assessed online or in-person, depending on the study area, with some providers recommending partnerships with industry for the capstone assessment. The research also noted that self-assessment was a future goal of some institutions (CICan, 2021). Capstone assessment and self-assessment approaches could be considered in the context of professional development in higher education to assess a stacked group of smaller units of learning.

Assessment, micro-credentials and PD for teachers

In a study of personalised professional development for teachers, French and Berry (2017), noted that micro-credentials refine and strengthen skills by focussing on "a variety of competencies, from highly granular aspects of teaching …to leadership and assessment literacy" (p. 39). In the context of professional development for school teachers, flexible delivery and content were described as important considerations when developing assessment tasks. For example, French and Berry (2017) found that professional development "needs to be of a granular size so that teachers can engage in it during a hectic school year" (p.38), and noting that individual micro-credentials were a preferred option for PD. This is supported by Bartz & Kritsonis (2019) who proposed that the traditional form of PD, which involves whole group instruction in a day-long format, is outdated and ineffective, and recommended professional development tailored to individual needs. Other literature supported these findings, outlining that personalisation and learner flexibility are important components of PD courses for educators (Brauer & Siklander, 2017; Copenhaver & Pritchard, 2017; Dyjur & Lindstrom, 2017; Gamrat et al., 2014).

Learner authenticity

The review of literature found that authenticating the identity of learners, security of certification, and security of data are challenges in the ever-evolving digital landscape. Authenticating learner identity maintains institutional credibility, endorses previous qualifications, and upholds academic integrity by preventing impersonation and identity fraud. However, current systems and tools have limitations.

In 2019, Oliver reported that "security and privacy issues will be of paramount concern and crucial to winning learners' confidence" (p.34), and, in 2018, UNESCO recommended a common approach for portability underpinned by electronic certificates/documents that could be shared, authenticated, and accessed anytime and anywhere (UNESCO, 2018). Online learner authentication is of critical importance, and the more factors "incorporated by the authentication system, the more robust it is" (Grassi, 2017, in Laamanen et al., 2021, n.p.). Other issues and approaches to security using digital badges, blockchain, and e-Quals, are further discussed in this section.

Digital badges

A digital badge is a visible digital representation of achievement. Digital badges are now widely recognised as validated indicators of accomplishment awarded for completing a set task, competency, or course (Hartnett, 2021; James, 2018). Digital badges offer an alternative to traditional university transcripts, contain detailed information and meta-data about achievement, and can be generated by the online platform used to deliver the micro-credential (Gibson et al., 2013; Hartnett, 2021).

The literature uncovered some concerns with regard to the use of digital badges. For example, there are security and verification issues around badges because any organisation or training company can award a digital badge to acknowledge achievement (Hartnett, 2021). Research into the perceptions and uses of digital badges for professional leaning in higher education found that "the appearance of a digital badge affects its perceived credibility" (Dyjur & Lindstrom 2017, p. 391). Also, in the context of higher education, Hartnett (2021) noted that factors influencing the acceptance of digital badges included organisational culture, finding that:

> Implementers of digital badging systems need to ensure staff understand the value and credibility of digital badges, and staff responsible for awarding digital badges need to be involved in decisions about how and why they are used beyond individual units of study. (Hartnett, 2021, p. 104)

Badges are also discussed in the section called Platforms and partnerships.

Blockchain

Blockchain is a relatively new technology which offers diverse applications, including automated and secure credentialling, and the ability to share tamper-proof digital information which can be shared with universities and employers (Williams, 2019). Blockchain systems can also be used to record attendance and payments.

Jirgensons & Kapenieks (2018) found that blockchain technology "creates an infrastructure to document, store, and manage credentials" (p. 145), noting that universities which have so far adopted blockchain "do *not* have to act as credential gatekeepers for student populations" (Jirgensons & Kapenieks, 2018, p. 147). Indeed, by using blockchain each learner is issued with a unique, permanent, verifiable, and trustworthy credentialing portfolio. Learners can manage their own portfolio instead of depending on their university or employer. However, a recent qualitative research study (Kishore et al., 2021), found there is a lack of general knowledge about using blockchain technology in the context of micro-credentials, and this lack of understanding is currently preventing wider uptake.

e-Quals

e-Quals is a secure platform used and operated by tertiary education providers in Australia and New Zealand to view, share and verify digital documents. The e-Quals platform is used to issue degree award certificates, academic transcripts, and AHEGS statements, but can also be modified for badges and other formal digital documents. e-Quals data are stored in Australia.

Volume of learning

Standardisation of the volume of learning is identified as an important theme when considering quality and consistency in the micro-credentialing eco-system (AQF Review, 2019; UA, 2021). Learners and employers want to better understand how a micro-credential compares with a traditional university degree (Brown et al., 2020). In Australia, micro-credentials can be implemented at all levels of learning, with universities in Australia offering credentials up to postgraduate level – AQF levels 8 and 9.[9] Under the AQF, this level of coursework qualification typically has 10-13 weeks of traditional on-campus study, usually equating to 130-150 hours for one subject/unit. Volume of learning expressed in hours is consistent with the AQF Review (2019), and the OpenCred framework. Therefore, when developing micro-credentials specifically to upskill university educators (including librarians, learning advisors and others) providers may choose to align the credential with an equivalent volume of learning and the level of skills and knowledge required for AQF-level 8 or 9 postgraduate study, and split the learning into manageable chunks which can provide academic credit on successful completion.

