# Developing a More Granular and Equitable Approach to the Learner-Earner Journey. The Role of Badging, Micro-Credentials and Twenty-first Century Skills Within Higher Education to Enable Future Workforce Development

**23**

Grame Barty, Naomi Boyer, Alexandros Chrysikos, Margo Griffith, Kevin House, Tara Laughlin, Ebba Ossiannilsson, Rupert Ward and Holly Zanville

**Abstract**

This chapter introduces trends within the global skills economy and explores how our learner-earner journeys can best align to these trends. It starts with a discussion of future global workforce skills requirements from higher education courses and discusses emerging Future Skills. It then considers how

G. Barty
Co-Leader ICoBC Global Workforce Development Working Group/Head of Issuing Authorities, ICoBC/Credshare, Neutral Bay, Australia
e-mail: hello@credshare.com

N. Boyer
Executive Director, Education Design Lab, Washington, DC, USA
e-mail: nboyer@eddesignlab.org

A. Chrysikos
Senior Lecturer and Researcher in Computing Science (Cyber Security), London Metropolitan University, London, UK
e-mail: a.chrysikos@londonmet.ac.uk

schools can align with higher education and workforce requirements through a skills-based approach to delivery and how higher education courses can better align to schools, workforce requirements and other potential outputs. The chapter then explores validation models, micro-credentials, and alternative credentials, considering alongside this the role of equity within skills-based education and hiring systems. Finally, it concludes with some key policy and process considerations.

## 23.1    Introduction

The global skills economy is increasingly reliant on an agile skilled workforce that can quickly adapt to changing consumer behavior and labor market demands. This agility has already seen profound changes to the careers and opportunities of learner-earners around the world. Workforce migration has increased signifi-

M. Griffith
Edalex Pty Ltd, Hobart, Australia
e-mail: info@edalex.com

K. House
Education Futures Architect, Education in Motion, Singapore, Singapore
e-mail: Kevin.House@eimglobal.com

T. Laughlin
Education Designer, Micro-Credentialing Project Manager, Education Design Lab,
Washington, DC, USA
e-mail: tlaughlin@eddesignlab.org

E. Ossiannilsson
Professor and Research Fellow, Victoria University of Wellington, Wellington,
New Zealand

R. Ward (✉)
Director of Strategic Partnerships & 21St Century Skills Working Group Co-Lead/
Professor of Learning Innovation and Associate Dean,
ICoBC/University of Huddersfield, Berlin, Germany
e-mail: rward@icobc.net

H. Zanville
Executive Committee of the ICoBC/Research Professor and Co-Director of the Program
Skills, Credentials & Workforce Policy (GWU), ICoBC/George Washington University,
Washington, DC, USA

cantly, job security has reduced, economies have transformed from local skill low income to high skill high income and vice versa through responding quickly to opportunity and through strategically planning skills development amongst their workforce, or by neglecting both of these. From the learner-earner perspective there are both opportunities and threats from this agile globalized economy. How can we best respond to this agility as learner-earners? What socio-technical solutions can assist us in managing this agility? What do we need to consider when looking to change careers, job roles or when trying to plan our learner-earner journey?

This chapter considers these questions from a social constructivist perspective, outlining some current trends which will be part of answering these questions. It considers, for example, how learner-earners will need to consider how they carry evidence of their skills around with them within digital wallets rather than as a traditional resume/CV, how they will be able to communicate to themselves and others what skills they have and how reskilling and adapting to new roles may become much more agile with specific skills being upskilled rather than the traditional requirement to completely retrain or undertake a full qualification. These changes introduce a new, more granular, and more lifelong learner-earner journey, based on badges, micro-credentials, and skills, which enable us all to better communicate our capabilities and competencies, and in so doing provide opportunities to address long standing structural inequalities by providing more equitable education and employment mechanisms.

Within this chapter, the term Future Skills relates to the NextSkills definition i.e. ***competencies that allow individuals to solve complex problems in highly emergent contexts of action in a self-organized way and enable them to act (successfully)***. *They are based on cognitive, motivational, volitional and social resources, are value-based and can be acquired in a learning process* (Ehlers, 2020; NextEducation, 2023)*.* They are also contextualized in respect to subjects, objects (e.g. systems) and organizations. In comparison, the term twenty-first Century Skills remains contested. For example, Partnership for twenty-first Century Learning provides a Framework for twenty-first Century Learning based on key subjects and twenty-first Century Themes (P21 – Partnership for twenty-first Century Learning, 2019), whilst Assessment and Teaching of twenty-first Century Skills (ATC21S) provided a framework based on tools for working, ways of thinking, and living in the world (ATS2020 Project, 2023). Twenty-first Century Skills also tend to be contextualized with respect to different perspectives which further adds to the lack of clarity when using the term.

In this chapter, twenty-first Century Skills are viewed from a personalized learning perspective (Ward, 2020); i.e., where Future Skills focus on the com-

petencies that permit learner agency, twenty-first Century Skills focus on how the learner can develop agency through competencies; i.e., how learners develops themselves. In this chapter we therefore define twenty-first Century Skills as *competencies gained by a learner that enable them to self-reflect, self-regulate, and self-optimize their capabilities within highly emergent contexts*. This is a very subtle difference and for the most part this means both terms can be seen as almost interchangeable throughout these discussions. The twenty-first Century Skills definition provided here lists many areas that can be seen as Future Skills. It is in their application to, or by, the learner therefore that there is this subtle difference.

## 23.2 Future Skills and the Global Workforce: The Challenge for Higher Education

What global workforce employers require, in terms of Future Skills from Higher Education, at its simplest is for new employees to be able to engage in productive work immediately upon appointment. We agree with the analysis that students want to undertake Higher Education training that is flexible, affordable, and with the high potential to lead them to the job or career they seek (Pichette et al., 2021). However, a number of factors are conspiring to force educators, employers and students to better understand the 'future' skills required for the global workforce. For example, one factor is that access to digital technology and platforms is increasingly ubiquitous. Satellite broadband, 5G Mobile Networks, and Artificial Intelligence are providing levels of broadband access and capability for the first time in the world's largest markets such as Greater China, South Asia, the countries of Africa and Latin America.

Low-cost smart devices available today can now also provide a high-performance computing capability to individuals in these markets to access new global digital services—including education and training. Given these technological developments, twenty-first Century Skills capabilities have become increasingly critical, not just desirable, for individuals to participate in the global workforce. For Future Skills, we also need to understand where the future source of global talent resides. Global demographics show us very large populations in emerging markets are proportionally younger and will require an unprecedented level of jobs, and require twenty-first Century Skills to match (Adekeye, 2019). In addition, in any future global workforce, the importance of skills that can be transferred between different jobs is critical. Young people entering the workforce

today may have many employers and different careers over their working lives (Foundation for Young Australians, 2017).

Another once in a generation change in new skills needed for workers has been brought on by the COVID-19 pandemic. What does that mean for employees' skills going forward? Growth in global sourcing and recruitment for nearly any job role is now more possible, even more attractive, because of the positive COVID remote working productivity experience of most of the world's businesses. However, this places a new emphasis on both worker and manager skills to maintain an esprit de corps, corporate culture and worker and business technical performance without the benefit of in-person communication. At the same time, we are moving to a more automated and global workforce. Alongside many jobs disappearing, as they become automated, the digitization of roles increasingly means global workforce fluidity in both how we can work and how we can be employed (Foundation for Young Australians, 2017).

