Research Whitepaper

Digital Micro-Credential Efficacy and Impact on Learner Confidence

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Edalex

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Foreword

This whitepaper details the findings of a research study conducted in 2022 over a six month period, in collaboration with a group of international cross-sector partners, as part of a Global Victoria EdTech Innovation Alliance initiative. Edalex's Innovation Sprint aimed to increase learners' confidence in the expression of their workplace skills by issuing a Personal Evidence Record of the skills they had developed in their studies. This evidence could then be shared with employers, sending a 'signal to hire' by demonstrating workplace readiness or 'signal of recognition' in the workplace of upskilling. This research validated the proof of concept of the expected efficacy of our Credentialate platform. But what we didn't expect was the extent of the effectiveness of our solution on increasing learner confidence. The research results show that learners readily embraced the more detailed information included in the credential - such as a detailed description of the credential components, how learners were assessed and the links out to Rich Skill Descriptors (RSDs) that provided job market context. Credentialate's Personal Evidence Record gave learners next-level understanding of what they had learnt and how they could apply it in their careers. They felt informed and empowered, which for the University of Dayton cohort had a positive impact on 76% of learner confidence levels. Employers, too, were very open to the deeper story the evidence records told. They told us that it gave them insight into the learner's level of human capability. This is particularly valuable in graduate hiring, as it provides independent validation that they're ready for the workplace, setting them apart from other candidates.

The research project provided the opportunity to share knowledge and practice across providers and EdTech organisations and generate new ways of working in the emerging areas of micro-credential and skills ecosystems. The insights from the research should inform future policy and practice around skill transparency and personal evidence of learning, and their benefits to participants in the digital credentialing and skills ecosystems as well as the learner/earner ecosystem.

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Melinda has 20 years' experience in people and outcomes management at program, project and business operations levels and is qualified in the application of AIPM, Agile and Critical Path methodologies. She has enjoyed long-term project engagements in the education, communications, building, retail, banking, accounting, entertainment and infrastructure industries, and has proven leadership skills and the ability to unite teams comprising diverse resources.

Contributing authors and project partners

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Margo's in-depth knowledge and experience of micro-credentialing is the result of working in and with higher education providers and edtech leaders, nationally and internationally. She is passionate about the positive impact of technology within education and the enablement of lifelong learning and agility. Margo is a connector at heart and is a strong advocate for diversity and inclusion in all areas of life.

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Naomi identifies product solutions that support the successful deployment and scaling of the Lab's 21st Century Skills Badges by facilitating the dialogue between the Lab, educational institutions, industry, and product vendors. She utilises her technology background, higher education administration experience, and community engagement techniques to design solutions that work within the blossoming digital credential ecosystem.

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Brian LaDuca is the founding Executive Director of the Institute of Applied Creativity for Transformation (IACT) at the University of Dayton where his research is focused on the relationship between 21st Century skills in the workforce and competency-based curriculum in post-secondary education. He has been with University of Dayton for ten years where he leads the ongoing evolution of all micro-credentials and badges for the University of Dayton students, faculty and staff. He also steers the ongoing city-wide collaboration of The GEM, Dayton's emerging education incubator with a mission to maximise possibilities for city educators to be innovative change agents for developing new teaching and learning solutions to help Dayton's community and society progress.

Project partner

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Karyn Giglietta was (during the research project) a member of the leadership team at the Melbourne School of Professional and Continuing Education (MSPACE) at the University of Melbourne. Karyn has worked in management and leadership roles for over 25 years across a diverse organisational settings , industries and sectors, including higher education, not-for profit, retail and consumer, music publishing, and design.

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Executive Summary

Through its vision, support, and funding opportunities, Global Victoria is building its strength and capability in education technology (EdTech) innovation, enabling EdTech organisations based in Victoria, Australia, to generate and excel in global education solutions. One funded initiative has been the establishment of the "Global Victoria EdTech Innovation Alliance", delivered by EduGrowth to support collaboration between Victorian EdTech companies, education providers, researchers, and international organisations to road test and promote the learning impact of EdTech products for export' (Global Victoria, 2023). During 2022, Edalex was successfully awarded a place in a research program to activate testbeds and run efficacy trials of EdTech products in Australian and international settings.

The focus for the Edalex project aimed at addressing the increasing need for education institutions to provide appropriate tools and resources for learners to bridge the learner-to-earner gap and meet the needs of industry for job-ready graduates. The Edalex project engaged two higher education institutions and their learners, as well as employers, and education nonprofit organisation in the skills ecosystem to explore their respective lenses of perception around personal evidence of skills and the best way to communicate this to future employers. Edalex's project investigated the efficacy of the personalised Personal Evidence Records, produced by their Credentialate platform, with the ultimate aim of improving employability outcomes for learners and helping address a talent shortage for employers.

We are at a global inflection point with regard to the higher education response to business talent pipeline development. The opportunity to collaborate on this important topic cross-continentally via the Global Victoria EdTech Innovation Alliance initiative provides insight into the field with regard to how to best leverage the skills ecosystem to the advantage of learners and their potential employers. Edalex was excited by the opportunity to work with three prestigious partners in skills and education development and delivery to research the efficacy of Personal Evidence Records and our Credential Evidence Platform. The Global Victoria EdTech Innovation Alliance research project is Edalex's inaugural investigation into whether a detailed evidence record improves learners' confidence in expressing their workplace skills and gives employers the ability to use information contained in the evidence record as a signal to hire. At the conclusion of the project we had collected the data we needed to understand how the Personal Evidence Record is currently perceived (Figure 1), and to gain insights into future directions for improving the Credentialate platform product.

Edalex's project partner, the University of Dayton, was keen to explore a process for deeper understanding of skill development in its current student cohort. For them, alternative digital credentialing is a means towards immediate impact for jobs, internships and co-ops and gives students a deeper understanding of the various levels of mastery achieved in their

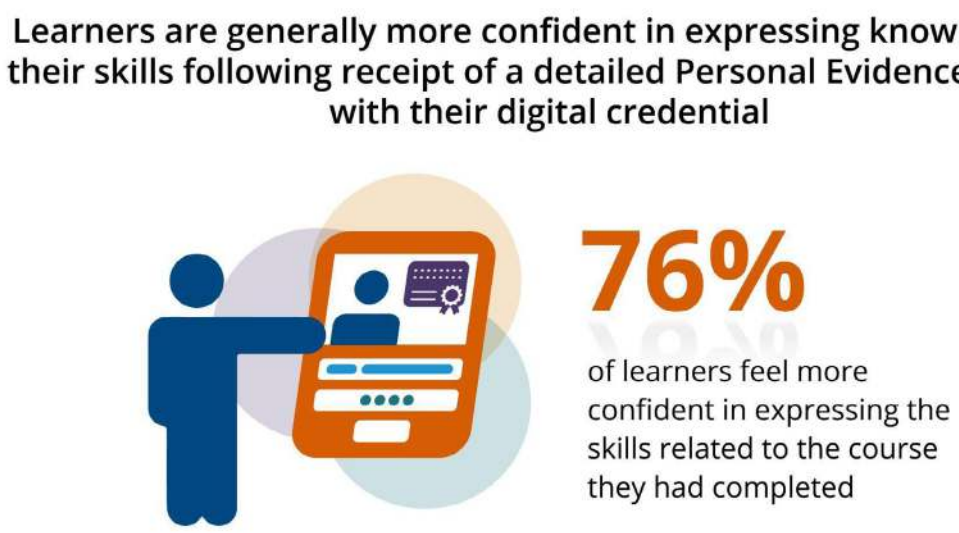

Figure 1: Research Finding - Edalex Global Victoria EdTech Innovation Alliance Research Project

sub-competency development. Insights from the digital micro-credentials issued to successful students serve to strengthen and create greater authentic understanding for the students as they look to transfer and apply these skills within the workforce and post-secondary education sectors.

Similarly, project partner University of Melbourne was interested in exploring the perceptions of their post-professional learners, to understand whether Personal Evidence Records add value to the University's digital micro-credentials. The University was also interested in gathering feedback from the employers of the digital micro-credential learners, who often fund their study, around the potential value of detailed digital micro-credentials with embedded Personal Evidence Records in the post-professional landscape.

Education Design Lab, an education nonprofit organisation, provided their 21st century skills framework as a building block for the project's skills definitions and afforded their invaluable experience in both micro-credentialing and research methodologies. The project's research aligned to the Lab's impact models - specifically the analysis of the efficacy of digital micro-credentials and their value as a signal to meaningful employment. All partners in the Global Victoria EdTech Innovation Alliance project were aligned in their shared desire to improve employability outcomes for learners and use the research results to inform future policy and practice around skill transparency and personal evidence benefits for participants in the learner/earner ecosystem.

Looking across the research data sets from the Universities of Dayton and Melbourne at the conclusion of the project, Edalex was able to gain insights into learner and employer perceptions across the initial professional and post-professional career trajectories.

Key findings

1. Digital micro-credentials that are designed with authentic assessment and are work-focussed will have high relevance and value for students and working professionals.
2. Learners are generally more confident in communicating knowledge of their skills following receipt of a detailed Personal Evidence Record embedded into their digital micro-credential.
3. Showing evidence of capabilities in a digital credential, particularly associated with micro-credentials, is likely to highlight to employers that the (l)earner has the specialised skills the employer is seeking.
4. When education providers map and align curriculum and assessment to skills and industry frameworks, there is increased course relevance for what Michelle Weise (2021) calls 'working learners' as they can apply to their current or future workplace contexts.

Introduction

The notion of networked alternative credentials (i.e. shareable digital records of achievement) emerged in the early years of the Internet when education institutions recognised that digital records could reduce the significant costs associated with paper credentials. Despite these revelations, awareness, technology, and change have proceeded slowly and even with the shift to fully digital e-transcripts (credentials) and digital learning and employment records (LERs), many digital versions offer little new information to the consumer beyond digital verification or innovations are often not scalable (Casilli & Hickey, 2016; Goger *et al*, 2022).

