BROOKINGS

Learning and working in the digital age:
Advancing opportunities and identifying the risks

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May 2022

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Introduction

The rapid expansion of new technologies into every sector has contributed to the proliferation of alternative models of education, learning, and skill signaling in global labor markets. From digital badges to bootcamps to learning and employment records (LERs), a wide range of public, private, and nonprofit initiatives and platforms have emerged to address ongoing demand for education and skills among employers and workers alike. Beyond simply moving existing courses and curricula into an online environment, the latest wave of educational innovation represents a more fundamental shift in how education and skills data are gathered, stored, taught, verified, accessed, and signaled in the labor market. Some observers refer to this shift as "Education 3.0," (Borden, 2015) and others refer to it as "The Internet of Education" (Learning Economy Foundation, 2020).

This paper provides a high-level map of the landscape of education and labor market innovations in formal and informal education (including the workplace), with an emphasis on digital credentials and LERs. As technologies and their uses rapidly expand, our goal is to make the emerging digital education-to-career ecosystem more accessible to non-technical audiences and specifically to inform decisionmakers, such as labor and education leaders, worldwide about the promises and perils of these initiatives for expanding access to opportunity. As we began this work, we found a disconnect: Most of these initiatives are led by organizations in the world's most wealthy, industrialized countries. Yet, youth and adults in low-income countries and in marginalized communities within wealthy countries are most likely to be excluded from traditional high-quality education and training opportunities. As such, these low-income countries and marginalized communities have the most to gain from having a more diverse range of learning and hiring options.

Many advocates argue that digital credentials, LERs, and other tech-enabled education and labor market solutions have the potential to increase equity in access to better livelihoods and well-being by offering more accessible learning and upskilling opportunities. However, critics are concerned that these innovations may ultimately exacerbate the digital divide more than they

democratize learning—especially in the absence of new governance frameworks to assure quality, ease transferability, protect users (including data ownership rights), monitor algorithmic bias, and address inequities in access and awareness.

The overarching research questions guiding this paper are:

- What are the leading global initiatives currently underway to develop digital credentials and LERs?
- Where are they located?
- Who are the main parties involved, and what problems are they trying to solve?

This paper will also highlight some of the key tensions, risks, and debates that are arising related to digital credentials and hiring platforms.

The research team drew on primary and secondary research to inform the landscape analysis. The team conducted consultations, attended convenings, and held interviews with 45 informants engaged in digital credentials initiatives, LER pilots, and other relevant education and skills research and projects. In addition, the team gathered and reviewed academic literature and reports. As this landscape report is preliminary in nature and aims to provide a snapshot of a rapidly evolving ecosystem, it is not intended to be exhaustive but rather to offer high-level frameworks for understanding the range of initiatives taking place globally and key issues shaping their implementation that are important to be on policymakers' radar. The landscape study and the feedback we receive on it will inform the development of a final report with case studies that shed light on how countries, collaboratives, and higher education institutions are trying to adapt to these innovations while also maintaining quality, ethical use of data, digital equity, and interoperability.

Key trends in education and skills pathways

Although initially the impact of technology in education and labor markets mainly focused on moving existing classes and curricula online and the creation of online job sites like *Monster.com*, more recent technologies such as machine learning, alternative learning platforms, virtual reality, and distributed ledger technologies have enabled many more fundamental shifts in the nature of how education and labor markets function (Table 1).

Table 1. Education 3.0: Technological shifts in education and skills pathways

	1.0 Analog	2.0 Online	3.0 Platform
Conceptual and theoretical learning	In person, classroom-based instruction	Online courses (recorded), remote instruction (live), and hybrid-online and in-person instruction	Dynamic learning and credentialing platforms, modularized courses with digital badging, and artificial intelligence to suggest jobs or learning progressions
Hands-on learning	In person, on-the-job learning in a workplace	Live or recorded demonstrations, hybrid work-based learning, and online instruction	Virtual and augmented reality training, interactive gamified courses or problem-solving activities, and real-time assessment platform data
Job matching process	Paper applications, "help wanted" signs, classifieds	Online job boards, applications, and professional networking sites	Artificial intelligence to suggest potential jobs, candidates, or professional connections; integration with learning platforms to suggest matches; and skills-based hiring algorithms
Skill signaling	Paper diplomas, degrees, transcripts, certificates, and licenses	Online degrees and digital credentials, online certifications, and professional license exams	Digital badges, nanodegrees, targeted skills-bundling through digital wallets, and artificial intelligence in candidate selection algorithms

Source: Authors' analysis.