The key element of this changing environment for Higher Education is that, over a career, lifetime tertiary knowledge expires (sometimes referred to as a 'half-life' of higher education) whilst skills and reskilling requirements are ongoing. Future Skills will need to be delivered differently, be affordable and flexible, and be able to relate 'exactly' to the employer's requirements as it's employers needs that are being met. Furthermore, significant employers, such as IBM, can no longer wait three or four years for students to graduate (Leaser, 2020). Short courses with the right skills for the role are now equally valuable. There are numerous interpretations of what Future Skills are. A recent International Council of Badges and Credentials (ICoBC) twenty-first Century Skills Report identified the categories of 'future' skills (ICoBC, 2021). These included **Learning/Cognitive/Thinking Skills** such as analysis, creativity, innovation, problem solving, researching, reasoning, synthesis; **Life Skills** such as adaptability, communication, initiative, planning, resilience, self-regulation; **Career/Working Skills** such as collaboration, entrepreneurship, leadership, management; **Digital Literacy/Tools for Working Skills** such as data analysis, presentation, reporting; and **Citizenship/Ways of Living in the World Skills** such as economics, ethics, health, professionalism, socio-cultural awareness, sustainability.

Interestingly, much of the discussion regarding future workforce skills refers not to technical competence, but rather to 'human capability'. That is, an individual's character, disposition, and mindset. In one workforce example, The Institute for Working Futures (IWF) has developed 'A Future Capability Reference Model on Human Capability Standards' which is available to educators and policy makers to improve graduate employability, and to accelerate the development of a future-ready workforce (The Institute for Working Futures, 2020). IWF claims

these are the non-technical worker and leadership capabilities that will form over 62% of all future job profiles.

Cheryl Oldham, Senior Vice President of Education and Workforce, U.S. Chamber of Commerce Foundation refers to these as 'durable skills' as a combination of how you use what you know, skills like critical thinking, communication, collaboration, and creativity, as well as character skills like fortitude, growth mindset and leadership (America Succeeds, 2021).

Durability, by definition, infers "enduring capabilities" which in turn delivers what America Succeeds describes as "Future Ready Capabilities". The challenge for higher education institutions in preparing students for the global workforce is to understand not only what it can provide in terms of historical, unique teaching methods, but how they can integrate internationally acceptable human capability and durable skills as an essential component of any course curriculum. Getting this right will provide institutions with a competitive ability to both source and attract the right students for the training for which they are best suited, as well as provide them with the level of immediate work skills employers require (The Institute for Working Futures, 2020).

## 23.3  Teaching and Learning in Schools: An Opportunity for Higher Education

### 23.3.1  Connecting High School with Higher Education

For an increasing number, one of the important transition points in lifelong learning is that between school and university. However, much of the contemporary literature examining Future Skills largely overlooks a learner's credential journey from compulsory to tertiary education. Therefore, this next section raises issues with this transition before going on to offer two examples of how there might be a better knowledge and skills alignment between the two education systems. Over the last 30 years, we have seen a continuation of the twentieth-century tradition of recognizing only a narrow range of 'academic' knowledge and skills as the core requirements for pre-tertiary student graduation. This means the final two to four years of the student learning experience in compulsory schooling prioritize a well-established, and largely siloed, set of disciplinary subjects, which then benchmark end point evidence of student knowledge using high stakes summative examinations that have remained unchanged since the eighteenth-century (Shackleton, 2014).

In the context of the twenty-first century future of work agenda, this means that most compulsory schooling provides little opportunity to nurture, practice or recognize the development of durable, soft skills amongst school leavers. The aim of this section of the chapter is to first provide a summary of the common current forms of school graduation recognition (credentialing), and their skills gaps, before moving to explore scenarios of how the final years of schooling might look in a future that better anticipates both tertiary and workplace learning and skills development.

## 23.3.2  The School Graduate Picture Today: A Tale of Two Worlds

Global school graduate credentialing is dominated by two systems, both of which historically evolved in Western education systems on both sides of the Atlantic Ocean. From North America we find various iterations of the Carnegie high school transcript model. This delivers a cumulative student transcript built over four years and based on credits that are directly related to what is known as 'seat time.' This term refers to the hours of instruction provided to cover the pre-established content of a specific disciplinary subject. A student's accumulation of knowledge and skills in these disciplinary areas is then evidenced by an assessment process that uses end-point examinations. The scores drawn from these examinations then lead to pass or fail judgements that directly relate to the credit entered on the four-year high school student transcript. On successful completion, this transcript leads to the award of diploma or diploma with honors. Today, in many contexts, advanced subject specialism is recognized by leveraging externally benchmarked examinations such as College Board's Advanced Placement or individual subject certificates drawn from the International Baccalaureate's Diploma Program. These specialist advanced qualifications often lead to students having recognized undergraduate credit with selected North American universities.

However, much of the rest of the world defaults to a qualification rather than transcript-based pre-tertiary approach. The reason for this, we would suggest, is largely to do with the level of centralization at the ministry of education level. The transcript model evolved because of a largely devolved approach to, and little centralized management of, education. Qualifications, on the other hand, grew out of more central government management of educational provision and its credentialing.

Qualification approaches come in many guises and are either awarded by a nation state's ministry of education or by a government-regulated awarding body that is external to the school system. However, qualifications rely on hours of instruction of a predetermined curriculum scope and sequence over a set period, which is not dissimilar to the transcript notion of seat time. Examples of centralized, ministry-awarded qualifications would be the French Baccalaureate and the German Abitur. Examples of regulated, externally-awarded credentials would include the English GCSE and A Levels and the International Baccalaureate's Diploma Program.

By and large, transcripts nor qualifications identify, evaluate, or award credentials for what are now referred to as twenty-first Century Skills. However, whilst not prioritized, there are many instances where the learning experiences do incorporate the development of these skills as a by-product of the school experience in traditional academic knowledge and skills curricula. However, they are to date doing nothing to recognize such skills development using credential systems, and this creates distinct problems related directly to any Diversity, Equity, Inclusion and Justice (DEIJ) agenda and impacts future citizens globally (Zhong & Shetty, 2021).

### 23.3.3 The Gaps

There are simple changes to high schooling that could both empower the Diversity, Equity, Inclusion and Justice agenda and better meet the needs apparent in the well-documented 'future of work' crisis. The current narrowness of knowledge and skills delivered through compulsory education limits the credentialing and recognition of a more diverse range of skills, knowledge, and dispositions. This is largely driven by well-established qualifications such as A Levels (United Kingdom), Advanced Placement (United States), and the International Baccalaureate's Diploma Program. Their global dominance is maintained by a university system that continues to view them as 'gold standard' qualifications, which dominate entry to undergraduate degrees. Consequently, this has led to vocational qualifications being regarded as second-class qualifications even though many deliver on Future Skills better than traditional academic qualifications. The institutional privileging of these qualifications, even when they have equivalency in nation qualification frameworks, creates a social hierarchy that leads to inequity in skills recognition, and ultimately limits access to lifelong learning, whereas better tertiary recognition of a wider range of knowledge, skills and dispositional traits would lead to a more inclusive education environment. Building wide-rang-

ing micro-credentials could break the current qualifications hierarchy by evidencing a wider knowledge and skills matrix, and this would enable better recognition of all learners' social capital and make the institutional practices of education and employers more just (Young & Hordern, 2022).

### 23.3.4  The Future

Few would deny that more equity is not desirable in future education and employment, but the question remains as to how we redesign compulsory schooling so that it better connects with higher education and workforce needs. To explore this further, below is a summary of two approaches currently being developed in high school contexts.

Here, we present two current high school models that each seek to build non-traditional learning experiences alongside recognition of longstanding and traditional knowledge and skills. The first example is built around a deep commitment to nurture dispositions, skills, and knowledge that will provide young people with a clear sense of their role in harnessing understanding to create a more sustainable relationship between human beings and the planet. Green School International[1] is a group of schools that have built a high school program that balances traditional academics with Project-Based Learning experiences to provide students with multiple opportunities to both apply learned skills and identify pathways for new learning. The second example is the School of Humanity,[2] which is an online first and hybrid high school model. Beyond traditional academics, School of Humanity again uses a PBL backbone to fully equip young learners with the digital fluency to navigate a world in which technology has become ubiquitous. However, this high school program is also founded on somatic and intellectual skills that aim to accelerate student awareness of human flourishing as a core educational principle in compulsory schooling.