At Edalex, we've examined multiple emerging challenges in the digital credentialing ecosystem, particularly as they intersect with the skills ecosystem and apply at both local and global scales. Many of these significant challenges, and progress towards solutions, have been documented at our Edalex website (www.edalex.com), for example:

- Leveraging the messy and ambiguous emergent skills ecosystem.
- Identifying employer proof-points of the value of digital credentials and personal evidence.
- Establishing the value of digital credentials and personal evidence for learners and earners.
- Bridging skills strategies between education and business.
- Navigating local, state and national policy matters that substantiate traditional systems and learning processes.
- Minimising organisational structures that impede innovation.
- Elevating skills to facilitate the visibility of candidate skills and job requirement alignment in the recruitment process.

Edalex's Credentialate software as a service (SaaS) platform aims to address some of these challenges by connecting curriculum to recognition; collecting and collating the learner achievement data within a learning management system (LMS) and aligning it to skills, competencies and frameworks. Credentialate has competencies at its core; these competencies comprise knowledge, skills, and abilities (Federal Government of the United States, ND). By integrating LMS data that relates to learner achievement or performance - e.g. rubrics, gradebook items, student performance data and course data - Credentialate is able to produce a learner specific Personal Evidence Record describing the skills achieved through learning and provide evidence of that learning via attached artefacts, resulting in rich skills visibility for learners and potential employers. Credentialate's affordances extend to the production of digital badges with the embedded Personal Evidence Record, creating a permanent, immutable digital record of achievement that is owned by the learner. Digital micro-credentials are a mechanism for recognising learning in multiple locations and environments (UNESCO, 2018). They unite classroom learning, skills development and individual knowledge and experience, allowing the learner to see their accomplishments in a more holistic manner (Sullivan, 2013).

About the project

Edalex partnered with the University of Dayton in Ohio USA, University of Melbourne in Victoria Australia and Education Design Lab in the USA for the funding grant provided by the Global Victoria EdTech Innovation Alliance and delivered by EduGrowth. Together with its partners, Edalex designed a research project focusing on investigating the efficacy of EdTech tools. More particularly, for the research project, Edalex piloted Credentialate at the University of Melbourne and University of Dayton. The primary aim was to integrate Credentialate with each institution's LMS or student data source and produce digital micro-credentials with fine granularity of coursework and learning details, including a record of personalised evidence of learning for each participating learner. These records are known as Personal Evidence Records by Edalex. A key focus of the project was to examine whether the transparency associated with the evidence of learning represented in the Personal Evidence Record builds confidence in the communication of skills during the hiring process, from the learner and employer perspectives. Edalex's university project partners designed digital micro-credentials with articulated skills that were assessed, thus providing evidence of attained skills, and the data configured in Credentialate.

Appendix A provides sample images of the micro-credentials (sometimes referred to as digital badges) and Personal Evidence Records designed for the University of Dayton and University of Melbourne and issued to learners during this research project.

Terminology

This section provides definitions for the terminology used in this whitepaper.

21st Century Skills - generally used to refer to certain core competencies such as collaboration, digital literacy, critical thinking, and problem solving that advocates believe educators need to teach to help students thrive in today's world.

Competencies - represent the knowledge and behaviours required to perform the skill.

Credentials - verify, validate, confirm, or corroborate a person's learning achievements, knowledge and preparedness for performing tasks. Credentials are diverse with regard to their scope, status and purpose.

Digital Badges - a visual representation of the achievement gained from a micro-credential and are an indicator of accomplishment, skill, quality or interest that can be displayed, accessed and verified online. They're visual emblems of achievement in digital format. Digital badges are earned in a variety of ways, for a variety of achievement levels - from 'low stakes' event participation to 'high stakes' achievements that are assessed, such as successfully completing a collaborative project. Digital badges have embedded metadata that provide richer validation of qualifications. They contain shareable information about the badge issuer, receiver, criteria for issuing, issue date, expiration date, standards adhered to and evidence of achievement.

Digital Credential - in this whitepaper 'digital credential' is the broader term used to describe a digital visual representation of learning or digital 'certificate' comprising an Open Badges standard digital badge and, where issued by Credentialate, includes an embedded Personal Evidence Record. Digital credentials may represent credit or non-credit bearing awards/recognition.

Digital Credentialing - the processes (e.g. developing micro-credential metadata, designing the digital 'badge' or certificate, integrating the Credentialate platform with the university's Learning Management System and their badging platform, the university's internal micro-credential award processes) involved with issuing a digital credential such as micro-credentials.

Digital Micro-credential - also see Micro-credential in this section. In this whitepaper reporting on the research project a digital micro-credential is a non-credit bearing achievement issued to a student once their learning has been assessed by academics at the university delivering the micro-credential course. Similar to a digital credential, the micro-credential comprises an Open Badges standard digital badge and an embedded Personal Evidence Record.

Employability - to most educational institutions, employability is defined as the number of learners who go on to be employed after graduation. To learners, employability focuses on the value of their education, the ROI in learner's education, opportunities to land in a preferred job (not just any job) after graduation and

Recognition of Prior Learning (RPL) and experience. Employers consider a candidate with employability skills as someone who can prove or verify their skills against the job requirements and can develop further job specific skills with additional training. Workplace skills such as communication, teamwork and critical thinking are employability skills prized by employers.

Employability Data - focuses on learner and performance data (typically found in assessment data) that show what skills - including technical, workplace and transferable skills - learner's possess that align to current job markets.

Employer/Corporate Education - also referred to as industry education. This is education developed or co-developed by businesses and employers and delivered to employees. Corporate education can range from regulatory requirements, such as training in occupational health and safety to management training courses offered to executives. Typically recognised within the business, recognition of corporate education can be difficult to transition to other businesses or industries.

Employment Data - essentially tells us which career path a learner took and is usually limited to a set period of time after they graduate.

Formal vs. Informal Learning - whereas formal learning happens in training- based organisations, workplaces, mobile devices, classrooms, online over the internet or through eLearning portals, informal learning is based on practical and lifelong learning. Formal education is often assessed and recognised by some form of credential, whereas informal learning is often not assessed or recognised by a credential that can be used by the learner.

Higher Education - education undertaken after the completion of secondary education, including university and postgraduate study, typically delivered by traditional education providers.

Learner - this is defined as any learner in an educational environment, whether that is formal or informal learning, high school, university, or even lifelong learning.

Macro-credentials - generally, these include degrees, diplomas, certificates and licences, often awarded by accredited, recognised or regulated educational and other institutions or organisations. They indicate learning achievement of a broad body of knowledge, transferable skills or technical proficiency and may take a number of years to complete.

Melbourne MicroCert - a professional development course offered and digitally credentialed by the University of Melbourne.

Micro-credentials - assessed, short-form courses that are typically developed to meet a specific skills gap, rather than replace the learning a full degree provides. They usually focus on a set of learning outcomes in a narrow field of learning and are achieved over a shorter period of time. As such, skills are integral to the creation of digital credentials. It is usually skills that are recognised upon completion in the form of a digital badge. For micro- credentials to have meaning in the market, and provide currency for learners, they must first be mapped to skills and competencies. The skills and competency data is then aligned to industry and/ or National frameworks and to labour market data, providing visibility and transparency to all in the skills ecosystem.

A micro-credential i) is a record of focused learning achievement verifying what the learner knows, understands or can do; ii) includes assessment based on clearly defined standards and is awarded by a trusted provider; (iii) has stand-alone value and may also contribute to or complement other digital credentials or macro-credentials, including through recognition of prior learning; and (iv) meets the standards required by relevant quality assurance.

Micro-credentials are offered by commercial entities, private providers and professional bodies, traditional education and training providers, community organisations and other types of organisations.

Personal Evidence Record (PER) - a Credentialate transcript embedded in a digital lmicro-credential. This artefact provides information on skills (l)earned, their alignment to a global standard skills description through rich skill descriptors (RSDs), qualitative and quantitative evidence of skill achievement, frameworks and occupational and job market data. With a Credentialate rich personal evidence record, learners' skills become visible and are positioned in context with job markets.

Post-Professional Learners - learners who are working, or having been in work, and are typically older than twenty-five years and vary in life stage, digital literacy, commitments and mindsets (University of Melbourne, 2020).

Professional Skills - career competencies that often are not taught (or acquired) as part of traditional coursework. Professional skills such as leadership, mentoring, project management, and conflict resolution are value- added skills essential to any career.

Rich Skill Descriptors (RSD) - human and machine-readable skill definitions that can be referenced from digital credentials, learner records, pathways, and job profiles. RSD's are published by skill authors, and conform to a standard global schema. They contain the context around skills-rich metadata and alignment to provide a universal skills vocabulary.

Skills-Based Learning - most skills-based learning is taking place in the lifelong learning environments that come either after, alongside, or in some cases in place of formal education.

Skills Ecosystem - comprising sectors within the education industry that facilitate the recognition, validation and sharing of learners skills rather than blanket qualifications. Sectors include learning management systems (LMS), assessment platforms, badging agents, credential exchanges, skills standards and certification authorities. The Skills Ecosystem is an evolving space as skills gain traction across education and employer groups and as technology develops to better meet the needs of learners.

Skills Recognition Continuum - the process education providers must undertake to identify, align and recognise skills in a meaningful way for the other stakeholders in the Skills Economy. It defines not only what must be done and in what order, but also how each step can be accomplished utilising existing systems and technologies.

Skills vs. Competencies - these two terms have become quite muddied, in large part because the difference means a lot in academia, but is not defined the same way by employers. We tend to think that skills are merely behavioural and demonstrable, though it has become normal to use the word skills in place of competencies. Competencies are more broadly defined and include knowledge, skills, abilities and even innate talents. But when we're referring to an open skills network, matching of skills, or skills based hiring, we are generally using the word skills in place of competencies. But when we're referring to academic programs established with learning outcomes that are competency statements, it's important to use the term competencies. Skills badges, for example, can be joined with various credentials, but the higher education community understands competencies to be different from skills. This creates additional confusion when communicating about skills across organisation.