Academic credit

The approach used for awarding credit is one of the biggest challenges to the value of a micro-credential. When discussing credit-bearing micro-credentials in the higher education context, Oliver (2019) outlines a comprehensive list of standards which could be applied (p. 47, see Appendix C of Oliver's paper). As with the previously mentioned UA approach, these standards are based on Australia's *Higher Education Standards Framework* (Commonwealth of Australia, 2021).

Micro-credentials vary in length and difficulty, and can be stacked into credit towards a traditional university qualification (James, 2018). The AQF Review (2019) suggested that there should be a common credit point system in Australia, for the benefit of students and to streamline credit transfer processes for providers. In its submission to the AQF Review, the Council for International Education's Expert Members noted that with no national credit point system, Australian qualifications lacked portability and international recognition (in the AQF Review, 2019). Further, the AQF Review stated that "expressing all learning outcomes in the same format could encourage credit transfer and signal the equivalence in value of learning from all sectors in the Australian education and training system to learners and overseas

---

[9] Level 9 – Master's degree, Level 8 – Graduate Certificate and Graduate Diploma.

audiences" (Australian Government, 2019, p. 70). This finding aligns with the report from Universities Australia (2021), which suggests that for micro-credentials to be portable they must contain information that can be understood and exchanged across Australian providers, and in the future, have a global reach.

When considering global reach, recognised credentialing frameworks (outside Australasia) which also provide insight into awarding credit within micro-credentials include The Quality Assurance Agency in the UK, the European Credit Transfer and Accumulation System, The International Certification Accreditation Council, the American National Standards Institute, and the Institute for Credentialing Excellence (Gallagher & Maxwell, 2019; Oliver, 2019).

Enabling Recognition of Prior Learning (RPL)

"Learners, universities and employers have an interest in a common standard to support lifelong learning" (EMC, 2019, p.1). This is supported by UNESCO (2018), which advocates for supporting the recognition of lifelong learning within countries and across borders, noting that "digital credentials have the potential to enable the recognition of prior learning" (p. 37). Formal recognition of micro-credentials connects with already established university processes for recognition of prior learning (RPL). Friesen and Wihak (2013) discuss ways that existing processes for RPL within universities could be modified and applied to the recognition of micro-credentials across different providers. In Australia, Deakin University offers Professional Practice credentials which are used as pathways to higher education (Selvaratnam & Sankey, 2021, p.7).

RPL processes can be inexact and time consuming, leading to a number of issues with assuring the quality of a student's learning as well as maintaining a positive student experience (Oliver, 2019; Orr et al., 2020). Overall, while RPL approaches may be useful in recognising micro-credentials across institutions, there are a number of challenges to be considered. For example, Oliver (2021) reported that consensus has *not* yet been achieved regarding the inclusion of RPL in the proposed micro-credential definition #3, which suggests "a micro-credential has stand-alone value and may also contribute to or complement other micro-credentials or macro-credentials, including through recognition of prior learning" (p. 16).

Formal study *and* RPL are recognised in the *New Zealand Quality Framework* (2021). "RPL leads to credit being awarded for existing skills, knowledge, and attributes acquired without regard for the length, place or method of learning (e.g., workplace, life experience, hobbies, self-directed study)" (NZQA, 2020, b, p. 3). Therefore, micro-credentials earned in

the workplace can be assessed for level and credit value by the New Zealand Qualifications Authority (NZQA), which then provides an employer/professional body with a statement of equivalency (NZQF, 2021); this supports the employer and the learner. The NZQA has a number of approaches to mitigate concerns about trust and quality in the context of RPL. For example, there are formal guidelines in place for tertiary education organisations (TEOs)[10] to "develop and implement regulations, policies and processes that assist learners to have their relevant learning recognised and credited" (NZQA, 2020, b, p.1). A national quality assurance policy is in place to enact the guidelines, and TEOs may be audited as part of the NZQA external review process.

---

[10] In NZ, a tertiary education organisation (TEO) is any organisation that supplies tertiary education and/or training and/or assessment services.

Platforms and partnerships

The literature review has already discussed a number of different providers and platforms which can be used for building and delivering micro-credentials. While the distinction between a provider and platform can be blurred, a provider is broadly understood as an organisation, university, industry employer, or sometimes a community-based organisation that delivers a micro-credential (Gallagher & Maxwell, 2019).

In Australia, TEQSA has four provider categories: an Institute of Higher Education, an Australian University, an Overseas University, and a University College. Within these four categories are self-accrediting authorities (SAA) and non-self-accrediting authorities. All Australian Universities are SAAs (TEQSA, 2021). It is anticipated that over 50 providers in Australia will join the Microcredentials Marketplace.

Overseas, The UNESCO Institute recognises the Open Badges Standard which encompasses a variety of organisations that supply digital badges. Open Badges is not a specific product or platform, rather a type of digital badge. Selvaratnam and Sankey (2021), outline the importance of providers being able to navigate the multitude of systems and platforms when selecting a resource, and further note that credentials gained must be visible to all stakeholders and not locked behind a Learning Management System (LMS).