Both models use the Mastery Transcript Consortium (MTC)[3] (see Fig. 23.1) online platform to build a competency-based credits system that captures durable, soft skills development as well as academic knowledge. This is done by mapping specific learning outcomes to a high school credit matrix, which students accu-

---

[1] https://www.greenschool.org/

[2] https://sofhumanity.com/

[3] https://mastery.org/

**Fig. 23.1** Mastery Transcript Representation by MTC (2023)[4]

mulate over the four years of the program. It ensures that a predetermined range of core credits are accumulated whilst also allowing for high levels of person-alization through self-identified areas of knowledge and skills specialism. The MTC platform also gives students the opportunity to curate a digital portfolio of extended knowledge artefacts, which provide evidence to their credited knowl-edge and skills being used.

Alongside this transcript approach, each school is designing a digital wallet that houses the entire digital record of a student's learning during the four years. This entails, for example, peer and faculty awarded Non-Fungible Tokens (NFTs) for soft skills displayed in collaborative activities, or badges recognizing partici-pation in learning events such as workshops or short-term externships. These wal-

---

[4] See https://mastery.org/what-we-do/mastery-transcript/.

**Transcript:** Mastery Transcript Consortium's platform offers a more expansive 21st century high school transcript.

**Micro-credentials:** A digital wallet comprising of micro-credentials that evidence beyond traditional academic learning to include *adaptive skills.*

**Portfolio:** A digital portfolio of student work to demonstrate a wider range of evidence of learning artefacts embedded in micro-credentials.

**Qualifications:** Stackable micro-credentials offer a new model of hyper-personalization for traditional pre-tertiary qualification.
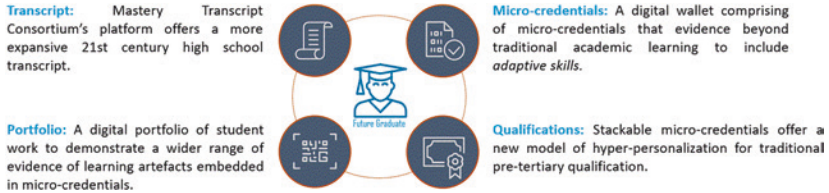
**Fig. 23.2**  Credential Ecosystem (own representation by Kevin House)

lets also house both verified micro-credentials issued by the school and certified ones issued by embedded industry and tertiary partners (Fig. 23.2).

In summary, the digital wallet becomes the repository for all learning and speaks to a learner's future learning pathways and future work trajectory. Fundamentally, the MTC transcript represents the pragmatic need to curate and represent granular components from the digital wallet in a form that speaks to the reality of today's tertiary admission industry processes. However, both these school models anticipate a time when the transcript concept falls to the wayside as it is replaced by the digital wallet. As societies move toward digital forms of identity across a wide range of areas such as taxation, health care, insurance, formal, non-formal, and informal credentialing will also follow suit. When digital credentialing is fully embedded there will be no need to rely on narrow academic qualifications or seat time-based transcripts because micro-credential wallets will reflect learners' full skill sets, bringing about more equity and a frictionless integration into higher education and continued lifelong learning.

This section has argued there is a problematic relationship between compulsory schooling and tertiary education, one that requires the development of digital wallets at school level, which contain a range of micro-credentials that can be added to during university and beyond. Therefore, it is now important to consider how such micro-credentials have been evolving in the tertiary system.

## 23.4   Future Skills and Teaching and Learning Within Higher Education: Contextualizing Micro-Credentials

Crawford (2021), president of Miami University, claims:

> *"Degree programs are no longer sufficient in supporting student success and meeting industry needs. Micro-credentials can do both, affordably and conveniently. As*

> *higher education aims to meet the needs of a rapidly changing post-COVID world and workplace, micro-credentials are emerging as a quick, compact, targeted way to instill and certify the particular skills that add value to a résumé and empower individuals to move toward their goals. These tools vastly expand the traditional education options that stretch from the two-year associate degree to the four-year bachelor's, additional-years master's and multi-year doctorate. They can be earned fast, and they provide employers with specific information about the person's qualification. A micro-credential can stand alone, become part of a curriculum or stack with other micro-credentials to demonstrate increasing knowledge".*

Micro-credentials are growing rapidly in the higher education world (Ossiannilsson & Kaur, 2021). Their growth is especially notable in colleges and universities committed to workforce development and alternative credentialing; in academic programs aligned with employers who require micro-credentials for entry (whether combined with academic degrees or not); and in regional, national, and international initiatives that focus on providing micro-credentials sought by individuals and employers for skilling and reskilling of workers.

While there is no common definition of micro-credentials, they can be defined as "proof of learning outcomes that a learner has acquired following a short learning experience" (European Commission, 2020, p. 10). These may be focused on a discrete set of competencies or a particular area of expertise, for example. They tend to be flexible in delivery and require demonstration of mastery. The term badges, which is often used synonymously with micro-credentials, is often used to represent the digital iconography associated with the micro-credential, that when clicked on provides information called metadata about the specifics of the earned digital credential, though it can also refer to the learning achievement itself.

According to OECD (2021a) "[t]he association of micro-credentials with a specific organized learning distinguishes them from badges" (p. 2–3); i.e., badges can represent a very broad range of learning achievements, whereas micro-credentials represent specific learning achievements aligned to organized learning, or indeed to a component of a credential, hence the term micro-credential. Where specific learning achievements are aligned to organized non-degree learning, and especially when these relate to workforce requirements, the term alternative credential is often used (Fong et al., 2016).

Micro-credentials are often designed as micro-learning modules (skills, knowledge, and attributes); and are often related to other credentials, stacked together, and portable (see Table 23.1).

Digital Credentials, or the digital representation of previously paper-based academic credentials such as degrees, diplomas, certificates, and certifications,

**Table 23.1**  Examples of Definitions of Micro-credentials

**European Commission** (2021, p. 1): "A micro-credential is the record of the learning outcomes that a learner has acquired following a small volume of learning. These learning outcomes have been assessed against transparent and clearly defined standards. Courses leading to micro-credentials are designed to provide the learner with specific knowledge, skills and competences that respond to societal, personal, cultural or labour market needs. Micro-credentials are owned by the learner, can be shared and are portable. They may be standalone or combined into larger credentials. They are underpinned by quality assurance following agreed standards in the relevant sector or area of activity."

**National Education Association** (2020): Micro-credentials are a digital form of certification indicating demonstrated competency/mastery in a specific skill or set of skill

**UNESCO** (2022, p. 20): "[…] typically focused on a specific set of learning outcomes in a narrow field of learning and achieved over a shorter period of time. Micro-credentials are offered by commercial entities, private providers and professional bodies, traditional education and training providers, community organisations and other types of organisations. While many micro-credentials represent the outcomes of more traditional learning experiences, others verify demonstration of achievements acquired elsewhere, such as in the workplace, through volunteering, or through personal interest learning. Micro-credentials are often promoted as an efficient way to upskill workers across the lifespan. A micro-credential: Is a record of focused learning achievement verifying what the learner knows, understands or can do. Includes assessment based on clearly defined standards and is awarded by a trusted provider. Has stand-alone value and may also contribute to or complement other micro-credentials or macro-credentials, including through recognition of prior learning. Meets the standards required by relevant quality assurance."

**Wikipedia** (04/2023): In higher education, a micro-degree and also micro-credentials and micro-masters is a qualification focused upon a specified professional or career discipline and typically comprises one or more sources of accelerated educational experiences

provide a means for electronically documenting, awarding, and sharing information about learning achievements and skills. While digital credentials is a term encompassing a broad swath of academic achievements, there is great variety in the deployment of these credentials for various purposes. For example, in terms of stackability, there are various models of accommodating micro-credentials within degrees, such as Reece's model for UK degrees (The Quality Assurance Agency for Higher Education/QAA, 2021) and the growth of micro-credentials has taken off particularly where there are policy directives from a governmental entity like a state higher education agency or national qualifications framework. In such instances, policy describes what micro-credentials are and how they fit among the array of approved credentials in an academic system.