Soft Skills - a combination of people skills, social skills, communication skills, character or personality traits, attitudes, career attributes, social intelligence and emotional intelligence quotients, among others, that enable people to navigate their environment, work well with others, perform well, and achieve their goals with complementing hard skills.

Talent Mobility - a learner's ability to move between positions within their company, within businesses within their industry and between industries. How well the learner can collect, organise and share proof of their skills, knowledge and capabilities.

Workplace Skills - the basic skills a person must have to succeed in any workplace. They are the core knowledge, skills and attitudes that allow workers to understand instructions, solve problems and get along with co-workers and customers. They can comprise a mix of soft skills (such as teamwork, leadership) and domain specific skills (such as digital literacy, programming or first aid).

Project Aims

Edalex and its partners explored the efficacy of the Credentialate platform and its use in the digital micro-credentialing process, with the aim to gain perspectives from the learner, employer and university. The project aimed to test the hypothesis that a digital micro-credential with embedded Personal Evidence Record, provides a detailed representation of skills achieved by the learner, and improves both learner and employer confidence in addressing the skill-to-job alignment criteria during a hiring situation or recognition of ongoing learning or upskilling in the workplace.

There are two important assumptions inherent in the research hypothesis, i) that being confident in speaking about one's abilities in a hiring situation is important, and ii) that employers are specifically looking for transferable, work-focused skills, rather than purely academic knowledge, during the recruitment screening and selection processes. Both of these suppositions are supported by empirical data from other research studies. For example, Susan Elzey's (2006) key finding in her qualitative case study was that candidate confidence is extremely beneficial in the interview process. Similarly, Carlin et al (2018) reported that lack of confidence in women candidates may lead to a gender gap which negatively influences the effectiveness of meeting their career aspirations and seeking career advancement. Confidence is clearly a valued attribute in candidates and key to equitable decisions being made about a candidate's suitability. In their 2022 report "Value Beyond the Degree: Alumni Perspectives on How College Experiences Improve Their Lives", Strada Education Network associated the development of a key set of skills, including both general and specialised elements, strongly with economic and non-economic benefits. Further, those alumni who reported strong skill development were earning more money and were at least three times more likely to feel their education had a positive impact on their career and life (Strada Education Network, 2022). The National Skills Commission's 2022 Skills Priority List report estimated 30% of employers advertising vacancies for low-fill rate (i.e. those in labour shortage) occupations required specific skills or experience, and the lack of these elements featured among the main reasons candidates were found unsuitable. There is a distinct correlation between employers seeking, valuing and rewarding skills and employees seeing direct benefits from possessing the skills employers require.

In this research project, Edalex worked with higher education providers, University of Dayton and University of Melbourne, to leverage learner data from their existing curriculum and assessment data sources within specified courses. Using Edalex's Credentialate platform, human effort to map course outcomes to skills frameworks such as Education Design Lab's set of 21st century skills, and the badging platforms that each institution used, digital micro-credentials with Personal Evidence Records were issued to learners that represented their earned achievements. Perceptions of students' confidence levels and employer perspectives of micro-credential metadata were analysed by quantitative and qualitative inquiry methods such as self-reporting questionnaires and focus groups or interviews.

The project research framework was designed with the aims of:

I. capturing learners' self-reported confidence levels in articulating their personal skills and competencies in hiring/ workplace performance appraisal contexts;

II. analysing the data to determine whether learners' perceived confidence changes with access to their Credentialate Personal Evidence Record;

III. collecting qualitative feedback from project partners and employers on the process and acceptability success criteria; and

IV. ascertaining employers' perceived value of digital micro-credentials comprising detailed evidence of a learner's skills.

The project also identified and explored a set of success criteria that addressed the key areas of the credential platform's (Credentialate) implementation processes, intended effects and outcomes of the digital credentials, acceptability of the credentialing solution by the target audiences and the feasibility of the solution for the partner institutions (Table 1). These success criteria were derived for the project informed by the efficacy framework designed for the Global Victoria EdTech Innovation Alliance by EduGrowth and led by researchers from Deakin University and Monash University (EduGrowth & Global Victoria, 2022b).

Table 1: Project success criteria

Analysis Category	Success Criteria
Process	• Defined competencies and credentials that are strategically aligned to curriculum. • Stakeholder acceptance of the platform and deployment processes. • Enhanced ability for an institution to analyse learner performance against learning outcomes. • Reduced administrative overheads in digital credential definition and awarding processes. • Increased institution engagement with digital credentials. • Increased understanding and application of Education Design Lab's 21st Century Skills to curriculum and credentials.
Intended Outcomes	• Enhanced levels of student confidence in discussing their skills and qualifications. • Enhanced levels of employer confidence in student's ability to articulate and prove their levels of skill attainment.
Acceptability	• Wider institution understanding and adaptation of digital credentials and the benefits they provide to both learners and employers. • Increased student understanding of, and engagement with, micro-credential awards. • Wider employer understanding and acceptance of digital credentials as evidence of a learner's attainment of claimed skills. • Insights that support analysis of Credentialate's product-market fit.
Feasibility	• Successful and timely establishment of Credentialate at domestic and international institutions. • Proof of efficiencies in the configuration of Credentialate to achieve scale in the collection of evidence of learning and the awarding of personalised digital recognition. • Credentials, i.e. badges and Personal Evidence Records, successfully produced and distributed to learners per the awarding criteria configured. • Increased interest within institutions of platform capabilities and application options.

The project success criteria (Table 1) were distilled into key research criteria and tested via research instruments purposely designed for the project and with regard to the challenges and limitations of accessing the various target audiences (Table 2). Students were provided with opt-in digital surveys, allowing them to complete the surveys in a given window of time at their own convenience, producing the quantitative data. Employers and project partners were interviewed to collect qualitative data on the areas of the project affecting their practices.

Table 2: Research criteria and research instruments used

Analysis Category	Research Criteria	Research instruments
Process	Credentialate's functionality to support and represent data mapping increases an institution's ability to analyse learner performance against learning outcomes.	Project partner interviews
Intended Outcomes	Transparency around the evidence of learning builds a learner's confidence in communicating skills.	Post-credential learner survey
Intended Outcomes	Transparency around the evidence of learning builds an employer's confidence in the communication of skills during the hiring process.	Employer interviews
Intended Outcomes	Transparency around the evidence of learning improves employability outcomes for learners.	Post-credential learner survey and employer interviews
Intended Outcomes	Credentialate's data mapping capabilities improves an institution's curriculum quality and constructive curriculum alignment.	Project partner interviews
Acceptability	Digital credentials provide valuable signals to employment.	Employer interviews
Acceptability	The transparency provided in a Personal Evidence Record improves employer perceptions of skill-to-job alignment.	Employer interviews
Acceptability	Learners felt more confident expressing their skills after being awarded a Personal Evidence Record.	Post-credential learner survey
Feasibility	Credentialate pilots at domestic and international institutions were established successfully, in a timely manner.	Project partner interviews
Feasibility	Credentialate enabled increased efficiencies in the micro credential configuration / awarding processes.	Project partner interviews

Research Methodology and Methods

The research methodology and methods have been influenced by the Global Victoria EdTech Innovation Alliance's efficacy-based research framework to support activating research-informed testbeds for EdTech products while EdTech organisations and universities collaborate in trials (see EduGrowth and Global Victoria 2022a & 2022b).

The research phase of the project was designed to conform to Global Victoria EdTech Innovation Alliance project timeframes and research framework and the project partners' academic cycles, which were integral to the success of assessing the efficacy of the Personal Evidence Records produced and issued to successful learners. Micro-credentials selected for the project from both the University of Melbourne and University of Dayton met the project timing and target learner demographics. The micro-credentials were mapped to show alignment between the curriculum, including the learning outcomes and assessment, to identified skills that would be represented in the digital micro-credentials issued through Credentialate. Skills surfaced in the assessment as evidence of learning were integrated into the assessment rubrics and also mapped to relevant skills frameworks such as the Education Design Lab's 21st Century skills competency framework.

Credentialate's Personal Evidence Record

The Personal Evidence Record designed for each university and their successful learners, reflected both the brand guidelines and credential culture of the individual institutions (Appendix A). University of Dayton learners received evidence records wherein skills were graded against a scoring system of gold (90-100%), silver (80-90%) or bronze (70-80%), providing visual reference to the granular level of achievement of mastery for each skill. The alignment section of the University of Dayton Personal Evidence Records provides learners with hyperlinks to Education Design Lab's 21st Century Skills Competency Framework, to which the credential aligns. For the University of Melbourne's micro-credentials, students are assessed for their proficiency at achieved / not achieved levels and not distinguished in the award beyond that the award is earned only if the learner has achieved at least 70% in the assessment. Thus there were no graded score indicators (such as gold, silver, bronze used by University of Dayton) integrated in the Personal Evidence Records issued for University of Melbourne learners. Relevant skills were identified from Education Design Lab's 21st Century Skills Competency Framework and integrated in Rich Skills Descriptor hyperlinks in the skill statements on the University of Melbourne Personal Evidence Record, and hyperlinks to relevant Australian Skills Classification Framework - Skills Clusters were provided to learners in the Alignment section of the Record.

Research design

Edalex worked closely with the project partners to design a research framework focused on investigating the efficacy of innovative EdTech applications and that provided clarity, coherence and integrity to the project's aims. The research project was submitted to, and approved by, their respective ethics committee or internal review boards at University of Dayton and University of Melbourne prior to collecting the student and employer data. The framework used a mix of qualitative and quantitative research methods, involving primary data collection via pre- and post-credential learner surveys and stakeholder interviews. Edalex drew on its partners' experience in research design and in the field of digital micro-credential research when designing relevant research instruments and techniques. A research analysis firm engaged by Education Design Lab in conjunction with the University of Dayton was contracted to provide support in quantitative analysis, statistical testing and identification of key emerging themes in the data. Furthermore, EduGrowth provided a research coach to support the research and for the project to meet the innovation sprint timeframe.