At the time of writing, there are numerous open badging platforms,[11] with Credly (Credly Acclaim), and Badgr (Mozilla) being widely used across Europe, North America, and in Australasia. These platforms design and issue certificates and badges[12] which can then be shared immediately to smart phone wallets and social media platforms by learners. Learning Management Systems, for example, Canvas and Blackboard utilise Badgr's services to generate certificates and badges.

Co-constructing micro-credentials in partnership with employers and specific industries has been mentioned previously in this paper as part of the design process, (see for example Brown et al., 2021; Oliver 2019), and is already common practice in Australian universities when developing new degree programs, especially those degrees dependant on professional accreditation. University partnerships for micro-credentials include partnerships with commercial entities and community needs. For example, in the US, Northeastern University was the first higher education institution to set up a partnership with IBM (in 2017) to integrate IBM's in-house education programs with the university's academic credit system. The IBM

---

[11] November 2021
[12] Promotes by Badgr as branded learning eco-systems

micro-credentials articulate into Master's-level degree programs (Northeastern University, 2017).

The micro-credentials eco-system is constantly evolving. In February 2020, Dublin City University in the Republic of Ireland applied the European CMF as its framework and launched the "first credit-bearing, stackable, fully online micro-credential through the Future Learn platform" (Brown et al., 2021, p. 234). Many platforms now integrating micro-credentials into the wider eco-system (some of which began as MOOC platforms). Examples are Coursera, EdX, FutureLearn, Kadenza, and Udemy. A sample of partnerships includes:

- Universities using Credly Acclaim, for example Charles Darwin University, also see Table 1.
- CPA partnering with Credly.
- Credly badges showing on the LinkedIn platform.
- Universities offering micro-credentials and short courses through FutureLearn, Coursera, and OpenLearning. For example, in 2020, FutureLearn partnered with Dublin City University, the Open University, Deakin University, The University of California, Irvine Division of Continuing Education (DCE), Monash University, and Queensland University of Technology.

A specific example of relevance to this research is the Open University's targeted micro-credential designed for educators, called Teacher Development: Embedding Mental Health in the Curriculum. The credential is positioned at postgraduate level and qualifies for 15 academic credits at UK level 7 (postgraduate level 8 in Australia).

A snapshot of partnerships is further illustrated in Table 1. An environmental scan of 10 Australian universities,[13] conducted in October 2021, lists providers, platforms and certification. It shows that some universities use a third party for the provision of a certificate/badge, some offer an internal credential, and some use a combination of both.

---

[13] These 10 universities were selected as they ranked highest on a Google search for micro-credentials +Australia +university in mid-October 2021. They are presented in alphabetical order.

Table 1. Environmental scan of 10 Australian universities (snapshot)

Australian Providers	Platform used	Example(s)	Certification/badge	Notes
Bond	Blackboard	Professional development programs - 4 courses, 10 hours per course	Digital Certificate of Achievement	No academic credit
		Building Information Modelling – one semester on campus, four courses.	University transcript.	Post-graduate level – RPL used for entry. Fully assessed as per degree enrolled students. For credit, promoted as aligning with Bond credit point subjects.
CQU	Moodle - called BeDifferent	Suite of 5 small business micro-credentials[14] plus 149 other courses.	Digital badge (Credly) and Certificate of Completion	2 hours. Not for credit.
		Inclusive Education: Introduction To Working With Students With Disabilities In The Classroom	Digital badge (Credly) and Certificate of Completion	6 hours, online quiz as assessment. Not for credit. Promoted as CPD.
Charles Sturt[15]	Blackboard Is partnered with Open Learning.	Grad Cert in Community Leadership and Resilience. 28 credentials listed.	Credly's digital badge platform	2 CP (35 hours). Also has 4 CP micro-credentials. 8 weeks. Stack to Grad cert then Masters. 5 micro-sessions = start dates.
Deakin	Future Learn	4 courses listed – all lasting between 10-13 weeks	Deakin (badge) and FutureLearn (cert)	1 CP of PG study at Deakin and Griffith
Griffith	Blackboard – moving to Canvas	Over 100 – also see notes column	Credly's digital badge platform	Griffith Credentials include digital badges for achievements, articulated awards, continuing professional development, open credentials, memberships, missions, skills, and work-integrated learning.
Monash	Future Learn	Data Science: Data-Driven Decision Making	Certificate FutureLearn	Aligned with the CMF[16] 6 CP at PG level
	Future Learn	Introduction to Psychology	Certificate Monash	Six units, one unit per fortnight.
RMIT	Canvas	RMIT Creds – designed for students and free for students	Credly's digital badge platform	Preparing for WIL is a 2-hour micro-credential.
		SAS - Academic Specialisation in Analytics		Used for specialisations additional to a Bachelor.