In a rapidly changing economy and technological landscape, individuals are already using micro-credentials to differentiate themselves in the job market, keep their skills fresh in their industry, and continue working while advancing their education with a reduced financial burden in pursuit of more economic security and mobility. The landscape of digital credentials is not limited to a singular type of learning achievement—rather, the credentials take various forms and serve as bridges that have the potential to create more economic mobility. They may also enable a career transition that an individual may not have known existed, allow learners to have a wider range of skills and experiences count toward a recognized credential, or create broader access to occupation-specific professional networks that previously were only accessible through more localized personal networks. With more flexible mechanisms of delivery, platform-based learning and digital credentials also could allow workers to keep their skills fresh or advance within an organization without leaving their job to accommodate an academic schedule.

Key terms

Badges: Badges are a type of digital credential. As learners successfully complete online learning activities or exams, they earn a badge that offers a shareable *visualization* that they can use to signal their qualifications to an employer. Typically, digital badges are offered through online learning platforms, such as LinkedIn, Mozilla, Badgr, or Pearson, and through traditional academic institutions.

Digital credentials: Similar to how a paper degree or diploma signals someone's education level for a job, digital credentials offer an electronic way for individuals to verify and signal their skill level. Digital credentials tend to capture shorter-term learning, job-specific certifications, or a discrete set of verifiable skills, although they are sometimes stacked into a longer career pathway. Providers of digital credentials include employers, third-party organizations, higher education institutions, and industry associations. For example, the Digital Credentials Consortium works with 12 institutions to issue diplomas as digital credentials and design infrastructure that supports issuing, storing, and verifying digital credentials.

Digital wallet: A digital wallet is an online or app-based tool that individuals use to market themselves based on data in their learning and employment record, such as generating a job application package or portfolio for potential employers. Users can store and then select which qualifications or credentials they want a prospective employer to see when they apply for a job, and digital wallets can use artificial intelligence to suggest jobs and learning opportunities that match their profile.

Interoperability: Interoperability allows data and information to be more securely and dynamically linked across data platforms, agencies, and systems. In the case of digital credentials, interoperability helps the end users verify their identity and link their data across multiple platforms or systems. A lack of shared data definitions and data standards often impedes interoperability.

Learning and employment record (LER): An LER is a system that can track work, earnings, skills, and credentials. Similar to an academic transcript, LERs can document, verify, and transmit qualifications between employers, learners, and institutions, rather than using a third-party entity (American Workforce Policy Advisory Board, 2020). LERs include data from formal and informal learning platforms, as well as skills acquired through self-instruction, military or volunteer experiences, hands-on training, and work experience. LERs may also be combined with an individual's employment, earnings, and academic history to provide a comprehensive digital record of qualifications.

Learners are turning to badges, certifications, bootcamps, and digital credentials to better signal their skills in the labor market. Badges such as "Job Readiness," "Data Analytics Essentials," "Data Visualization with R," "Advanced Presentation Skills," "3D Design for Educators," and "Technical Writing" convey the specific purpose of the credential and what the learner has gained from the credential. By contrast, the education section of a resume may only communicate a general idea of knowledge or skillsets to the hiring manager.

Although employers often struggle in differentiating the value among different options given the flooded state of the credentialling marketplace, early research suggests that employers increasingly value digital credentials and micro-credentials to identify candidates with job-specific skills or reach a more diverse pool of talent without post-secondary degrees. Through interviews with employers from RStudio, Taulia Inc., Blue Cross Blue Shield, and others, Gallagher, et al. (2021) found that companies and employees each recognized the value of micro-credentials as a pathway to academic degrees and job-related skills. Many employers are re-evaluating which jobs truly require a bachelor's or master's degree, and they are observing that their investments in skills-based hiring and micro-credential learning platforms hold promise for improving employee engagement and retention (Gallagher et al, 2021).

Nevertheless, there is still very limited data available on the short- and long-term outcomes of micro-credentials and their impacts on earnings and career trajectories (Beer, Brown, and Juszkiewicz (2021). Previous evidence on short-term credentials and their impacts on learning and employment outcomes is mixed (Ositelu, McCann, and Laitinen, 2021), and there is little evidence that they are used in a stackable fashion in practice, which likely diminishes their effectiveness.