In the project setup, a process of platform integration with existing Learning Management System (LMS) and badging infrastructure was completed to establish Credentialate environments at the University of Dayton and University of Melbourne. An iterative data design process was undertaken with each partner to ensure correct configuration and data-to-credential alignment. In the production environment, data harvested from partner systems and sources drives the issuance of digital credentials to achieving learners. Harvested score and student information are assessed against the evidence matrices configured in Credentialate. Learners whose assessment scores attain pre-defined benchmarks in the evidence matrices are digitally issued their micro-credentials with embedded detailed Personal Evidence Records.

Students were surveyed at pre- and post-digital credential issue points to gather data about their confidence in expressing knowledge of their skills before and after receiving their micro-credential. Employers were interviewed to gather their perspectives on the impact a detailed digital micro-credential might have in a hiring situation, and the value of a candidate's ability to express detailed knowledge of the skills they have earned.

Table 3 provides a summary of the research design.

Table 3: Research design framework

Who	What	How	When
University of Dayton students [n=244]	Pre-credential learner survey	Survey distributed via email	1 February 2022
University of Melbourne students [n=14]			12 May 2022
University of Dayton students [n=244]	Post-credential learner survey	Survey distributed via email	2 May 2022
University of Melbourne students [n=14]			1 July 2022
Employers [n=2]	Employer interview	Interview via Zoom	30 June 2022
Project team [n=4]	Project partner interviews	Interview via Zoom	8 - 17 June 2022

Demographics of students, employers and university project partners

The demographics of our target research participants can be categorised as undergraduate and postgraduate students and their potential or current employers. Students from the University of Dayton were typically undergraduates enrolled across five programs offered during Feb-June 2022: Business and Professional Writing, Principles of Marketing, The Practice of Applied Creativity, Innovative Transformation, and Mechanical Engineering. Some of these students may have had prior experience with digital micro-credentials in the form of digital badges. Students from the University of Melbourne were postgraduate and, more specifically, post-professional learners, often employed and looking to upskill. These Australian learners were aged 25 years or older (76% identified as being in the 25-44 age category) and all were enrolled in the digital micro-credential Strategic Social and Sustainable Procurement Melbourne MicroCert. Employers were identified as those with the potential to hire the graduates from the project partner's courses. University of Dayton employers potentially include firms such as General Electric, Emerson Electric, Crown Equipment, VNDLY Inc., MITRE, Air Force Research Laboratory, Oakmont Education and Brixilated. In the case of the University of Melbourne, the learners were often funded by their employers who were seeking to upskill their staff in social procurement across industry sectors such as engineering, manufacturing, construction, health, government and government agencies.

In addition, interviews with the university project partners (i.e. University of Dayton and University of Melbourne) provided further insights into the efficacy of implementing Credentialate into their respective learning ecosystems.

Data analysis

Research results were collected by each participating university and provided to Edalex and its research analysis partner in de-identified and aggregated form, protecting confidentiality and privacy of individuals and organisations. Quantitative data, i.e. data resulting from the student

surveys, were analysed by the researcher partner using methods such as independent sample t-tests, and statistical analysis results provided back to Edalex for further analysis. Qualitative data, i.e. employer interviews, were assessed for emerging themes by the project team. Both qualitative and quantitative data were mapped against the analysis categories of Process, Intended Outcomes, Acceptability and Feasibility and the Research Criteria (Table 2) that were determined from the Global Victoria EdTech Innovation Alliance's efficacy-based research framework. This allowed for findings to be analysed and aligned with the project's stated success criteria.

Student survey and employer interview question details are presented in Appendix B - Survey and interview questions.

Research Findings

The research indicated that the efficacy of the Credentialate platform provided benefits to key stakeholders present at the intersection of the digital credential and skills ecosystems: learners, employers and universities.

Overall, analysis of the research data showed a positive trend towards acceptance of a digital micro-credential with Personal Evidence Record by both learners and employers. There is a resultant boost in the confidence of learners when asked about their ability to speak to their digital micro-credential, and a willingness by employers to consider the digital micro-credential data when assessing a candidate's suitability for a role. Further, employers indicated a cautious acceptance of digital micro-credentials and personalised evidence records as a mechanism for validating claims of skill mastery.

Perceived student confidence of learned skills and expressing them in recruitment scenarios

University of Dayton were interested in exploring the impact of digital micro-credentialing (badging) on their undergraduate students' confidence to perform in the recruitment process. Students are aware of their *knowing* (Barnett and Coate, 2005) process or knowledge about how their digital micro-credential supports their performance in recruitment activities such as applying for positions, developing a resume, or participating in an interview.

The data from the University of Dayton illustrates student confidence rose, on average, from the pre to post-digital credential student survey across all three recruitment-related questions after receiving their digital micro-credential award:

- 'Expressing the knowledge of your digital micro-credential ('badge') through application or example' showed an average increase in confidence of 19%.
- 'Expressing the knowledge of your digital micro-credential ('badge') on a resume' showed an average increase in confidence of 22%.
- 'Expressing the knowledge of your digital micro-credential ('badge') in an interview' showed an average increase of 18% (Figure 2).

The project data from the University of Melbourne showed that student confidence remained at 100% confident (combining both 'confident' and 'completely confident' response categories) across the three recruitment-related questions on the pre- and post-digital credential surveys. This may correspond with the data that reported 100% of the cohort were already employed and likely to have significant work experience since they fell in the 25-64 years age group range, which may underpin this high confidence

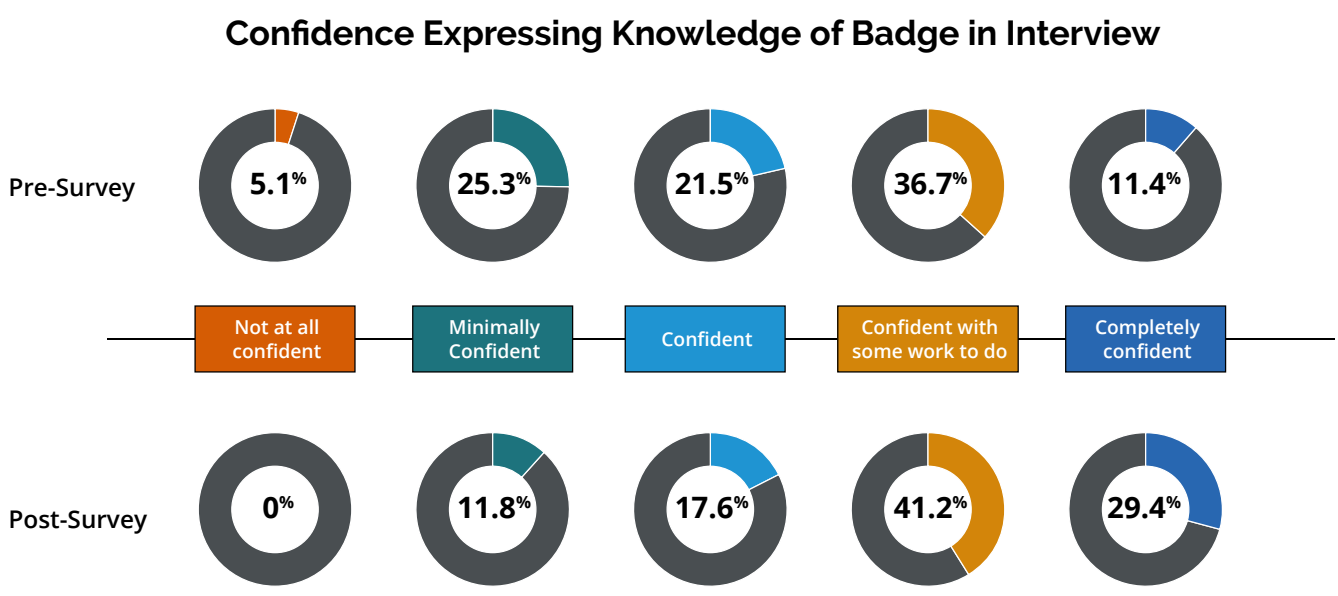

Figure 2: University of Dayton results pertaining to the research question *"How confident do you feel expressing the knowledge of your badge in an interview?"*

and awareness of their skills. In contrast, while University of Dayton students tended to be employed (61%) during their university studies, they also significantly represented (87%) the undergraduate age-group (18-24 years), which may suggest lower levels of work experience, particularly in specialised workplace contexts represented by their studies and may influence initial lower levels of confidence in speaking about their skills prior to receiving their digital micro-credential. Furthermore, the micro-credentials earned by University of Dayton students focused and assessed for the 21st Century Skills i.e. skills that are transferable in the workplace and often valued by employers (e.g. Bruce *et al*, 2022; Kolot *et al*, 2022). Yet such transferable skills can be challenging for learners to articulate and provide evidence for and are 'a lot more difficult' to teach but not impossible (Smith, 2018, p.131). In contrast, the social procurement digital micro-credential at University of Melbourne assessed a combination of technical and 21st Century skills. Both institutions utilised a rigorous alignment to the Education Design Lab's 21st Century Skills framework that substantiates a common lens and definition to the skills confidence described by students.

Figure 3 graphically represents the general increase in confidence of University of Dayton students to express their skills across various recruitment scenarios following their digital credential award. As illustrated in Figure 3, it appears after University of Dayton students were awarded their micro-credential, the greatest gains in confidence were associated with the preparation of applications and resumes.