---

[14] Funded by the Department of Employment, Small Business and Training
[15] $12 million from government to expand short courses as part of the JRG.
[16] The Common Microcredential Framework (CMF) is developed by the European MOOC Consortium consisting of FutureLearn (UK), FUN (France), MiríadaX (Spain and IberoAmerica), EduOpen (Italy), and OpenupEd/ the European Association of Distance Teaching Universities (EADTU)

	Future Learn	Decentralised Finance	FutureLearn	4 weeks, 3 hours per week. Free access for six weeks.
Torrens	Blackboard	Blockchain course. Articulates into Grad Cert. 6 weeks. Expensive. Also stand-alone courses that do not articulate.	Smart Skills Digital Badge, uses Credly's digital badge platform	From website: "When you have 6 Digital Badges, you have the option to take an assessment and gain credit towards a formal qualification. This is equivalent to one subject within a complete Torrens University Australia course."
UNSW	Various partnerships	EDST5808 Key Concepts in Gifted Education (6UOC)	Credly's digital badge platform	"Micro-credentials enable you to convert one of our accredited professional learning courses into 6 Units of Credit (UOC) which can be used towards a postgraduate degree in Education."
		Partnered with FutureLearn, Coursera, and Open Learning.	As per platform.	
University of Melbourne	Canvas and Open Badges	Melbourne MicroCerts. example: Teach Digital Safety, Ethics and Wellbeing	Digital Badge, Open Badges platform.	5 weeks. Online. Expensive. Badges - Has a page of example badges – very useful. Example is Evidence-based teaching and learning (42.5 hours) Aligned with AITSL.

Conclusion

"The micro-credentialing movement is not just another passing educational fad"

(Brown et al., 2021, p. 228).

There is growing interest in, and uptake of, micro-credentials in Australia. This paper gives a broad overview of the current landscape while also providing a narrower focus on micro-credentialing for educators. Specifically, the review informed the creation of a taxonomy for university educators. A number of consistent themes were identified throughout the literature, as follows:

1. Definitions: much of the literature explored the issue of finding a common definition for micro-credentials, especially with regard to the inclusion of assessment in that definition. It found that the lack of a common definition can lead to fragmentation and slow uptake.

2. Collaboration: building micro-credential programs in partnership with learners, industry experts, and employers was a consistent theme.

3. Assessment: when assessment *is* included in a micro-credential, the literature noted that formative assessment to authenticate practice with demonstrable learning outcomes is a commonly used approach.

4. Learner expectations: the literature confirmed that learner pathways should be personalised, self-paced, and flexible. Learners expect a micro-credential to provide upskilling, additional knowledge in a specific field, and/or career progression.

5. Validity: credentials are considered valid when issued by a trusted, recognised provider, for example an institution listed on TEQSA's national register. Certificates and badges must be 'future-proofed' using technology that will ensure validity and permanency, and retain legitimacy.

6. Portability: credentials must be shareable across media and portable across universities and countries. To enable this, micro-credentials should be embedded in, or align with, national and international frameworks. The literature confirmed the need for a coherent micro-credential framework in each country, with consistency in volume of learning.

Further considerations for credentialing professional learning for university educators

A taxonomy for micro-credentialing professional learning for university educators provides a guiding structure and approach for use across higher education providers nationally and internationally. It offers recognition and pathways for a variety of staff.

Using the insights gained from this review of literature, it is proposed that the definition of a university educator encompasses academic teaching staff and professional staff who are involved in quality teaching and learning initiatives, for example: librarians, educational designers, academic developers, learning advisors, laboratory technicians, and other learning enhancement staff, such as those working in student retention and transition. The definition of university educator purposefully includes sessional and casual staff members who may often be denied professional development opportunities. It also includes industry-based staff who are engaged in work-integrated-learning, curriculum design, and teaching. Using this approach, the term educator demonstrates the varied contributions that individuals make to student learning.

It is further proposed that three principles underpin the taxonomy:

1. Recognition and value:
    - Authenticity and credibility are essential to the value of a micro-credential, and can be enacted through the adoption of consistent national and international standards.
2. Portability and flexibility:
    - Portability is underpinned by secure electronic certificates/documents that can be shared, authenticated, and accessed anytime and anywhere (UNESCO, 2018). Portability is considered in the design stage.
    - Flexibility is required for the mode, timing, and delivery of micro-credentials for university educators.
3. Quality design and assessment:
    - Designing micro-credentials for university educators facilitates lifelong learning and promotes a culture of professionalism. Design and assessment follow prescribed quality frameworks and standards and support recognition and reward in teaching and learning. The literature recommended a collaborative approach to the development of micro-credentials. TEQSA's online learning

good practice website has assessment integrity resources which can be applied to assessment in micro-credentials.

In summary, the UK's *Professional Standards Framework* (PSF) - which underpins the Educational Fellowship Scheme (EFS), the evaluation of the *Academic Professional Development Effectiveness Framework* (Chalmers & Gardiner, 2015), and the *Australian Universities' Provision of Professional Learning Report* (CAULLT, 2019), have provided the inspiration for the development of a taxonomy which is responsive to the needs of university educators. The literature demonstrated the potential of micro-credentials in providing high-quality, personalised continuing professional development for educators, when applied within a coherent framework. This framework can be developed within an institutional context and using existing systems.

References

For a regularly updated account of reports, policies and research in this area the authors recommend accessing the Research Observatory on Micro-credentials complied by the US National Institute for Digital Learning and the European Consortium of Innovative Universities.

Acree, L. (2016). Seven lessons learned from implementing micro-credentials. In M. A. Wolf & A. Dreier (Eds.), *Raleigh, NC. Friday Institute for Educational Innovation at the NC State University College of Education*. https://www. fi.ncsu.edu/wp-content/uploads/2016/02/microcredentials

Anderson, T. (2013). Promise and/or peril: MOOCs and open and distance education. *Commonwealth of Learning,* 3, 1-9.