Micro-credentials, digital badges, and industry-recognized certificates have expanded their scope considerably in recent years, driven by increasing demand for upskilling, retraining, and lifelong learning, as well as the sharp reduction in unit costs made possible by digitization. In the United States, the State University of New York (SUNY) policy sets standards guiding principles for development and support for a broad range of micro-credential types. A SUNY micro-credential is (1) competency-based, (2) endorsed by the issuing campus, (3) developed through faculty governance, and (4) meaningful and of high quality. Six guiding principles have been established: (a) academic quality is paramount, (b) faculty governance engagement is required, (c) aligned with campus mission and strategic goals, (d) aligned with industry-sector standards, (e) portable and stackable, and (f) online or in class, non-credit to credit, credit (State University of New York, 2023a, 2023b). SUNY further plans to launch a searchable database of micro-credentials, streamlined application processes, a data tracking and reporting system, and identify gaps in areas of focus and academic disciplines to ensure there are pathways from the undergraduate to graduate levels in high-demand fields (Proctor, 2021).

In Canada, there has been an explosion of micro-credentialing initiatives over recent years. Ontario's government-backed digital learning organization, E-Campus Ontario (2020), has been established alongside strategic micro-credential development at the University of New Brunswick, Dalhousie University, and the University of British Columbia (Macdonald, 2022).

In Europe, small learning experiences, such as short courses leading to micro-certificates, enable targeted acquisition of skills and competencies adapted to a rapidly changing society and labor market, without replacing traditional qualifications. Their aim is to be complementary. The European approach to micro-credits aims to provide a clear definition and European standards so that the learning outcomes of these small experiences can be easily recognized and understood by employers, learners and education and training institutions, and to develop guiding principles to be considered when designing or issuing high-quality micro-credits. Common approaches to the development and use of micro-credentials at European Union level can support and enhance national efforts to ensure their quality, transparency, cross-border comparability, recognition, and transferability. They can also help build confidence in micro-credentials for the benefit of learners, employers, and education and training institutions (European Commission, 2023a).

Continuing Education Units are particularly well positioned to facilitate the adoption of micro-credentials. "Continuing Education teams rely upon their understanding of student demand, employer demand and regional economic development to ensure their viability. Continuing Education teams have the abil-

ity to share our market identification, program design and operational skills that support short-cycle learning as a partner to academic faculties that are ready to venture into the micro-credential space" (LeBlanc, 2021).

There is growing recognition that infrastructure capacity must be bolstered to accelerate micro-credentialing. Key to infrastructure capacity are government policy and funding incentives. The latter will be particularly needed to assist (1) micro-credential providers to develop micro-credentials; (2) learners to participate in micro-credentials through loans/grants; (3) employers to offer work-integrated learning experiences and provide learners the opportunity for skilling and upskilling; and (4) development of interoperable data systems to track the acquiring of micro-credentials needed to determine the return on investments of these credentials in the workforce. Better data on the value and utility of micro-credentials will encourage postsecondary education institutions to create more micro-credentials, whilst governments, employers and publicly funded postsecondary institutions must work together to accelerate this work in response to policy and resource requirements.

The OECD (2021a) has issued several recent reports on micro-credentialing and is continuing to work in this area, especially in partnership with the European Commission (EC). The EC has undertaken an extensive consultation to help underpin a European approach to micro-credentials. Based on extensive consultation and evidence gathering, the Commission adopted a proposal for a Council Recommendation on a European approach to micro-credits for lifelong learning and employability in December 2021 (European Commission, 2023a). The proposal aims to:

- Enable individuals to acquire the knowledge, skills, and competencies to succeed in a changing labor market and society, and to benefit fully from a socially just recovery and an equitable transition to a green and digital economy.
- Support the readiness of micro-credit providers to improve the flexibility and transparency of their learning offerings to enable individuals to design personalized learning and career pathways.
- Promote inclusion and equity as a contribution to achieving resilience, social justice, and prosperity for all, in the context of demographic change and across business cycles.

To achieve these goals, the proposal outlines a European approach that recommends member states to apply a common EU definition, standards, and basic principles for the design and issuance of a micro-credit, including its portability;

develop an ecosystem for micro-credentials; and exploit the potential of micro-credentials to support lifelong learning and employability. As a result, micro-credentials can be developed, used, and benchmarked in a coherent manner by member states, stakeholders, and various providers (from education and training institutions to private companies) across different sectors, domains, and borders. The European approach aims to support ongoing work on micro-credits by Member States, stakeholders, and diverse groups of providers across the EU. The proposal was subsequently adopted together with a proposal for a Council Recommendation on Individual Learning Accounts, which can support the development, use, and uptake of micro-credentials.

The OECD (2021a, 2021b) has identified three key drivers of micro-credentials in many countries: (1) incredibly rapid innovation on the part of the higher education institutions; (2) surge in learning platforms and training programs providing micro-credentials; and (3) a struggle on the part of governments to understand what's happening and to make use of micro-credentials as a way of improving their education and training offerings. Also, across the span of OECD member countries, there are three emergent and distinct purposes to micro-credentials: employment and wage advancement; educational advancement; and enjoyment and personal growth.

The micro-credential and alternative credential offerors include those outside higher education ─ business firms, professional bodies, training firms, and vocational education institutions. These developments have and will continue to occur in competition with higher education institutions or in collaboration with higher education institutions. In the latter case, micro-credentials are often embedded in the higher education curriculum (Kato et al., 2020). One recent development, for example, is linking micro-credentials from organizations such as LinkedIn Learning, to recognition of academic credit (University of Huddersfield, 2023).

The ICoBC has developed a taxonomy and quality grid for micro-credentials (Ossiannilsson & Kaur, 2021). This taxonomy, quality criteria, and quality grid are based on current research and discourse in this field, and are intended to be universal and interoperable for use and implementation. The target groups for these guidelines include learners, employees, employers, program coordinators, and organizations of all sizes.

Based on the characteristics of the MicroHE[5] (2020) and the EC-suggested quality indicators (relevance, valid assessments, flexible learning pathways, recog-

---

[5] Support Future Learning Excellence through Micro-Credentialing in Higher Education, see https://microhe.microcredentials.eu/ for more information.

nition, portability, learner-centered, authentic, stackability, validation, and information and guidelines), the ICoBC have also proposed the following as overarching quality criteria: (i) accessible; (ii) authentic; (iii) digital; (iv) and universal. These four quality criteria are the suggested minimum requirements to guarantee the success of micro-certificates, their validity and reliability, their ability to sustain learners, and their overall value to all stakeholders. These four criteria can be subdivided into sub-criteria that provide more clarity by defining the measurement parameters when assessing the quality of micro-certificates (Ossiannilsson & Kaur, 2021).

ICoBC research conducted for the proposed ICoBC taxonomy, quality criteria, and quality grid show that all major organizations and stakeholders in education worldwide (for example, UNESCO, OECD, COL, MQA, EC, ICDE, and others) are currently strongly emphasizing the paradigm shift for education and labor markets, as well as the movement toward lifelong learning and everything related to it—not least the movement toward badges and micro-credentials. Thus, the development of digital credentials is urgently needed. This will require the use of best practices for badges and credentials on a regional and global scale, such as the design of badges and credentials (curriculum, testing, verification); use (internal marketing, practices); and taxonomies and alignment with official certification systems.

For micro-credentials to take their place among the array of valuable and trusted credentials (e.g., degrees, certificates, certifications, and licenses), governments, credential providers (colleges, universities, and third-party providers), employers, and other key stakeholders in the learn-and-work ecosystem will face many challenges ahead. Four will be key:

1. *Governments* will have the key role in setting policy to guide and incentivize through resources the development of micro-credentials. There will particularly be a two-fold challenge to governments: how can micro-credentials meet both labor market demand and the learning needs of students? Policy must incentivize pathways to study that are more open and more flexible than what students have today, allowing individuals to pause in their work journeys to return to resume education and training and update their education credentials. Policy will also need to support employer labor market needs by, for example, incentivizing employment-focused skill building and recognition. Governments will have to devise new funding models for micro-credentials, including funding for these credentials along with other types of credentials such as degrees. This will include funding formulas by federal and state governments, and revisions to traditional student aid systems.