As stated above, the post-professional learner cohort at University of Melbourne were significantly more confident than the undergraduate learners in voicing their skills prior to receiving their digital micro-credential. This may indicate that having relevant work experience, like the University of Melbourne learners who were already working in related procurement fields and seeking upskilling in specialised work of social procurement, can situate their learning and more readily apply or transfer their ***knowing*** and ***acting*** into their workplace contexts. Thus it seems they have integrated their learning and the artefacts (such as the micro-credential award or 'badge') into the self, or ***being*** (Barnett and Coate, 2005) and can recognise how to promote their skills. This phenomenon may not have occurred for the University of Dayton's undergraduate cohort until they were able to see their micro-credential ('badge') award with the Personal Evidence Record, supported by the performance-based learning they undertook as part of the transferable skills micro-credential developed by Education Design Lab integrated within the University of Dayton subjects. Undergraduates not only learn and develop transferable skills through classroom work, they learn through reflective practice, i.e. reflecting on their 'doing', as demonstrated by

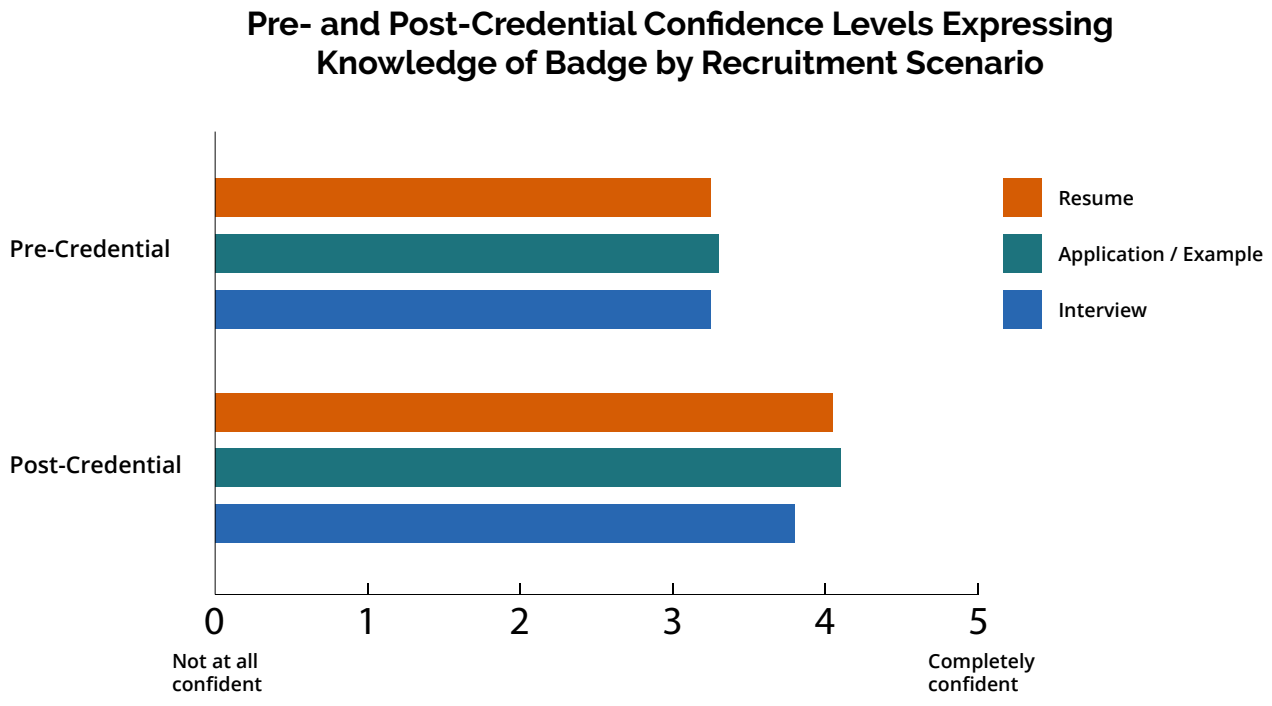

Figure 3: Average confidence scores and comparison of recruitment scenario (resume vs. application/example vs. interview)

a 2017 study of student employees in campus recreation programs (Bolton & Roselli, 2017, p.141).

Perceptions of efficacy of Credentialate from academic and employer perspectives

Using the Global Victoria EdTech Innovation Alliance's efficacy-based research framework to evaluate the efficacy of the EdTech innovation (i.e. Credentialate) through variables of process, intended outcomes, acceptability and feasibility (EduGrowth and Global Victoria 2022a), revealed the following insights from academics and employers participating in the project.

University providers perceived the use of Credentialate supported improvement in curriculum design and development with its focus on aligning curriculum with skills explicitly. Interviews with the project's university partners (i.e. University of Dayton and University of Melbourne staff, see Table 3) revealed that the use of Credentialate to produce digital micro-credentials may sharpen the focus of learners on the skills they've developed because of the transparency of the skills representation provided by the Personal Evidence Record. On reflection, academics reported that the use of Credentialate also enhances and sustains the quality of the academic work, particularly with curriculum alignment that incorporates skills transparency and representation.

Likewise, interviews with employers within this project (refer to Table 3) perceived the artefacts generated by Credentialate as improving the employment processes and articulating or surfacing the significant skills required in the workplace to upskill the workforce. An analysis of the qualitative data from the employer interviews showed that digital micro-credentials help differentiate candidates, giving employers additional tools to find the best fit for their company's needs. Further, evidence of the skills incorporated with the resume or integrated into the micro-credential (or 'badge') that is provided by the Personal Evidence Record, will help filter and identify the most suitable candidate(s). For such digital credentials to be a differentiating factor however, employers believe learners should discuss their learning evidence in the interview and demonstrate its application in examples of how they address a workplace need or challenge. Therefore, from the employer perspective, this indicates the digital micro-credential with Personal Evidence Record enhances the resume and interview recruitment outcomes by increasing the trustworthiness of the evidence offered to employers. The project team acknowledges that the small number of employers available for interview for the purposes of this research lends to a limited generalisability for each instance of reported results from the employer interviews.

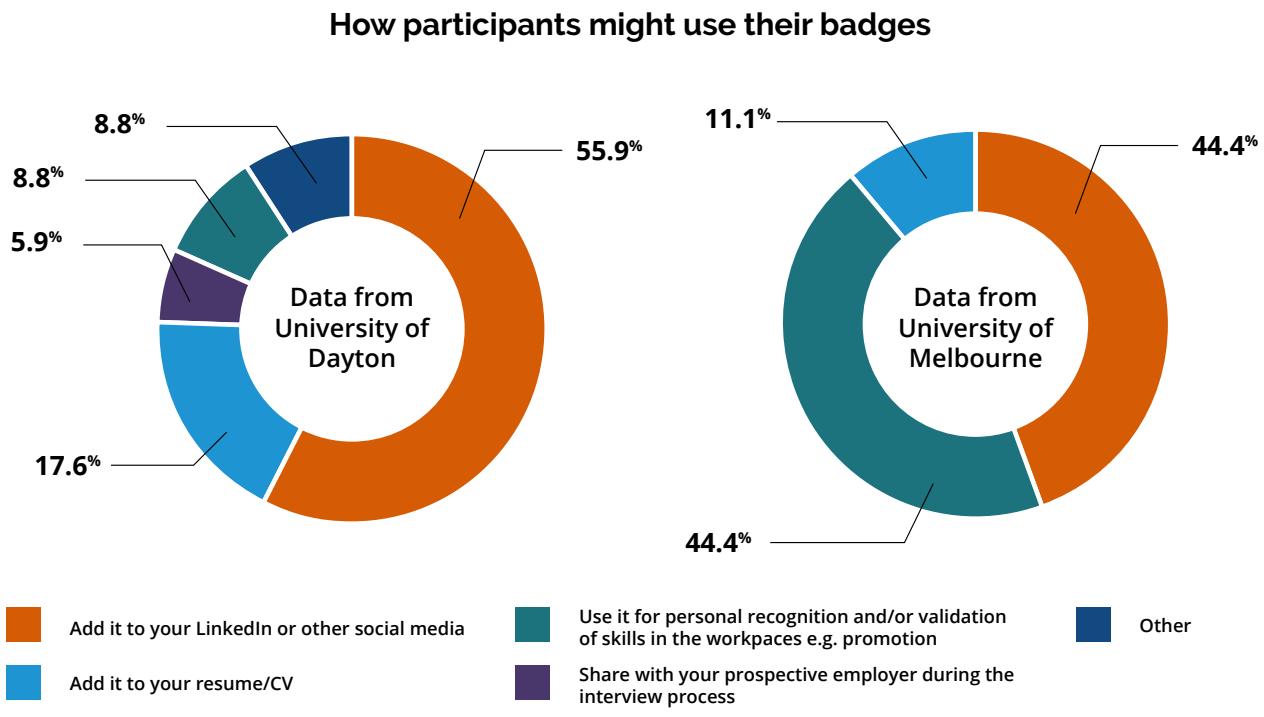

Figure 4 - University of Melbourne and University of Dayton preferences for digital badge use

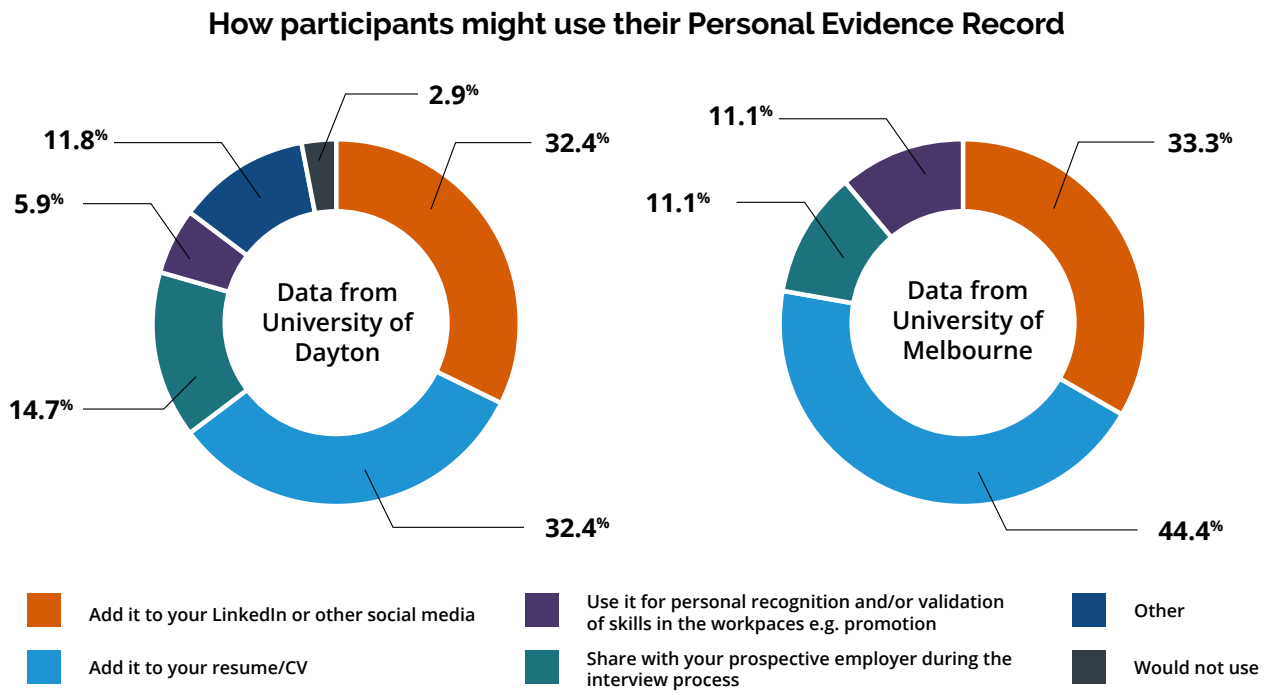

Figure 5 - University of Melbourne and University of Dayton preferences for personal evidence record use.