Australian Institute for Teaching and School Leadership. (2021). *Australian Professional Standards for Teachers*. https://www.aitsl.edu.au/teach/standards/understand-the-teacher-standards

Australian Government, (2019). *Review of the Australian Qualifications Framework Final Report 2019*. Department of Education, Skills and Employment. www.dese.gov.au/higher-education-reviews-and-consultations/resources/review-australian-qualifications-framework-final-report-2019

Australian Health Practitioner Regulation Agency (AHPRA). (2019). *Continuing Professional Development*. https://www.ahpra.gov.au/Registration/Registration-Standards/CPD.aspx

Australian Qualifications Framework Council. (2013). *Australian Qualifications Framework*. 2nd Edn. www.aqf.edu.au

Bartz, D. E., & Kritsonis, W. A. (2019). Micro-credentialing and the individualized professional development approach to learning for teachers. *National Forum Teacher Education Journal*, 29(3), 1-11.

Brauer, S., & Siklander, P. (2017). *Competence-based assessment and digital badging as guidance in vocational teacher education.* Paper presented at the Me, Us, IT! Proceedings ASCILITE2017: 34th International Conference on Innovation, Practice and Research in the Use of Educational Technologies in Tertiary Education Toowoomba: University of Southern Queensland.

Brown, M., Nic Giolla Mhichil, M., Beirne, E., MacLochlainn, C. (2021, July). The Global Micro-credential Landscape: Charting a New Credential Ecology for Lifelong Learning. *Journal of Learning for Development*. 8(2), 228-254.

Case, R. E. (2008). Independent learning and test question development: The intersection of student and content. *Assessment Update, 20*(1), 5-7.

Catalano, F., & Doucet, K. J. (2013). *Digital 'badges' emerge as part of credentialing's future*. New York, NY: Professional Examination Service.

Center for Teaching Quality. (2021). *Micro-credential Strategy Framework.* https://www.teachingquality.org/developing-a-micro-credential-strategy-a-framework/

Center on Innovations in Learning. (2018). *Micro-Credentials for Competency-Based Learning. A Solution-Finding Report*. In Center on Innovations in Learning, Temple University. Philadelphia, PA 19122. 1-30.

Chalmers, D. & Gardiner, D. (2015). An evaluation framework for identifying the effectiveness and impact of academic teacher development programmes. *Studies in Educational Evaluation*, Vol. 46, 81-91. https://doi.org/10.1016/j.stueduc.2015.02.002

Chou, C., & He, S-J. (2017). The Effectiveness of Digital Badges on Student Online Contributions. *Journal of Educational Computing Research*, 54(8), 1092–1116. https://doi.org/10.1177/0735633116649374

Cheng, Z., Watson, S. L., & Newby, T. J. (2018). Goal setting and open digital badges in higher education. *TechTrends, 62*(2), 190-196.

Coleman, J. D. (2018). Engaging undergraduate students in a co-curricular digital badging platform. *Education and Information Technologies, 23*(1), 211-224. DOI:10.1007/s10639-017-9595-0

Colleges & Institutes Canada. (2021, a). *National framework for microcredentials*. https://www.collegesinstitutes.ca/policyfocus/micro-credentials/

Colleges & Institutes Canada. (2021, b). *The Status of Microcredentials in Canadian Colleges and Institutes. Environmental Scan Report*. Colleges and Institutes Canada (CICan).

Commonwealth of Australia. (2021). Higher Education Standards Framework (Threshold Standards). *Tertiary Education Quality and Standards Agency Act 2021*. The Department of Education, Skills and Employment.

Commonwealth of Australia. (2021). *Gamification*. The Department of Education, Skills and Employment. https://www.dese.gov.au/australian-curriculum/national-stem-education-resources-toolkit/i-want-know-about-stem-education/different-kinds-stem-education-initiatives/gamification

Conole, G. (2015). Designing effective MOOCs. *Educational Media International, 52*(4), 239-252.

Copenhaver, K., & Pritchard, L. (2017). Digital badges for staff training: Motivate employees to learn with micro-credentials. *Journal of Electronic Resources Librarianship,* 29(4), 245-254.

CPA Australia. (2019). *Ways to Complete CPD*. www.cpaaustralia.com.au/member-services/continuing-professional-development/ways-to-complete-cpd

Council of Australasian University Leaders in Learning and Teaching. CAULLT. (2019). *Australian Universities' Provision of Professional Learning: Environmental Scan.* https://www.caullt.edu.au/wp-content/uploads/2019/12/Final.2-CAULLT-Professional-Learning-Report.pdf

Czerniewicz, L. (2018). Unbundling and rebundling higher education in an age of inequality. *Educause Review.* https://er.educause. edu/articles/2018/10/unbundling-and-rebundling-higher-education-in-an-age-of-inequality

Daniel, J. (2012). Making sense of MOOCs: Musings in a maze of myth, paradox and possibility. *Journal of interactive Media in education*, 2012(3).

Dawson, S. J., S. Kovanovic, V. Gasevic, D. Siemens, G. (2015). *Recognising learner autonomy: Lessons and reflections from a joint x/c MOOC.* Paper presented at the Higher Education Research and Development Society of Australia, 2015.