The rise of social media platforms such as LinkedIn, TikTok, and Twitter have had many impacts globally, and one of them is the utility they provide to employers, job candidates, and learners who may not have already connected with each other or for communicating an individual's level of knowledge, skills, or experience using digital credentials and other signaling mechanisms. Posting achievements on social networking sites helps individuals connect with communities and professional networks they were not part of before and can

generate potential matches that would not have occurred otherwise. In these ways, social media has made it easier for people who are already digitally connected to interact with a broader range of jobs, professional networks, and learning opportunities. On the other hand, user and learner data from social media may also contribute to predatory algorithms and advertisement-driven business models. Another challenge for marginalized populations globally is that this increased connectivity in some areas of the labor market may further disadvantage those who continue to lack access to broadband, electronic devices, and digital literacy skills.

Drivers of innovation in education and hiring

Education technologies and digital learning initiatives have proliferated in the past decade since the introduction of Massive Open Online Courses (MOOCs) in 2008 and Open Badges in 2011. Understanding the key drivers and reasons behind the expansion of digital credentials, micro-learning, and skills-based hiring is a critical step for understanding why they matter to learners, employers, educators, and governments. Several factors have motivated the most recent wave in education innovation, including:

- **Existing education institutions have excluded talent:** Education institutions in most countries have generally been slow to respond to changes in demand for certain skills in industry. Rigid course structures, hours-based accreditation processes, rising costs, and the need for learners to devote intensive effort to coursework over a long period have excluded many learners, especially learners from low-income communities and first-generation university students. Many institutions have started to adapt competency-based education and online and hybrid options to reach a broader set of learners.

- **Employers struggle to keep workers' skills fresh as technologies change**: The rapid diffusion of technologies, such as automation, has permeated jobs in every industry, and employers tend to underinvest in retraining their staff and managers ([Negoita & Goger, 2020](#)). Because training varies by company size, small-sized organizations may need more worker training and support

compared to that of midsized and larger ones. Research suggests that resource constraints, high rates of turnover, and administrative barriers make investing in and training workers difficult (Stewart et al, 2017). In many countries, it is also challenging for employers to effectively articulate their needs to education and training providers to keep curricula updated and fill important gaps.

- **New technologies offer a wider range of learning and skill signaling options:** Many new education technologies make education accessible remotely and at a more flexible pace than a typical academic schedule (Figure 1). For example, what used to be a semester-long course can be broken into "stackable" modules that learners can complete on their own time frame. Likewise, many employers are using machine learning to screen job candidates, such as analyzing resumes based on key terms or phrases, rather than manually reviewing each resume.

Figure 1. New digital technologies emerging in education and employment

DISTRIBUTED LEDGER TECHNOLOGY

Distributed Ledger Technologies (DLTs) record transactions and information, verify digital assets, detect fraud, and distribute information across networks on the blockchain. Known for helping with implementation in cryptocurrency and other financial technology sectors, DLTs store electronic information in a decentralized manner. Through decentralization, the network can validate transactions—or, in the case of digital credentials—with trust and quality assurance without having a third-party institution such as a bank. Common benefits from DLTs in digital credentials include giving individuals more control over their own data and reducing fraud in connected ecosystems (Lemoie and Soares, 2020). However, certain forms of DLTs require very high energy usage, which threatens to accelerate climate change (UNFCC, 2021).

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) is used in talent acquisition to scan a high volume of applicants and match individuals to positions. With AI, the screening allows recruiters to process resumes faster, shortlist candidates, and analyze candidate videos. Although AI may offer many benefits such as lowering the cost of talent acquisition and selecting candidates that manual processes may have missed, theses technologies also may incorporate bias and other ethical challenges that are difficult to monitor, detect, and regulate.

CLOUD-BASED TECHNOLOGIES

Platform, data warehouses, software as a service, and repositories are cloud-based technologies that offer new ways to store, connect, and collect education and skills data. Cloud-based data and services are considered "distributed" or "decentralized" technologies because they can be accessed from multiple devices (rather than housed on a single machine) and they can be linked to other data sets in a dynamic fashion (rather than through one-time data collected through a one-time data merge that must be manually repeated each time). With essential information and data collected through platforms and stored in warehouses and repositories, education and labor market outcomes can be measured and evaluated in a semi-automated, real-time fashion. However, these technologies raise critical questions about data ownership, privacy, ethics, and rights.