Learner perceptions: value and use of Credentialate's Personal Evidence Record

In general, the research found that learners valued, and they felt they could readily use, the skills developed while undertaking their digital micro-credentials. Furthermore, learners perceived that the Personal Evidence Record was useful to support their skill representation - but there was a range of perceived level of usefulness offered by the Personal Evidence Record. University of Melbourne students reported that the Personal Evidence Record made them 50% more confident in expressing the skills relating to the course they had completed, the University of Dayton cohort were 76% more confident.

At the University of Melbourne 44% of students stated they would add their digital badge to LinkedIn or other social media platforms and 44% would add it to their resume (Figure 4). The University of Dayton cohort were more open to publishing their digital badge via social media with 56% likely to share their badge on LinkedIn or other social media.

Meanwhile, the Personal Evidence Record was more likely (45%) to be added to a resume by University of Melbourne students (Figure 5); being the more detailed component of the micro-credential award it possibly finds a more natural fit within a resume-style reporting of skills. University of Melbourne students seemed to report a slightly higher value to share their Personal Evidence Record than the University of Dayton students to LinkedIn and to add it to their resume.

A limitation of the study is we don't have follow up data to unpack the learners' thinking about why they would or wouldn't share their digital micro-credential award, particularly in the recruitment process. We can only speculate on the differences between the self-reported behaviour patterns by University of Melbourne and University of Dayton learners, which may link to the differences in where they are in their respective career life span. Further research could build our knowledge in this area of learner behaviour in digital credential use.

Student survey data analysis

University of Melbourne data was not statistically analysed due to the small sample size limiting the potential to draw adequate conclusions, however several independent sample t-tests were conducted using the University of Dayton dataset to understand whether there is statistical evidence that the pre- and post-survey population means were significantly different. Four null hypotheses were tested against University of Dayton data:

i. There is no difference in confidence levels expressing knowledge of credentials through application or

example by pre- and post-credential recipients

ii. There is no difference in confidence levels expressing knowledge of credentials on resume by pre- and post-credential recipients

iii. There is no difference in confidence levels expressing knowledge of credentials in an interview by pre- and post-credential recipients

iv. There is no difference in perceived levels of importance of credential sub-competencies by pre- and post-credential recipients

The only case in which statistical evidence recommended the null hypothesis be rejected ($p<.05$) was hypothesis II. Therefore, there was a statistically significant difference in confidence levels expressing knowledge of credentials on a resume post micro-credential award. The raw data indicates that confidence levels rose significantly in both the 'Completely confident' (17% increase) and 'Confident with some work to do' (18% increase) categories for the University of Dayton students.

Limitations of the study

The t-test results appear to contradict earlier assertions that there was a general rise in University of Dayton student confidence across all categories. However, the caution is that the analysis of the research data in this project is limited and small in scale. Therefore, further research to examine the efficacy of the Credentialate platform by the diverse stakeholders will be important. The University of Melbourne sample size was too small for robust statistical analysis; six students participated in the pre-credential surveys and four in the post-credential surveys. The University of Dayton cohort was greater in size as their digital micro-credential program spanned several fields of study; 79 students completed the pre-credential survey and 34 the post-credential survey.

Gender bias may have influenced the research results; 100% of University of Melbourne survey respondents were female, while a majority of male (63%) respondents completed the University of Dayton's pre-credential survey and majority female (62%) respondents completed the post-credential survey for that cohort. The employer sample size consisted of two male employers and it is recognised a much broader research piece needs to be done in this area to obtain employer data representative of socio-demographic diversity.

There were challenges associated with the research processes. We found that student and employer engagement with the surveys was, somewhat predictably, low or erratic. This was partially due to surveys being sent out at the end of the course / semester when students are likely disengaging / disengaged and because one of the cohorts, the University of Melbourne cohort, was very small (n=12). Research about EdTech efficacy could be strengthened by repeating the research cycle across multiple and diverse cohorts, programs, and institutions to test findings across different processes that are characterised by administrative undergraduate (pre-professional) and postgraduate (post-professional) processes and their specific needs.

Likewise, engaging employers to participate in research activities was difficult, possibly due to external influences such as end of financial year resource pressures, staff shortages as an ongoing effect of the Covid-19 pandemic, and response to subsequent economic challenges. In retrospect, employers need to be engaged from the commencement of the project and included in the project processes to promote their interest in student's attainment of skills and student's ability to discuss the skills l/earned.

This project indicates that further research is necessary to support reasoning around the efficacy of educational technologies, such as Credentialate, and how they may represent evidence of learning that is meaningful and useful to key stakeholders (e.g. learners, employers, providers) in the micro-credential and skills ecosystems. Future studies can explore the myriad of credentialing issues to enhance efficacy of education technologies that are able to enhance recruitment, promotions, and acknowledgement of upskilling in workplace processes.

Discussion of Implications

As a result of the research outcomes from the Global Victoria EdTech Innovation Alliance project, university providers can see the value of utilising Credentialate to enhance institutional processes and academic professional knowledge and practice to i) strengthen the connections between the curriculum and skills and ii) understand how skills may be represented by verifiable, transparent and fine-grained Personal Evidence Records embedded as part of the issuing of digital credentials and their metadata.

As this project indicates, implementing a digital credentialing process into a higher education institution to support the issuing of digital credentials is not without challenge. Greater awareness and shared understandings and practices of digital alternative credentials among higher education institutions can support and mitigate risks during implementing digital credentialing systems (AACRAO, 2022). Digital credentials may be awarded for micro-credentials or the more conventional macro-credentials such as bachelors or masters programs. While this research project focussed on digital credentialing within micro-credential contexts, many of the findings are likely to be transferable to macro-credential contexts.

University partners in the project reported the use of Credentialate disrupted current education technology and curriculum practices that necessitated establishing new processes. It became evident that the human-behaviour change required to successfully implement the new curriculum practices associated with producing Credentialate's digital credentials takes time. Additionally, partner institutions felt that more clarity is needed to support academics about how to surface skills alongside the use of Credentialate's processes. They also wanted more guidance or evidence about how the finer granularity of data will be accepted and used by learners and employers, resulting in some skepticism of the digital credentialing innovation and its purpose and impact. However academics within the project agreed that establishing a process for the option of personalising digital credentials with a Personal Evidence Record showing differentiated achievement scales (e.g. gold / silver / bronze) is an important component of an institution's ability to analyse learner performance against learning outcomes for their ongoing improvement in teaching and to signal achieved levels of proficiency and/or mastery to learners. Further, it was recognised that the processes of skills identification and digital micro-credential curriculum design has a reciprocal, and complementary, positive impact on pedagogical practices such as enhancing learning outcome definition and assessment design. Other researchers have also indicated seeing positive pedagogical changes in the contexts of micro-credential design. For example Richard E. West and his colleagues have argued that well-designed digital micro-credentials can motivate learners through the integration of feedback in order to help the learner note performance discrepancies and areas of possible improvement, enhancing their motivation, goal-setting and desire to invest effort into the task to be learned (West e*t al*, 2020).

Employers interviewed as part of this project also perceived value in the digital artefacts developed from the use of the Credentialate platform to improve their employment and recruitment processes. Employers said their participation in the project has opened new ways of thinking with implications for working to align skills into their recruitment processes. For example, the employers expressed that skills like those represented in the University of Dayton's digital micro-credentials that were aligned with 21st Century Skills, could be discussed by learners on their resume and interview. Furthermore, learners who can describe their skills that are represented by their digital micro-credentials and how these fit in their professional 'tool kit' would differentiate themselves to employers, who in turn would feel more confident that the learner could use those skills in practice. The research data showed that when it comes to skills, employers tend to rely on evidence of skill attainment, such as education transcripts and documentation, and are less accepting of an interviewee who says they have certain skills but provides no evidence to back their claim. Employers also expressed scepticism of digital micro-credentials ('badges') as stand-alone mechanisms for skill claims but were open to reviewing 'detailed skills transcripts' such as Personal Evidence Records which provide details of how the learner earnt or demonstrated the claimed skills.

Generally, however, employers felt they needed to know a lot more about the digital credentialing process before they trust and embrace it as a component of candidate screening technique and this has been found in other studies (1EdTech, 2021; Camilleri, Muramatsu and Schmidt, 2022). There were two clear narratives identified in the employer interviews concerning the perceived value of detailed digital credentials:

1) Scepticism and mistrust arising from questions of digital micro-credential validity and value, e.g.

> *"If I'm an employer that has no idea what a digital credential or micro-credential potential is, my first initial reaction would be scepticism."*
>
> *"Did they just take a quick course and check a box and, you know, anybody who did that gets that credential?"*
>
> *"My brain was going to what I trust; an assessment (transcript), over soft skills."*

2) A genuine interest and belief in digital micro-credentials as a differentiator of candidates who have the applied skills the employer is seeking, e.g.