Department of Education, Skills and Employment. (2020). *Job-ready Graduates.* DESE, Higher Education Reform Package. https://www.dese.gov.au/job-ready/resources/job-ready-graduated-discussion-paper

Department of the Prime Minister and Cabinet. (2020, August). *Heads of Agreement for Skills Reform.* https://www.pmc.gov.au/resource-centre/domestic-policy/heads-agreement-skills-reform%20

Dimitrijevic, S., Devedzic, V., Jovanovic, J., & Milikic, N. (2016). Badging Platforms: A Scenario-Based Comparison of Features and Uses. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundations of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies*. Switzerland: Springer.

Dyjur, P., & Lindstrom, G. (2017). Perceptions and uses of digital badges for professional learning development in higher education. *TechTrends*, 61(4), 386-392. DOI:10.1007/s11528-017-0168-2

Ellis, L. E., Nunn, S. G., & Avella, J. T. (2016). Digital badges and micro-credentials: Historical overview, motivational aspects, issues, and challenges. In D. Ifenthaler, N.

Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials* (pp. 3-21). Switzerland: Springer.

Engineers Australia. (2019). *Continuing Professional Development (CPD).* https://www.engineersaustralia.org.au/Training-And-Development/Continuing-Professional-Development

European MOOC Consortium. (2019). *EMC Common Microcredential Framework.* https://emc.eadtu.eu/images/EMC_Common_Microcredential_Framework_.pdf

European Union. (2018). *European Qualifications Framework - supporting learning, work and cross-border mobility.* Luxembourg: Publications Office of the European Union.

European Union. (2021). *Micro-credentials – broadening learning opportunities for lifelong learning and employability – Roadmap.* February 2021. https://ec.europa.eu/info/law/

French, D. & Berry, B. (2017). Teachers, Micro-Credentials, and the Performance Assessment Movement. *Voices in Urban Education*, n46, 37-43.

Friesen, N., & Wihak, C. (2013). From OER to PLAR: Credentialing for open education. *Open Praxis, 5*(1), 49-58.

FutureLearn (2021). *What is the Common Microcredential Framework?* https://www.futurelearn.com/info/the-common-microcredential-framework

Gallagher, S., & Maxwell, N. L. (2019). *Community Colleges and the New Era of Work and Learning. Working Paper 66.* https://eric.ed.gov/?id=ED594041

Gamrat, C., Zimmerman, H. T., Dudek, J., & Peck, K. (2014). Personalized workplace learning: An exploratory study on digital badging within a teacher professional development program. *British Journal of Educational Technology*, 45(6), 1136-1148. DOI:10.1111/bjet.12200.

Gauthier, T. (2020). The value of microcredentials: The employer's perspective. *Competency-based Education.* Western Governors University. https://doi.org/10.1002/cbe2.1209

Gibson, D., Ostashewski, N., Flintoff, K., Grant, S., & Knight, E. (2013). Digital badges in education. *Education and Information Technologies*, 20(2), 403-410.

Gibson, D., Coleman, K., & Irving, L. (2016). Learning journeys in higher education: Designing digital pathways badges for learning, motivation and assessment. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies.* 115-138.

Gedeon, S. A. (2019). Theory-based design of an entrepreneurship microcredentialing and modularization system within a large university ecosystem. *Entrepreneurship Education and Pedagogy.* 0(0), 1-22.

Gordon, N. (2014). *Flexible Pedagogies: Technology-enhanced learning*: The Higher Education Academy. DOI:10.13140/2.1.2052.5760.

Grant, S. (2016). Building collective belief in badges: Designing trust networks. In D. IFenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials : Demonstrating and Recognizing Knowledge and Competencies*. Switzerland: Springer.

Hartnett, M. (2021). How and why are digital badges being used in higher education in New Zealand? *Australasian Journal of Educational Technology*, 37(3).

Hamson-Utley, J., & Heyman, E. (2016). Implementing a badging system faculty development. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies* (pp. 237-258). Switzerland: Springer.

Higher Education Academy. (2011). *Professional Standards Framework*. UK. https://www.heacademy.ac.uk/

Higher Education Academy. (n.d.). *What is the UK Professional Standards Framework?* https://www.heacademy.ac.uk/

Hudak, R. & Camilleri, A. (2018). *The Micro-credential User's Guide.* MicroHe Consortium. https://microcredentials.eu/wp-content/uploads/sites/20/2021/05/D3_3_MicroHE-Users-Guide.pdf.

Iansiti, M., & Lakhini, K. (2017). The Truth About Blockchain. *Harvard Business Review.* January-February 2007. https://hbr.org/2017/01/the-truth-about-blockchain.

James, N. (2018). *A Critical Evaluation of Micro-Credentialing and Stacking in Legal Education*. Paper presented at the Sino-Australian Law Deans Conference, Wuhan, China.

Jansen, D., Rosewell, J., & Kear, K. (2016). Quality frameworks for MOOCs. In J. Mohamed, K. Kinshuk, & M. Koutheair (Eds.), *Lecture Notes in Educational Technology* . 261-281. Berlin Heidelberg: Springer.