VIRTUAL REALITY AND AUGMENTED REALITY

Technologies such as virtual reality (VR) and augmented reality (AR) allow users to experience a simulated, 3D environment. This technology emphasizes movement and presence because a user can be exposed to new situations, places, and cultures in a cost-effective manner (World Bank, 2020). VR and AR are commonly associated with video games, but their uses have expanded to fitness, education, art, and workforce training in healthcare and law enforcement, as well as other social purposes (World Economic Forum, 2021). Experiential learning in this digital realm has potential to scale access to learning in many forms and does not necessarily require an internet connection, but VR and AR technology must also address concerns about how to protect user privacy, biometrics, and tracking data.

Source: Authors' analysis.

- **More learners can find options that align with their needs and constraints:**

  Expensive tuition and fees, prerequisites, high costs of living, limited transportation, care responsibilities, and course availability are just a handful of the barriers that frequently interrupt degree completion. Because many digital credentials are employer- or government-subsidized and offer more flexibility in delivery and program structure, they may increase accessibility. On the other hand, it is still unclear to what extent digital credentials pay off for learners in terms of career advancement and earnings compared to traditional academic degrees.

  > In response to job loss and the economic crises of the COVID-19 pandemic, edX, a leading provider of certificates and micro-degrees launched by Harvard and MIT, designed the Workforce Recovery Acceleration Program to give learners a 30 percent discount on its MicroMasters programs, professional certificate programs, and MicroBachelors programs. Additionally, providers such as Mozilla, LinkedIn, IBM, Google, and Credly offer free badges and certificates for programming languages, data science foundations, blockchain essentials, and analytics. edX was sold to 2U, a private online program management company, in November 2021 (MIT, 2021).

- **Tight labor markets prompt employers to recruit a wider pool of talent:** Over-reliance on traditional degrees in recruitment and hiring practices has categorically excluded people who may have achieved the same level of competency as those who attained knowledge, experience, or skills in informal ways, such as in the military or through on-the-job learning. When labor markets are tight, employers have greater incentive to identify talent from a wider pool of candidates, but that requires the use of different signaling mechanisms for skills—a void that certificates, badges, and other micro-credentials have expanded to fill.

- **Some universities seek to reach more learners:** As many higher education institutions have faced challenges such as budget cuts and declining enrollment, some have begun to reinvent their offerings to reach a wider pool of learners and adapt their education models through innovative curricula formats and delivery mechanisms. For example, a growing number of universities has adopted competency-based learning and micro-credentials, as well as a wider range of options (Credential Engine, 2021) for working professionals, that are designed to fit into a working learner's lifestyle (rather than assuming one's status as a full-time student) and meet employer demand for applied skills and hands-on problem-solving abilities.

- **Freelance and task-based gig work are increasing:** Technologies have enabled employers to reorganize work processes by outsourcing more tasks

to non-employees, such as contract workers and gig workers. The largest share of online gig work, 45 percent, is in the software development and technology category followed by multimedia work, translation and writing, data entry, and sales (ILO, 2021). The United States dominates online labor demand; however, the supply of labor comes from low- and middle-income countries, with India as the largest supplier. For web-based platforms, technology and software development work increased from 39 percent to 45 percent between 2018 and 2020, with the highest supply of labor coming from India, Bangladesh, Pakistan, the Philippines, and Ukraine. Online freelancing and gig work may also be increasing due to the pandemic and surge in remote work (Stephany et al, 2020). As these platforms for transnational gig work expand, regulatory and social protections frameworks have not adapted in tandem to prevent exploitation or provide social protections such as retirement savings or health insurance.

Although most of these factors have motivated the expansion of digital innovation in education and hiring for a while, early evidence suggests that the pandemic has accelerated these trends (Kidwai, 2020). The labor market is now undergoing an intensified era of change—employers that used to have human employees are automating certain functions and supplementing their employee labor with artificial intelligence or freelance labor. Many employers are also struggling with hiring and retention, which can increase their incentive to find other ways of getting their work done. At the same time, remote work and learning has become more normalized, as workers, students, and teachers have also become more accustomed to it during the COVID-19 lockdowns. That said, the COVID-19 lockdowns demonstrated a great need to better understand how to make remote learning more effective and what pedagogies help retain learners and produce better learning outcomes (UNICEF, 2021).

Technological change has deployed into almost every job and industry at rapid pace, and with it, employers are rethinking work processes and divisions of labor. Within the next five years, 50 percent of all employees will need reskilling and 40 percent of core skills are expected to change (World Economic Forum, 2020). As the number of skills required for one job increases 10 percent annually, the emerging work culture emphasizes workplaces with more remote or hybrid work, more digital skills, and more managerial functions and support (Muro et al, 2017).