2. *Data systems* must be in place to assess micro-credentials with an explicit vocational orientation, monitoring of occupational and earnings outcomes. The challenge is including micro-credentials in current education records systems since they are not generally included now. Until data systems are updated, education data cannot be linked to employment information systems that allow the type of assessment and monitoring of outcomes that will be needed.

3. *Quality assurance systems.* Countries will need appropriate systems to assure the quality of the micro-credential providers and the programs they offer. The current processes for higher education quality assurance are generally not fit for this now. Micro-credentialing will require revised or entirely new procedures for accreditors, standards bodies, and others concerned about the value and quality of micro-credentials.

4. *Trust and value*. The related issues of building trust and understanding among educators about micro-credentials, especially to achieve recognition and portability, will be a major challenge for all the stakeholders in the learn-and-work ecosystem.

## 23.5 Beyond Higher Education: Connect Learning to Opportunities Through twenty-first Century Skills

As the global skills economy develops, we are increasingly suffering the effects of what Ward et al. (2021) refer to as the ***Capability-Competency Chasm***. Capability (learning a skill along with any knowledge required to perform the skill) is different from competency (application of a skill with proficiency within a particular context). To be competent we need to know not just what (knowledge) and how (skills), but also why (dispositions) (CC, 2020, 2020), this is done through application.

Within schools and higher education, the traditional pedagogical model is one based on knowledge imparting and the development of capabilities within learners, the educational analogy of teaching a driver to pass their driving test. However, in the global skills economy they need to be able to drive in different road conditions, different weather conditions and with different amounts of traffic, i.e., they need to be a competent driver rather than simply a capable one. The skills economy therefore requires learners to experience different contexts, to apply their learning within these and through this to develop competence. Traditionally, this has been achieved to some extent at least within schools and higher education

through work experience, work-based learning, internships/placements and live projects, but these tend to represent non-compulsory or insubstantial elements of the overall learning experience and therefore when looking from an employment perspective it is little wonder that employers continue to complain that graduates lack the skills that are needed for employment.

The Capability-Competency Chasm, however, is as much a communication chasm as it is an educational one. The fundamental problem is really with how learning, and earning, are expressed rather than the learning and earning activities themselves. A chasm persists because of the language that is used to define learning and earning. On the capability side of the chasm, learning is defined and measured as learning outcomes, i.e., has this learning been gained? Or, perhaps more usefully in this discussion, has this capability been achieved? On the competency side of the chasm, earning is defined and measured as competencies expressed within competency frameworks and job roles, i.e., can this learner-earner demonstrate that they can apply their learning to a particular earning context?

A further difficulty when considering this chasm is the ability to communicate across subjects, organizations, and countries. On the capability side of the chasm, there exist national and international educational standards where comparability and value can be easily understood and exchanged. For example, in Europe, the European Qualifications Framework (CEDEFOP, 2023) provides an eight-level structure defining qualifications in terms of learning outcomes and enabling individual national qualifications frameworks to interconnect. It has also been piloted in Australia, New Zealand, and Hong Kong and UNESCO is seeking to agree on comparability for qualifications around the world through its Global Convention on the Recognition of Qualifications concerning Higher Education. On the competency side of the chasm, however, things quickly get more complex and fragmented. Considering the equivalent system within Europe, for example, the European Skills, Competences and Occupations (ESCO) classification (ESCO, 2023) provides a reference language for education and employment, and attempts to align non-formal and informal learning through open badges and digital credentialing, with qualifications, skills, micro-credentialing frameworks and employment. However, this is a very large undertaking. ESCO describes 13,485 skills and 2942 occupations. ESCO needs to connect with the Europass framework (Europass, 2023) in order to provide transparency and understanding of formal, non-formal, and informal qualifications and skills and how they are recorded and represented. The EU's Digital Education Action Plan (2023b) then intends to incorporate micro-credentials within all educational levels by aligning micro-credentials with the existing qualification framework structures. This alignment

and interconnectivity is to be applauded, however there are still significant gaps when making these connections, not least of which is the lack of clearly defined international agreement on standardized competency frameworks. Whilst there are international standards on competency frameworks, such as those developed through the IEEE (2023), they only standardize what competency frameworks should do and do not define what they are; i.e., a common competency framework standard. The challenge then is two-fold, how to better define competency standards, and how to better connect capability and competency.

The solution to these challenges is through the development of an intermediary that bridges the Capability-Competency Chasm. This solution (Ward et al., 2021) involves the use of a set of twenty-first Century Skills descriptors that enable skills profiles to be developed for both learners and earners. By translating learning outcomes into skills gained, and by breaking down job roles and competency frameworks into the skills required, educationalists, employers and learner-earners themselves can better understand what they have and what they need to have to proceed through their lifelong learner-earner journey. The choice of twenty-first Century Skills and the agreement on a universal taxonomy are perhaps still some time away, but there are clear benefits that can already be seen from adopting a twenty-first Century Skills approach to link Future Skills with education and employment.

For example, in the United States, Education Design Lab (hereby, Lab), a non-profit organization located in Washington D.C., uses human-centered design thinking to respond to complex issues that inhibit equity and quality of the learn to work talent pipeline. Two early design challenges that the Lab tackled were: 1) How might we capture and credential learning outside the classroom in ways that will be meaningful to employers? and 2) How might we demonstrate in different job markets that twenty-first century skill credentials have hiring value? As a result of this foundational work over the last eight years, the Lab co-designed, prototyped, tested, and scaled, a twenty-first Century Skills Framework with employers, higher education partners, and learners, which includes nine in-demand competencies: critical thinking, collaboration, creative problem solving, oral communication, resilience, intercultural fluency, empathy, initiative, and self-directed learning (Boyer & Payne, 2022). These high level, durable, cross-domain competencies are built upon four measurable sub-competencies creating a taxonomy over overlapping, complementary skills. Figure 23.3 below provides a visual representation of the framework, with the concentric hubs depicting the intersections between the 27 competencies.

The Lab's open framework has been adopted in a variety of secondary schools, higher education and career and technical institutions, alternative edu-
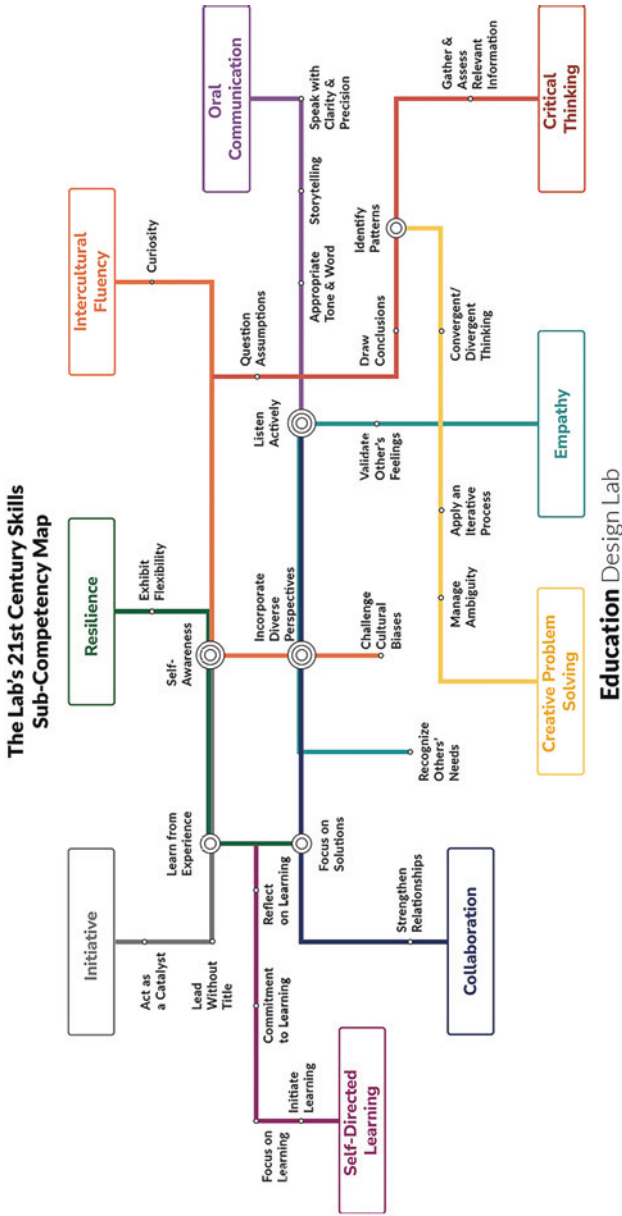
**Fig. 23.3** Education Design Lab twenty-first Century Skills Framework Representing Nine Digital Micro-credentials and 27 Sub-Competencies (Education Design Lab, 2023)