Jirgensons, M. & Kapeniek, J. (2018). Blockchain and the Future of Digital Learning Credential Assessment and Management. *Journal of Teacher Education for Sustainability,* vol. 20, no. 1. 145-156. https://files.eric.ed.gov/fulltext/EJ1218203.pdf.

Johnson, D. L. (2008). Collaborative Development of Assessments at Western Governors University. *Assessment Update, 20*(1), 10-16.

Kishore, S., Chan, J., Muthupoltotage, U.P., Young, N., & Sundaram, D. (2021). *Blockchain-based Micro-credentials: Design, Implementation, Evaluation and Adoption.* 10.24251/HICSS.2021.821.

Laamanen, M., Ladonlahti, T., Uotinen, S., Okada S., Bañeres D., & Koçdar S. (2021). Acceptability of the e-authentication in higher education studies: views of students with special educational needs and disabilities. *International Journal of Information and Learning Technology*. 18. 4. https://doi.org/10.1186/s41239-020-00236-9

Lewis, M. J., & Lodge, J. M. (2016). Keep calm and credential on: Linking learning, life and work practices in a complex world. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies*. 41-54.

Lewis, N., & Shore, C. (2019). From unbundling to market making: Reimagining, reassembling and reinventing the public university. *Globalisation, Societies and Education, 17*(1), 11-27. DOI:10.1080/14767724.2018.1524287.

Mallon, M. (2019). Micro-credentialing. *Public Services Quarterly, 15*(2), 116-125.

Matthews, K. E., Garratt, C., & Macdonald, D. (2018). *The higher education landscape: trends and implications*. University of Queensland.

McCowan, T. (2017). Higher education, unbundling, and the end of the university as we know It. *Oxford Review of Education, 43*(6), 733-748. DOI://dx.doi.org/10.1080/03054985.2017.1343712.

Mendenhall, R. W. (2012). Western Governors University. In D. G. Oblinger (Ed.), *Game Changers: Education and Information Technologies*. 1-381. Educause.

Milligan, S., & Kennedy. (2017). To What Degree? Alternative micro-credentialing in a digital age. In R. James, S. French, & P. Kelly (Eds.), *Visions for Australian Tertiary Education*. The University of Melbourne: Melbourne Centre for the Study of Higher Education.

Mischewski, B. (2017). *Micro-credentials: A model for engineering education.* New Zealand: Report commissioned by the Tertiary Education Commission (TEC).

Mohamed, M. & Hammond, M. (2017). MOOCs: A Differentiation by Pedagogy, Content and Assessment. *International Journal of Information and Learning Technology*. 35. 00-00. DOI: 10.1108/IJILT-07-2017-0062.

National Institute for Digital Learning & the European Consortium of Innovative Universities (2021). *Research Observatory on Micro-credentials.* https://www.dcu.ie/nidl/micro-credential-observatory.

Neem, J. N. (2012). A University without intellectuals: Western Governors University and the academy's future. *Thought & Action, 28*, 63-79.

Newby, T. J., Wright, E., & Beese, E. (2016). Passport to designing, developing, and issuing digital instructional badges. In D. Ifenthaler, N. Bellin-Mularski, & D. K. Mah (Eds.), *Foundation of Digital Badges and Micro-Credentials: Demonstrating and Recognizing Knowledge and Competencies*. Switzerland: Springer.

New South Wales Education Standards Authority. (2021). *Professional Experience Framework.* https://educationstandards.nsw.edu.au/wps/portal/nesa/teacher-accreditation/resources/professional-experience-framework

New Zealand Qualifications Authority. (2018). *Micro-credentials in New Zealand's education and training system: A consultation paper.* https://www.nzqa.govt.nz/assets/About-us/Consultations-and-reviews/Micro-credentials/Micro-credentials-consultation-paper-March-2018.pdf

New Zealand Qualifications Authority. (2020). *Recognising learning for credit: Guidelines for the recognition and award of credit for learning.* https://www.nzqa.govt.nz/assets/qualifications-and-standards/CRT-RPL-guidelines-Oct-20.pdf.

New Zealand Qualifications Authority. (2021, a). *Micro-credentials. What is a micro-credential?* www.nzqa.govt.nz/providers-partners/approval-accreditation-and-registration/micro-credentials/

New Zealand Qualifications Authority. (2021, b). *New Zealand Qualifications Framework* (NZQF).www.nzqa.govt.nz/assets/Studying-in-NZ/New-Zealand-Qualification-Framework/requirements-nzqf.pdf.

Nicastro, G., & Moreton, K. M. (2008). Development of quality performance tasks at Western Governors University. *Assessment Update, 20*(1), 8-9.

Northeastern University. (2017). *Northeastern university and IBM partnership first to turn digital badges into academic credentials for learners worldwide.* https://news.northeastern.edu/2017/09/25/northeastern-university-and-ibm-partnership-first-to-turn-digital-badges-into-academic-credentials-for-learners-worldwide/

Oliver, B. (2016). *21C Credentials: Curate, credential and carry forward digital learning evidence.* https://ltr.edu.au/resources/SP13_3236_Oliver_Report_2016_0.pdf

Oliver, B. (2019). *Making micro-credentials work for learners, employers and providers.* http://dteach.deakin.edu.au/microcredentials/

Oliver, B. (2021). *A conversation Starter: Towards a common definition of micro-credentials.* Draft Preliminary Report. UNESCO, Paris.