> *"I think that success has brought us to a point where we're actively seeking this (soft skills / digital credentials) out... skill sets there's not dedicated coursework for... how do we ensure all of our staff have those skills? So it's becoming a thing now, we're looking for that (soft skills / digital credentials) to come into the hiring process."*
>
> *"Conversations I've had with workforce development introduced me to the concept of [digital micro-] credentialing. .. I would say, both with hiring recent graduates, and with upscaling, credentialing or micro-credentialing allows us to be more precise with what we're hiring for."*

These insights speak to the need for industry awareness-raising and education required to address the lack of information employers are receiving about the beneficial role digital credentials have in hiring processes. Employer unawareness that a digital micro-credential may have higher credibility and verifiability than a digital badge, or perhaps even a conventional certificate, because these digital micro-credentials are issued with evidence of learning through assessment and there is transparency of what is assessed and to what level of mastery. The acknowledgement by employers that digital micro-credentials may be a logical evolution in candidate screening is encouraging and shows there is an appetite within industry to understand more about the technology, what it can do, and what it means for learners and employers. The issue of how employers may be supported by use of emerging talent acquisition technologies is gaining attention in the intersection of the skills and micro-credential ecosystems (e.g. Gallagher, Leuba, Houston, and Trieckel, 2023). Furthermore, the recent Edalex Skills Meet-Up Discussion Paper: *Towards a Roadmap for the Emerging Skills Ecosystem in Australia* also asserts that employers and industry 'will need to learn how to [navigate and] leverage the validity and security of the [digital] credentials that have become a part of the learner's education record' to better meet their needs to fill skills shortages (Bean, McFadyen, Scacco, Griffith, and Chompff, 2023, p. 5). Further research is needed to better understand the needs of employers as they engage with the micro-credential and skills ecosystems. It is a nascent research field, particularly within the higher education sector, but a recent report *Credentials to Employment: The Last Mile* by Digital Credential Consortium (Camilleri, Muramatus and Schmidt, 2022) begins to articulate a more nuanced and complex representation of employers and the findings found in this project are also reflected in their deeper dive into employer perspectives.

Likewise, students in academic environments appear ready to embrace the receipt and use of digital micro-credentials to support, and provide deeper context to, their academic achievements. All University of Dayton post-survey respondents stated they would use their digital badge in some way with 97% saying they would also use their Personal Evidence Record. All University of Melbourne respondents (4) in the post-survey said they would use, or share, their Melbourne MicroCert digital credential in some way; one participant would also use it for personal recognition and/or validation of skills in the workplace (e.g. seeking promotion). This data supports the hypothesis that learners assign value to receiving formal recognition of the skills they have (l) earned during their course and represented in the digital credential. All post-survey respondents (4) at the University of Melbourne valued undertaking the Melbourne MicroCert and receiving a digital credential and gave multiple reasons including, for example:

- upskilling of better practices in social procurement
- applying knowledge and skills into their workplace
- exposure to a network of collegial peers to learn from and share experiences

Overall, this initial research into the efficacy of digital credentials that were produced by the Credentialate platform has provided encouraging results. It shows that transparency around the evidence of learning,

> *"Establishing research outcomes of short-range tech projects is exceedingly difficult. Doing rigorous evaluation of impact and results requires significant time for planning, deploying, and analysis."*
>
> *- Project research partner*

provided through a Personal Evidence Record, resulted in enhanced levels of learner confidence, particularly for the undergraduate learners, when discussing their skills and credentials. The impact of the Personal Evidence Record on undergraduate student confidence expressing knowledge of their skills across different recruitment modes (in interviews, on resumes and through application or example) was noticeably higher. For example, 23% more students, on average, were 'completely confident' in expressing their skills following receipt of their digital micro-credential with an embedded Personal Evidence Record. This supports the project supposition that transparency around the evidence of learning improves employability outcomes for learners, because an applicant who is confident in their abilities is more likely to influence and affect recruiter's decisions and selection outcomes when considering the applicant suitable for the position, inviting the applicant to a second interview and hiring the applicant (Dimopolous, 2020).

Key findings

The project provided the opportunity to share knowledge and practices across providers and generate new ways of working in the emerging areas of micro-credential and skills ecosystems. There is a commitment by the participating providers to continue to trial this work with further programs to test the application and efficacy of Credentialate within their learning environments. Key findings from the project research include:

- Digital micro-credentials that are designed with authentic assessment and are work-focussed will have high relevance and value for students and working professionals.
- Learners are generally more confident in communicating knowledge of their skills following receipt of a detailed Personal Evidence Record embedded into their digital micro-credential.
- Showing evidence of capabilities in a digital credential, particularly associated with micro-credentials, is likely to highlight to employers that the (l)earner has the specialised skills the employer is seeking.
- When education providers map and align curriculum and assessment to skills and industry frameworks, there is increased course relevance for what Michelle Weise (2021) calls 'working learners' as they can apply to their current or future workplace contexts.

As a consequence of this research project Edalex has noticed there is an opportunity for us, and other EdTech organisations in the skills recognition community, to act as a facilitator or bridging agent to promote collaboration between key stakeholders (e.g. education and industry) in the intersection of the digital credential and skills ecosystems (Bean *et al*, 2023). This is likely to expand the ways of working within these education-skills-credential ecosystems to enhance the learning and associated outcomes for learners as they engage with lifelong learning within their working lives. This research project has informed the establishment of a series of "Skills Meetup" workshops to connect interested parties to share their experiences, hear from policymakers and explore practical avenues for closing the skills gap in Australia.

Key challenges

- There is a digital micro-credential knowledge gap as well as issues of trust of the accompanying digital credential technology that prevents employers from fully understanding and embracing the use of digital credentials in hiring situations; however, trust alone will not serve as a mechanism to convince employers of the value of these credentials.
- Further investigation is required to understand how learners and employers will interact with the metadata associated with digital credentials and the skills and and micro-credential ecosystems, for example:
    - its artefacts (e.g. Personal Evidence Record, digital micro-credential or 'badge')
    - how these digital artefacts influence articulation and positioning of skills in recruitment, hiring, and promotions processes
- Processes need to be devised that make it as easy as possible for academics and other relevant stakeholders to engage with digital credentials and credentialing platforms such as Credentialate.
- There is a need for education providers, employers, government and EdTech organisations to collaboratively engage with digital credentialing and its research to better understand the function it may play in providing evidence of learning that is valid, credible and reliable) for purposes of recruiting, workforce planning and upskilling, promotions, and crediting towards further learning.

- Digital micro-credentials remain new and less familiar territory in the minds of learners and it will take time, education, and adoption for digital micro-credentials to become accepted as contemporary practices issued to learners. Micro-credentials also pose technical challenges when it comes to digitally sharing them as it is often not a seamless process for learners.
- Digital micro-credential metadata (including skills surfacing) requires careful crafting by universities to provide relevance and insights to intended audiences - particularly in post-professional markets where recipients are already familiar with demonstrating practical application of their skills on resumes and under interview conditions and workplace performance appraisal contexts.
- Making, managing, updating and authorising digital credentials is not without a learning curve or recurring technical challenges. Significant resource commitment by all key stakeholders is required to bring a digital credentialing strategy to fruition.

Product roadmap

This project's findings have identified several themes and requirements that have informed Edalex's development and marketing of the Credentialate platform, including:

- An improved visual and functional design for the Personal Evidence Record. The refurbished design includes improved information accessibility via embedded links to external skills data such as Rich Skills Descriptors (RSDs).
- Innovations in international platform hosting.
- Use of the Credentialate public API toolkit in a production environment for non-LMS sourced data, paving the way for future integrations with unique / bespoke data sources, which is important for innovative credential programs. Many use non-credit and alternative systems for unique learning opportunities.
- Collaboration across education organisations, governments and nonprofits to discover and realise Credentialate's potential as a system to transform skills recognition and learner efficacy.
- Using the findings of the research project to discuss learner and employer perceptions of the digital credentials produced by Credentialate and the efficacy afforded by skills-oriented learning and recognition.

Edalex is currently working towards developing initiatives that were identified through the project and placed on the Credentialate product roadmap, for example:

- Deeper embedding and use of Rich Skills Descriptors (RSDs) within Credentialate, specifically with an outlook to integrate the openRSD repository.
- Development of a detailed onboarding process for organisations; a 'skills playbook' that provides, in short-module format, the information an organisation needs in order to start their skills definition and digital credential issuing journey.
- Further collaboration with employers and businesses who are open to digital micro-credentials but who are not yet engaged in the conversations with those focused on teaching and training the skills perceived to be required in the jobs marketplace.
- Expansion of the research conducted during the Global Victoria EdTech Innovation Alliance project, using the research instruments developed, to gather further stakeholder data from future participating education providers using Credentialate that issue digital micro-credentials and Personal Evidence Records.

Conclusion

Typical educational credentials, particularly within the higher education context, fall short of skills-recognition requirements as discussed by Richard West and his colleagues (2020) in that they are:

i. incomplete as a record of what a person has accomplished, knows and can do

ii. data-poor, usually only communicating broad overall data that may be summarised as grades with little contextual or personal achievement data,

iii. cognitive-centric, and do not relay the 'soft-skills' employers seek and value iv. difficult to understand in the context of role / industry requirements.

Digital micro-credentials aim to address these inefficiencies by providing contextualised, certification-style credentials that focus on a particular area of discipline and the proficiency of skills the learner has developed in that area. The project findings from the project partner interviews identified that students reported being excited about the granularity of skills descriptions contained within their Personal Evidence Record. Edalex is currently developing a 'skills playbook' onboarding guide for educational institutions to help them address the key challenges of implementing a digital credentialing program, such as that used by the Universities of Dayton and Melbourne for this project, and provide students with the understanding of the skills they've learned and the digitised evidence of those skills to use in recruitment situations.