cation providers and employers in the United States, South Africa, Australia, Pakistan, and Canada. Despite the global interest in the structure and specifications of the twenty-first Century Skills, the implementation strategy, and technical processes of deployment present challenges to scalability and the tracking of learner-earner progress. To support this work, the Lab constructed "Rich Skill Descriptor" collection(s) that provide data schema for capturing the metadata, specific information about the individual sub-competencies, and can empower organizations and technology vendors when aligning curriculum, assessments, and earner achievements (Open Skills Network, 2023).

The twenty-first Century Skills have been emerging in importance over a number of decades. However, more recently the demand for these skills has escalated due to technological advancements, virtual work, and the lack of social development due to COVID isolation. The implementation of programs and structures to explicitly address the twenty-first Century Skills in practice through the award of digital micro-credentials involves a targeted learning pedagogy and a plan for delivery. The integration of digital micro-credentials provides the opportunity for higher education institutions to alter traditional learning practices to optimize: learner personalization; engaging learning methodologies; communication of competencies to be mastered; and critical reflection throughout the learning experience. Optimizing learner personalization, for example, supports twenty-first Century Skills development as competencies are gained by the learner that enable them to perform best in highly emergent contexts, and thus allow them to act successfully, with their Future Skills competencies communicated as they are mastered. Assessment of the twenty-first Century Skills is therefore both a critical component of the micro-credential delivery and award process, and a way of demonstrating Future Skills acquisition.

The Lab has two types of assessment available to validate mastery of the sub-competencies within the framework. First, activities called *proving grounds*, which incorporate performance-based, employer-informed scenarios that result in a variety of evidential artefacts that are assessed by facilitators against a binary rubric. The criteria in this rubric also underscores the second form of assessments that have been developed utilizing two next generation technologies, text-based simulations and extended reality immersive experiences, to create innovative auto-graded assessments. Quality, rigor, and consistency is maintained across the assessments through the common criteria, as any award of the Lab's twenty-first Century Skills digital micro-credentials is validated against the same standard.

Higher education institutions have implemented the Lab's twenty-first Century Skills framework in a variety of models. The base information and content of the twenty-first Century Skills credentials can be accessed through openly avail-

able resources in a resource Toolkit, such as https://eddesignlab.org/. Institutions are able to craft their own learning experiences from the provided information. In addition, organizations, for non-commercial use, can "map" their curriculum to the criteria in the rubric, capitalizing on existing content and courses being delivered in the curriculum across disciplines and programs. Finally, the most seamless and supported mode is the availability of online content modules that can be applied within a variety of academic delivery models. Organizations have deployed the twenty-first Century Skills in a plethora of ways from credit, non-credit, and extracurricular to workforce focused and humanities infused.

Implementation models of twenty-first Century Skills digital micro-credentials in higher education institutions include **credit-based approaches** such as modules integrated into existing traditional academic coursework, alignment of the twenty-first Century Skills framework and assessment criteria to course and program learning outcomes, optional opportunities for learners in required or elective coursework (e.g., University of Dayton, Fisher, 2021), stand-alone courses representing twenty-first Century Skills (with each digital micro-credential representing about 15 h of coursework), clustering of credentials into certificates in elective courses and upper secondary education ($11^{th} + 12^{th}$ grade in the United States) and integrated into existing curriculum (e.g., Propel Polk Initiative). **Non-credit-based approaches** include continuing education for non-admitted learner enrolment, designed and deployed directly for business partners (e.g., San Antonio Goodwill, UpSkill San Antonio), open enrolment in response to local workforce needs and in partnership with community agencies (workforce boards, youth groups, advocacy groups) to elevate a local citizenry. **Extracurricular approaches** include infused in workplace learning experiences (i.e., internships, co-ops, apprenticeships, and clinicals, etc.), as part of clubs and student groups (student government and affinity groups such as sports and academic achievement), open enrolment as an optional value added for learners to connect the higher education experience to specific job requirements, as part of an extracurricular STEM program, coupling content, support services, and twenty-first century digital micro-credentials in an extended industry support program such as Unity in Africa (https://www.uina.co.za/) and aligned to student affairs required compliance training to communicate job value of skills such as financial management and diversity, equity, and inclusion. **Liberal Arts and Sciences examples** include integrated and aligned across general education requirements and assessments utilized as accreditation documentation of mastery of required standards. **Workforce examples** include credentials coupled with industry certifications to form micro-pathways in either credit or non-credit learning options and direct response to economic development and talent pipeline needs identified by local or prospective employers.

## 23.6    Challenges and Further Research

There is a clear set of next steps required in research, policy, and processes in order to better connect higher education with schools, with employment, and with Future Skills. Firstly, it is critically important that global approaches to granularizing learning through badges, micro-credentials and alternative credentials are better understood, collated and communicated to a broader audience that for the most part are aware of, but not fully understanding of, how these approaches work and can provide significant benefit to society. ICoBC, for example, is developing an approach to recognizing organizations who work in this sector, enabling best practice to be shared and fostering growth in the skills ecosystem. Secondly, mechanisms for representing badges, micro-credentials, and alternative credentials need to work better with one another. Recognition will help with this, but a further key step is to identify skills framework structures, such as the twenty-first Century Skills approach highlighted above, that can work with badges, micro-credentials, and alternative credentials to support the transfer of value within the skills economy, i.e., by being able to break down qualifications and work experience into component skills which can be understood and recognized individually. This has enormous benefits for learners, earners, and employers as it will mean that less retraining is required and that the workforce can be more adaptable and responsive to skills economy needs. Thirdly, this greater interconnectedness can foster a more granularized and bespoke approach to education and employment. This has two key benefits that will benefit from further research. The first of these is the opportunity to reduce and remove many existing impediments to optimal learner-earner progress based on structural and societal barriers. This area of research is commonly referred to in the United States skills-based hiring and represents a broader focus on more equitable and fairer education and employment practices. The second of these is a more expansive version of the first. As well as the potential to reduce barriers to learner-earner journeys based on existing modes of education and employment, there is also the potential to optimize learner-earner journeys, i.e., to personalize learning and earning such that each learner-earner can take on a journey that optimizes their productivity within the skills economy but also optimizes their happiness, fulfilment and purpose within life. This has clear benefits not only within the skills economy but also in the better functioning of society as a whole.

    The challenges to enacting this are both structural and socio-cultural. Structurally existing standards and frameworks need to be leveraged or new structures developed that enable friction-free interoperability amongst education and

employment and between them. This chapter discusses some mechanisms to do this. Socio-culturally, trust in the currency of badging and micro-credentialing needs to increase. The currency value can be pegged to known value such as micro-credentials linked to existing formal qualifications, but challenges remain in particular in employment and in how we recognize non-formal and informal learning in commonly understood ways. Without this understanding within key stakeholder groups, such as employers, parents, teachers and learners, the use of and exchange through badges and micro-credentials will be limited. However as greater use is made of these mechanisms, familiarity, uses, and trust will all increase and therefore the main challenge is in widespread use of standards, frameworks, and ecosystem processes that facilitate interoperability and interconnectedness of badging, micro-credentialing, and skills-based hiring to enable a friction-free learner-earner journey.