Oliver, B., & Souter, K. (2013). *Imagining the future of assessment: For evidence, for credit and for payment.* Paper presented at the 30th Annual conference on Australian Society for Computers in Learning in Tertiary Education.

Open University Australia.(2019). *OpenCreds. A lifelong learning micro-credentialing framework.* https://solutions.openlearning.com/opencreds/opencreds-microcredentials-for-australia

Organisation for Economic Co-operation and Development. (2021). Quality and value of micro-credentials in higher education: Preparing for the future. *OECD Education Policy Perspectives,* No. 40, OECD Publishing, Paris. https://doi.org/10.1787/5cc2d673-en.

Organisation for Economic Co-operation and Development. (2018). *The Future of Education and Skills. Education 2030.* www.oecd.org/education/2030/E2030%20Position%20Paper%20(05.04.2018).pdf OECD Publishing, Paris.

Organisation for Economic Co-operation and Development. (2019). *Trends Shaping Education 2019.* https://read.oecd-ilibrary.org/education/trends-shaping-education-2019_trends_edu-2019-en#page1. OECD Publishing, Paris.

Orr, D., Pupinis, M., and Kirdulytė, G. (2020). *Towards a European approach to micro-credentials: a study of practices and commonalities in offering micro-credentials in European higher education.* NESET report. https://education.ec.europa.eu/sites/default/files/document-library-docs/towards-european-approach-micro-credentials-analytical-report.pdf

Powell, S., Leary, H., McLachlan, L., & Brock, K. (2018). *Teachers Collaboratively Creating Micro-Credentials for Professional Development.* Paper presented at the International Society of the Learning Sciences.

Ralston, S. (2021). Higher Education's Microcredentialing Craze: a Postdigital-Deweyan Critique. *Postdigital Science and Education.* 3. 10.1007/s42438-020-00121-8.

Rosenberger, K. (2019). Designing digital badging programs: Findings from an interview-based study with instructional designers. *TechTrends, 63*(4), 477-484. DOI:10.1007/s11528-018-0349-7.

Schmidt, P. A. (2008). Assessment at Western Governors University and the NCATE accreditation process. *Assessment Update, 20*(1), 11-15.

Selvaratnam, R. & Sankey, M. (2021). The State of Micro-Credentials Implementation and Practice in Australasian Higher Education. *Open Praxis*, 13(2), 228–238. DOI: http://doi.org/10.5944/openpraxis.13.2.130.

Sharrock, G. (2015). Making sense of the MOOCs debate. *Journal of Higher Education Policy and Management, 37*(5), 597-609. DOI:10.1080/1360080X.2015.1079399.

Sharrock, G. (2017). Organising, Leading and Managing 21st Century Universities. In R. F. James, Sarah Kelly, Paula (Ed.), *Visions for Australian Tertiary Education*. Melbourne University: Melbourne Centre for the Study of Higher Education.

Stracke, C. M. (2017). The Quality of MOOCs: How to improve the design of open education and online courses for learners? In: Zaphiris P., Ioannou A. (eds). *Learning and Collaboration Technologies. Novel Learning Ecosystems.* LCT 2017. Lecture Notes in Computer Science, vol 10295. Springer, Cham. https://doi.org/10.1007/978-3-319-58509-3_23.

Tehan, D. & Cash, M. (2020, June). Department of Education, Skills and Employment. Joint Media Release: *Marketplace for online micro-credentials.* https://ministers.dese.gov.au/tehan/marketplace-online-microcredentials

United Nations Educational., Scientific and Cultural Organization. (2018). *Digital credentialling. Implications for the recognition of learning across borders.* UNESCO, Paris.

Universities Australia. (2021). *Guidance for Portability of Microcredentials*. Universities Australia.

Wheelahan L., & Moodie G. (2021). Analysing micro-credentials in higher education: a Bernsteinian analysis, *Journal of Curriculum Studies*, 53:2. 212-228. DOI: 10.1080/00220272.2021.1887358

Wiley Education Services. (2020). *Online College Students.* 9th edition. Wiley. US. https://edservices.wiley.com

Williams, P. (2019). Does competency-based education with blockchain signal a new mission for universities? *Journal of Higher Education Policy and Management, 41*(1). 104-117.

Willis III, J., Strunk, V., & Hardtner, T. (2016). Microcredentials and Educational Technology: A Proposed Ethical Taxonomy. *Educause Review*.

World Health Organisation. (2021). *Global Recognition of Learning Achievement Framework.* WHO Academy. https://www.who.int/about/who-academy/quality-standards-credentialing/global-recognition-of-learning-achievement-framework

Zane, T. W. (2008). Domain Definition: The Foundation of Competency Assessment. *Assessment Update,* 20(1). 3-4.

Appendix A

Initial approach – systematic literature review

Identify aim of literature review

↓

Conduct literature search of academic and grey literature databases using search terms

↓

Read abstracts of identifed articles and exclude irrelevent articles

↓

Read full articles and identify major themes

↓

Synthesise and consolidate main literature themes

n = 131 sources identified

↓

n = 22 sources excluded

↓

n = 46 articles read n = 17 major themes identified