Furthermore, project findings indicate that learners and educators have an appetite for skills and competency-based digital credentials that can be woven into existing curriculum design. These key stakeholders in the micro-credential and skills ecosystems could see that the Credentialate platform could facilitate higher education institutions to transition into a previously daunting space, and where recognition of competencies, better articulation of skills and the implementation of a skills-focus in universities is possible and achievable. Although limited employer participation in this project, interviews revealed that employers value skills which affirms research outcomes from other investigations (e.g., Gallagher, 2016; Smith, 2018). The practice of digital micro-credentialing allows institutions and learners to align with the skill needs of industries and professions, with the digital micro-credential certificate ('badge') and Personal Evidence Record providing personal, portable and easily verifiable evidence of learning.

Most importantly, the quantitative research showed a distinct trend of students being more confident in articulating their skills following receipt of their digital credential, particularly in the area of resume writing. Carlin et al (2018), Dimopolous (2020) and Elzey's (2006) research supports the postulation that an applicant's confidence in hiring situations is a fundamental aspect of their success in being awarded a role. Digital credentials are a tool that institutions can use to bring greater value proposition to their education offerings and to augment the career success of their students. The 'gamification' of achievements in education through the use of digital badges has also emerged as a means to motivate and reward students (Delello *et al*, 2018), thus keeping them engaged with the learning process and may have implications for digital micro-credential design.

Through this study, digital credentials have emerged as a positive influence on both learners' and employers' confidence in addressing the skill-to-job alignment criteria during a hiring situation. Survey participants (i.e. learners) indicated improvements in confidence across all mediums (resumes, interviews, application / example) when presented with the skills information contained within the digital credential with the Personal Evidence Record. Of particular noteworthiness is the result that female undergraduates, those most likely to be affected by gender gap related inequalities in the workplace (Carlin *et al*, 2018), their confidence was increased across all mediums post-credential issue, implying that digital credentials can and do provide the opportunity for women to participate equitably with men when discussing the skills and attributes they bring to a role.

Appendix A - Sample digital 'badge' icons used in the digital micro-credential and Personal Evidence Records

University of Dayton Credly digital 'badge' icon images (see below) representing Education Design Lab's *Collaboration and Empathy* 21st Century Skills Micro-credentials. When issued, digital micro-credentials such as those produced by badging platforms Credly (as in the case of University of Dayton) and Badgr (as in the case of University of Melbourne) contain metadata describing the micro-credential attributes and allowing badges to be validated using an Open Badges Validator.

University of Melbourne Badgr digital 'badge' icon image used in the digital micro-credential representing the *Strategic Social and Sustainable Procurement* Melbourne MicroCert.

The following images present the improved visual and functional design for the Personal Evidence Record; a development completed following the recommendations from the research study. The refurbished design includes improved information accessibility via embedded links to external skills data such as Rich Skills Descriptors (RSDs).

The data presented on each learner evidence record contains detailed information of skills demonstrated through assessment tasks and alignments which capture relevant professional standards and key policy frameworks that are not represented in the badge or RSD metadata.

University of Melbourne Personal Evidence Record

University of Dayton Personal Evidence Record

University of Dayton
Institute of Applied Creativity for Transformation

EXAMPLE Badge

Joe Learner

has been awarded

Micro-credential name

based on the evidence catalogued below

Awarded on: 2/5/2023 Issued by: University of Dayton

Verify Print Share

Skills

Listen Actively
Uses other words to reflect what the speaker has said, showing ability to do more than one of the following: express using body language to show engagement, listens with focus on what speaker is saying, refrains from giving advice, and adapts speaker ideas throug...
Read More
Level: Silver

Strengthen Relationships
Strengthens personal relationships by doing all of the following:
• Treats team members respectfully by being polite and constructive in tone and word choice.
• Uses positive language to justify personal decision...
Read More
Level: Gold

Focus on Solutions
Identifies one or more approaches for solving the problem. Proposes a solution/hypothesis that is difficult to evaluate because it is vague, weighs impacts of solution and makes vague connection between individual issues and solutions. Idenitifies...
Read More
Level: Bronze

Incorporate Diverse Perspectives
Student is developing this skill
Level: Developing

Alignments

21st Century Skills Competency Framework - Original
21st Century Skills Competency Framework - Original

Focus on Solutions
Create forward momentum that advances the work of the organization.

Incorporate Diverse Perspectives
Enlarge the conversation; challenge their own thinking; and maximize group effectiveness.

Listen Actively
Form productive working relationships; ensure that others feel heard and valued; and grasp and retain information.

Read More

Powered by Credentialate

Appendix B - Survey and interview questions

Due to the differences in the two participating universities' demographics, equivalent questions occasionally required slightly different wording to maintain meaning and relevance depending on the cohort. The Tables below represent the two bespoke versions of the questions per their tailoring to suit purpose.

Table A: Pre-credential survey questions

University of Melbourne Version	University of Dayton Version	Question Format
What is your gender?	Please indicate your gender.	Multiple options
What is your age?	What is your age?	
What is your current employment status?	Are you externally employed (e.g. not as a work study at the institution) while a student?	Multiple options
What is your highest qualification prior to commencing this Melbourne MicroCert?	What is your program/major/degree?	Open text
How confident do you feel expressing your skills relating to your Melbourne MicroCert to your current or prospective employer?	How confident do you feel expressing the knowledge of your badge through application or example?	Likert scale
How confident do you feel expressing your skills relating to your Melbourne MicroCert through a job application or promotion?	How confident do you feel expressing the knowledge of your badge on a resume?	Likert scale
How confident do you feel expressing your skills relating to your Melbourne MicroCert in an interview?	How confident do you feel expressing the knowledge of your badge in an interview?	Likert scale
Contact information for matching survey responses	Your contact information entered above is also used to match your pre-test survey responses with your post-test survey responses.	Open text

Table B: Post-credential survey questions

University of Melbourne Version	University of Dayton Version	Question Format
What is your gender?	Please indicate your gender.	Multiple options
What is your age?	What is your age?	Multiple options
What is your current employment status?	Are you externally employed (e.g. not as a work study at the institution) while a student?	Multiple options
What is your highest qualification prior to commencing this Melbourne MicroCert?	What is your program/major/degree?	Open text
Please rate how important you think each skill development is for your current career success.	The (skill name) Badge you have enrolled in has several sub-competencies incorporated within it. Please rate which of the following competencies you think are the most important for your job after graduation:	Likert scale
How confident do you feel expressing your skills relating to your Melbourne MicroCert to your current or prospective employer?	How confident do you feel expressing the knowledge of your badge through application or example?	Likert scale
How confident do you feel expressing your skills relating to your Melbourne MicroCert through a job application or promotion?	How confident do you feel expressing the knowledge of your badge on a resume?	Likert scale
How confident do you feel expressing your skills relating to your Melbourne MicroCert in an interview?	How confident do you feel expressing the knowledge of your badge in an interview?	Likert scale
What impact does the evidence record have on your confidence expressing your skills relating to your Melbourne MicroCert?	What impact does the evidence record have on your confidence expressing your skills relating to your University of Dayton Micro-credential(s)?	Likert scale
How might you use your awarded digital credential, Strategic Social and Sustainable Melbourne MicroCert?	How might you use your digital badge?	Multiple options
How might you use your Personal Evidence Record?	How might you use your Personal Evidence Record?	Multiple options

Employer semi-structured interview questions

Information was gathered from potential student employers via an informal interview format. The interviews were recorded and transcribed for analysis. The interview questions script is available below.

1. How do participating employers perceive the value derived from undertaking a University of Melbourne/University of Dayton program which is a digital credential?
    - What is your understanding and experience of digital credentials?
    - Describe the perception of digital credentials within your workplace.
    - Describe how you think the procurement sector values (or not) digital credentials to upskill the workforce. Can you illustrate with an example?
2. How do participating employers perceive Credentialate is supporting the representation of skills through the artefacts of the digital credential and evidence record?
    - How would a digital credential and evidence record improve your ability as an employer to evaluate an employee's / applicant's skills? Why is this important?
    - How does your organisation provide for upskilling the workforce currently? Are there any issues?
    - How is the development of skills acknowledged/ recognised within your organisation? Are there any issues?
3. How do the participating employers perceive the value of the learner's Personal Evidence Record to bridge the communication gap in the skills ecosystem to enhance employability outcomes for learners and employers?
    - Using the sample images of the digital credential and Personal Evidence Record, discuss the value (or not) of these assessed and verified artefacts of professional learning and development in your workplace.
        - How might your workplace use/ recognise the employees who will earn these digital credentials?
    - How could the digital credential and Personal Evidence Record be used by employers in recruitment and/or promotions processes?
    - What would be the enablers to using digital credentials and Personal Evidence Record within the workplace? Why?
    - What would be the barriers to using digital credentials and Personal Evidence Record within the workplace? Why?
    - How do you view the relationship between digital credentials with embedded Personal Evidence Record and upskilling/employability?

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About Edalex

Power your single source of truth for learning and skills data

Edalex is an EdTech company powering your single source of truth for skills and learning data. Founded in 2016, Edalex develops technology solutions that extract hidden value from educational data to make it accessible and more meaningful. Edalex brings together the team behind the CODiE award-winning **openEQUELLA** open source platform that centrally houses teaching and learning, research, media and library content.

In 2019, Edalex launched **Credentialate**, the world's first Credential Evidence Platform, that helps discover and share evidence of workplace skills. Credentialate creates order from chaotic data, provides meaningful insight through framework alignment and equips each learner with unique, rich, industry-aligned evidence of their skills and competencies. Credentialate has continued to evolve at an accelerated pace, informed in partnership with educators and industry leaders from around the world.

openRSD was released by Edalex in 2022 to help create, store and share rich skill descriptors (RSDs) and RSD collections. openRSD uses Edalex's open source technology stack to create locally- and globally-relevant libraries of RSDs that are open to all contributors and consumers. RSDs are the building blocks of a skills-driven labour market. They structure skills data, add context around a particular skill and are both human and machine readable. RSDs bring equity to the learner and the skills ecosystem and provide an even playing field for skills recognition

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