## 23.7   Learnings and Recommendations

This chapter has sought to provide an overview of the current challenges facing higher education in connecting better with schools, employment, and indeed the learner-earner themselves. In terms of practical recommendations, the key focus within higher education should be on how granularizing learning can benefit all of these stakeholders. Badges, micro-credentials, and alternative credentials present an opportunity to review why and how learning is delivered within higher education (Ward et al., 2022). Higher education institutions should look on this as a critically important moment for them. The world, in the form of the global skills economy, is changing at an ever-faster pace. Education can and should respond to this by reflecting on what it delivers and how this best meets the needs of those it seeks to serve. Learning outcomes have long been the currency of education, and can easily be traded amongst many parts of the global education system, but they do not exchange well with the world of work and as we seek a more fluid lifelong learner-earner journey there are some key steps that higher education needs to take to minimize barriers and maximize opportunities for learner-earners. We propose a four-step plan for higher education to meeting Future Skills requirements:

1) Map existing provision to skills through the approach outlined by Ward et al., (2021, 2022).
2) Introduce opportunities to badge and micro-credential content using the approaches outlined by Ossiannilsson and Kaur (2021).

3) Review the skills developed within higher education courses against those sought by the global skills economy through working with existing labor market information data and organizations.
4) Develop a more personalized learner-earner journey through higher education by working better with schools to ensure better onboarding and recognition of existing capabilities, and with employers to ensure better transitioning and development of competencies for the global skills economy.

By taking these steps we can address many of our current global skills economy challenges and meet Future Skills demands, and in so doing, we can develop more effective, and indeed more fulfilled, lifelong learner-earners.

**Future Skills in Practice: Our Recommendations**
- Granularizing learning, through the increased use of badging and micro-credentialing, benefits all
- Badges, micro-credentials, and alternative credentials support restructuring of higher education
- Badges, micro-credentials, and alternative credentials support greater labor marker alignment
- Personalizing the learner-earner journey through twenty-first Century Skills can address Future Skills gaps
- Granular learning-earning routes optimize our lifelong adaptability in highly emergent contexts

## References

Adekeye, O. (2019). These are the 5 skills African employers are looking for. https://www.weforum.org/agenda/2019/09/skills-african-employers-are-looking-for/. Accessed 8 Feb 2023.

America Succeeds. (2021). The high demand for durable skills. https://americasucceeds.org/portfolio/the-high-demand-for-durable-skills-october-2021. Accessed 8 Feb 2023.

ATS2020 Project. (2023). Assessment of transversal skills resource portal. https://resources.ats2020.eu/resource-details/LITR/ATC21s. Accessed 8 Feb 2023.

Boyer, N. R., & Payne, S. S. (2022). Leveraging self-directed learning in the skills-based economy. In J. Keengwe, P. Hughes, & J. Yarbrough (Eds.), *Self-Directed learning and the academic evolution from pedagogy to andragogy* (pp. 78–96). IGI Global. https://doi.org/10.4018/978-1-7998-7661-8.ch005.

CC2020. (2020). *Computing curricula 2020: Paradigms for future computing curricula* (Computing Curricula Report).

CEDEFOP. (2023). European qualifications framework (EQF). https://www.cedefop.europa.eu/en/projects/european-qualifications-framework-eqf. Accessed 8 Feb 2023.

Crawford, G. (30 November 2021). Microcredentials empower change and growth. *The Evolllution.* https://evolllution.com/programming/credentials/microcredentials-empower-change-and-growth-2/.

E-Campus Ontario. (2020). Micro-credential principles and framework. https://micro.ecampusontario.ca/wp-content/uploads/2020/12/Micro-credentials-en_v2.pdf.

Education Design Lab (2023). The Lab's 21st Century Skills Micro-credentials: Pedagogy. Available at: https://eddesignlab.org/microcredentialing/microcredentials/pedagogy/.

Ehlers, U.-D. (2020). *Future skills: The future of learning and higher education.* BoD–Books on Demand.

ESCO. (2023). ESCO. https://esco.ec.europa.eu/en. Accessed 8 Feb 2023.

Europass. (2023). What are digital credentials. https://europa.eu/europass/en/what-are-digital-credentials. Accessed 8 Feb 2023.

European Commission. (2020). A European approach to micro-credentials: Output of the micro-credentials higher education consultation group. https://education.ec.europa.eu/sites/default/files/document-library-docs/european-approach-micro-credentials-higher-education-consultation-group-output-final-report.pdf.

European Commission. (2021). A European approach to micro-credentials. https://education.ec.europa.eu/sites/default/files/2022-01/micro-credentials%20brochure%20updated.pdf. Accessed 4 Apr 2023.

European Commission. (2023a). A European approach to micro-credentials. https://education.ec.europa.eu/education-levels/higher-education/micro-credentials. Accessed 8 Feb 2023.

European Commission. (2023b). Digital education action plan (2021–2027). https://education.ec.europa.eu/focus-topics/digital-education/action-plan. Accessed 8 Feb 2023.

Fisher, J. (21 September 2021). Closing the skills gap: Why UD teamed up with a national nonprofit. *Dayton Business Journal.* https://www.bizjournals.com/dayton/news/2021/09/21/ud-micro-credentials.html.

Fong, J., Janzow, P., & Peck, K. (2016). Demographic shifts in educational demand and the rise of alternative credentials. https://upcea.edu/wp-content/uploads/2017/05/Demographic-Shifts-in-Educational-Demand-and-the-Rise-of-Alternative-Credentials.pdf.

Foundation for Young Australians. (2017). The new work order: Ensuring young Australians have skills and experience for the jobs of the future, not the past. https://www.fya.org.au/app/uploads/2021/09/new-work-order-2015.pdf.

ICoBC. (2021). The role for 21st century skills in badging, micro-credentialing and skills-based hiring. https://icobc.net/wp-content/uploads/2022/07/20211028_ICoBC_21st_Century_Skills_Environmental_Scan.pdf.

IEEE. (2023). P1484.20.2 – Defining competencies working group. https://sagroups.ieee.org/1484-20-2/. Accessed 8 Feb 2023.

Kato, S., Galán-Muros, V., & Weko, T. (2020). *The emergence of alternative credentials* (OECD Education Working Papers 216). Paris.

Leaser, D. (2020). New volume: How IBM used badges to connect on-the-job learning to academic credit. https://www.ibm.com/blogs/ibm-training/new-volume-how-ibm-used-badges-to-connect-on-the-job-learning-to-academic-credit/. Accessed 8 Feb 2023.

LeBlanc, S. (23 December 2021). How continuing education can facilitate the adoption of microcredentials. *The Evolllution.* https://evolllution.com/programming/credentials/how-continuing-education-can-facilitate-the-adoption-of-microcredentials-2/.

Macdonald, M. (2022). Are microcredentials the future of higher ed? https://www.universityaffairs.ca/features/feature-article/are-microcredentials-the-future-of-higher-ed/. Accessed 8 Feb 2023.

NEA. (2020). Microcredentials. http://web.archive.org/web/20200531060136/http://www.nea.org//home/microcredentials.html. Accessed 25 June 2023.

NextEducation. (2023). Future skills. https://nextskills.org/future-skills-overview/future-skills/#:~:text=Future%20Skills%20are%20competences%20that,acquired%20in%20a%20learning%20process. Accessed 8 Feb 2023.

OECD (2021a). *Micro-credential innovations in higher education: Who, what and why?* (OECD Education Policy Perspectives 39).

OECD. (2021b). *OECD skills Outlook 2021: Learning for life*. OECD Publishing.

Open Skills Network. (2023). Rich skill descriptors. https://www.openskillsnetwork.org/rsd. Accessed 8 Feb 2023.

Ossiannilsson, E., & Kaur, A. (2021). *ICoBC taxonomy, quality criteria, and quality grid*. Lund.

P21 – Partnership for 21st Century Learning. (2019). Framework for 21st century learning. BoD–Books on Demand.

Pichette, J., Brumwell, S., Rizk, J., & Han, S. (2021). Making sense of microcredentials. Toronto. https://heqco.ca/pub/making-sense-of-microcredentials/.

Proctor, C. P. (28 December 2021). Defining a role for high-quality microcredentials in higher education. *The Evolllution.* https://evolllution.com/programming/credentials/defining-a-role-for-high-quality-microcredentials-in-higher-education-2/.

QAA. (2021). Quality compass: Which way of micro-credentials? https://www.qaa.ac.uk/docs/qaa/news/quality-compass-which-way-for-micro-credentials.pdf?sfvrsn=25c6d481_8.

Shackleton, J. R. (2014). The history of qualifications and the role of competition. In G. Heller Sahlgren (Ed.), *Tests worth teaching to*: *Incentivising quality in qualifications and accountability* (pp. 6–27). The Centre for Market Reform of Education.

State University of New York. (2023a). Microcredentials – SUNY. https://www.suny.edu/microcredentials/. Accessed 8 Feb 2023.

State University of New York. (2023b). SUNY launches new micro-credential policy. https://system.suny.edu/academic-affairs/microcredentials/suny-launches-new-micro-credential-policy/. Accessed 8 Feb 2023.

The Institute for Working Futures. (2020). Human capability standards: Reference model. https://www.workingfutures.com.au/wp-content/uploads/2020/06/HumanCapabilityStandards_7Level_FULLSUMMARY_290420.pdf.

UNESCO. (2022). Towards a common definition of micro-credentials. Paris. https://unesdoc.unesco.org/ark:/48223/pf0000381668.

University of Huddersfield. (2023). LinkedIn learning pathways. https://www.hud.ac.uk/postgraduate/linkedin-learning-pathways/. Accessed 8 Feb 2023.

Ward, R. (2020). *Personalised learning for the learning person*. Emerald Publishing Limited.

Ward, R., Phillips, O., Bowers, D., Crick, T., Davenport, J. H., Hanna, P., et al. (2021). Towards a 21st century personalised learning skills taxonomy. In IEEE (Ed.), *2021*

*IEEE Global Engineering Education Conference (EDUCON)* (pp. 344–354). IEEE. https://doi.org/10.1109/EDUCON46332.2021.9453883.

Ward, R., Shamim, T., Hull, B., Hayes, A., Davenport, J., Lengyel, D., et al. (2022). QAA collaborative enhancement project report on badging and micro-credentialing within UK higher education through the use of skills profiles. https://www.qaa.ac.uk/docs/qaa/members/report-on-badging-and-micro-credentialing-within-uk-he-through-the-use-of-skills-profiles.pdf?sfvrsn=f710a481_18.

Wikipedia. (2022). Microdegree. https://en.wikipedia.org/w/index.php?title=Microdegree&oldid=1107268820. Accessed 8 Feb 2023.

Wikipedia (04/2023). Microdegree. Available at: https://en.wikipedia.org/wiki/Microdegree.

Young, M., & Hordern, J. (2022). Does the vocational curriculum have a future? *Journal of Vocational Education & Training, 74*(1), 68–88. https://doi.org/10.1080/13636820.2020.1833078.

Zhong, M., & Shetty, T. (2021). Diversity, equity and inclusion in responsive career pathways. https://fsc-ccf.ca/wp-content/uploads/2021/11/FSC-RCP-DEI-EN.pdf.

**Grame Barty** is an entrepreneur, education technology, and global innovation commercialization specialist currently working with Credential Exchange provider CredShare. He is a member of the ICoBC Future Skills Working Group and co-leads the ICoBC Global Workforce Development Working Group.

**Dr. Naomi Boyer** is an educational strategist and innovative leader at Education Design Lab with over 20 years of education experience. Currently serving as the Executive Director, Digital Transformation, she focuses on the future of work catalysts of 21st Century Skills, digital micro-credentials, the learner-earner data ecosystem, and competency/skill frameworks. Dr. Boyer has expertise on competency-based education, leads many nonprofit Boards, and maintains scholarship on self-directed learning.

**Dr. Alexandros Chrysikos** received a BSc (Hons) in Computing Science at the Computing department of the University of Huddersfield in June 2010. In October 2011, in the same institution, he completed a MSc degree in Information Systems Management and in June 2016, he completed his PhD Thesis. Currently, he works at the London Metropolitan University as a Senior Lecturer and Researcher in Computing Science & Cyber Security. ORCID ID: 0000-0003-0550-3128

**Margo Griffith** is a recognised leader in educational technologies as they relate to open and digital recognition. She has decades of experience working nationally and internationally for corporate organisations involved in education sectors and currently serves as the head of growth for Edalex. Her work focuses on technology enablement of the emerging skills ecosystem by providing equitable opportunity through skills visibility. She is a consultant on digital recognition technologies and represents Edalex as a member of the Open Skills Network and Skills Validation Network. In Australia Margo chairs several working parties on microcredentials and skills based learning.

**Dr. Kevin House** is International Curriculum Director for Dulwich College International and most recently led quality assurance processes for the International Baccalaureate Organization as the Head of IB World Schools. Previously, he was Head of High School at the German European School of Singapore, Director of Curriculum at Suzhou Singapore International School, and Head of English at the International School of Valencia. Kevin recently completed his doctoral thesis in International Education at the University of Bath and has been working to align program standards across awarding bodies such as CIS, WASC and IB. Kevin is also a qualified trainer for global safeguarding practices and protocols.

**Dr. Tara Laughlin** is an Education Designer focused on Micro-Credentialing, who facilitates the design of next-generation skills assessments and contributes to Education Design Lab's 21st Century Skills Micro-credentials in the vsbl platform. Tara previously spent four years as Director of Curriculum and Training for edtech startup PAIRIN, leading the development of a comprehensive competency-based curriculum focused on soft/social-emotional skills. Tara has also spent over a decade as an educator, teacher leader, and district administrator for school districts in Colorado and South Carolina. Tara holds an EdD in Curriculum and Innovation, for which she developed a framework for the systematic integration of soft skills into the K12 classroom.

**Professor Ebba Ossiannilsson,** Sweden, is an independent researcher, expert, consultant, quality reviewer, and opinion leader in the areas of open, flexible, online and distance education related to SDG4 and the future of education, with a focus on quality, innovation, leadership, and personalized learning. She is a member of the ICDE Board of Directors and chairs the ICDE OER Advocacy Committee. Ossiannilsson is a visiting professor at several international universities and was recently appointed professor and research fellow at Victoria University of Wellington, New Zealand. She is a member of the Digital Skills and Jobs Coalition Sweden and vice president of the Swedish Association for Distance Education. ORCID ID: 0000-0002-8488-5787

**Rupert Ward** is a former Special Adviser and Project Lead for iDEA, one of the world's most successful digital badging platforms. He is Director of Strategic Partnerships for the International Council on Badges and Credentials (ICoBC), a National Teaching Fellow and Principal Fellow of the Higher Education Academy. His technology acceptance model, GETAMEL, is one of the most highly cited technology acceptance models globally since publication. He has authored two books on Personalized Learning and is Professor of Learning Innovation and Associate Dean (International) within the School of Computing and Engineering at the University of Huddersfield. ORCID ID: 0000-0003-1514-5870

**Dr. Holly Zanville** is a Research Professor and Co-Director of the Program on Skills, Credentials & Workforce Policy at George Washington University, Washington, DC. Previously, she served as a strategy director at Lumina Foundation, overseeing portfolios on adult learners, student success, future of learning and workforce, and research. She has held leadership positions at state higher education systems/boards in Oregon and Washington, and the Western Interstate Commission for Higher Education (WICHE); and held academic positions at community college and non-traditional university programs in multiple states. She serves on the Executive Committee of the International Council on Badges and Credentials (ICoBC).