One way to conceptualize these changes is to focus on two key dimensions of change—the intensity of skills acquisition and how the learning is applied to a specific occupation or industry. Most of the innovation is occurring among shorter, less intensive learning opportunities that are also more job-specific or hands-on (Figure 2). Rather than completing a longer program, individuals bundle a combination of short-term credentials or work experiences to demonstrate their qualifications in the labor market.

Figure 2. Learning and skill pathways are expanding most rapidly in low intensity learning opportunities that are job-specific
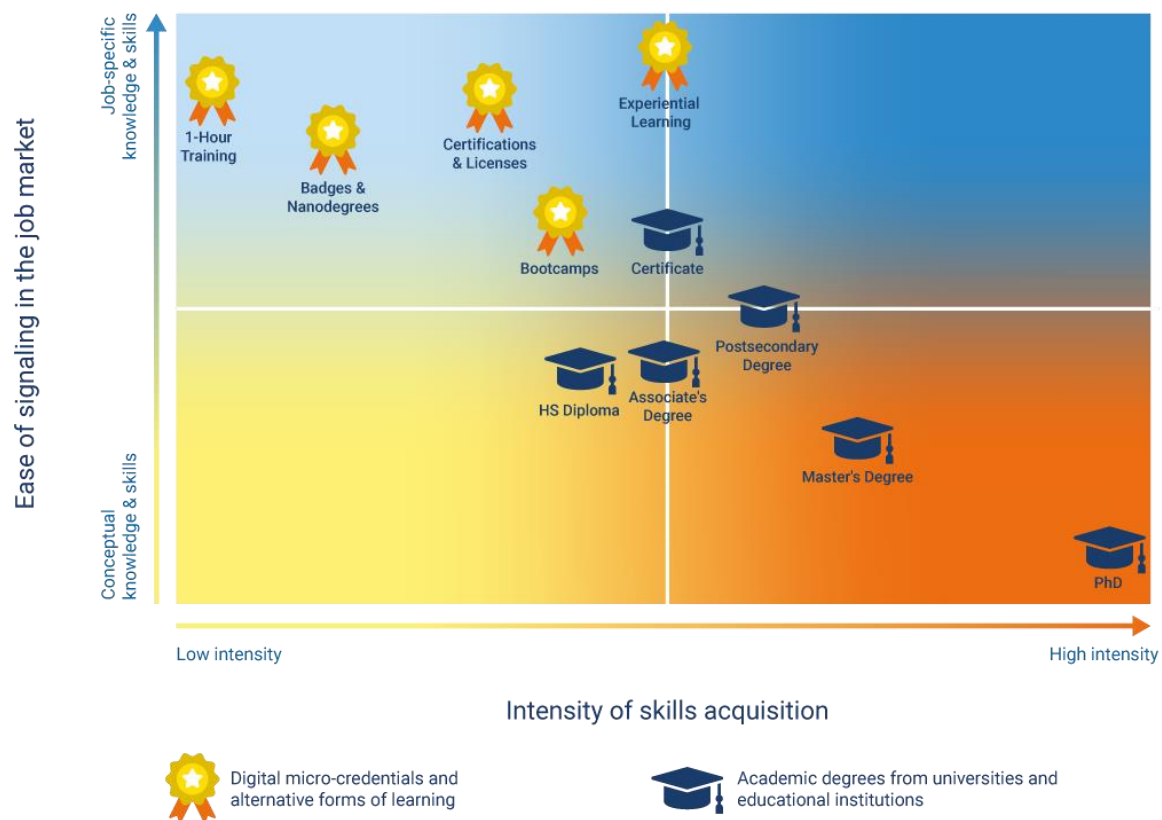
Note: This represents a quadrant chart of skills acquisition and ease of signaling in the labor market for the end user: The X-axis measures intensity of the acquisition from low to high, with low intensity being a one-hour training, and high intensity being a PhD. The Y-axis measures ease of signaling in the labor market via skills earned with conceptual knowledge (a postsecondary degree) and job-specific skills (i.e., credentials, badges, and bootcamps).

Source: Authors' analysis.

Overall, the education and labor market institutions and regulatory structures from the past will not be adequate to position individuals, countries, or regions

for success in the 21st century. There is a growing need for ongoing reskilling and more applied problem-solving. The lack of governance frameworks for creating more harmonization, transparency, and interoperability across systems leaves many workers and learners vulnerable to exploitation or unaware of their options. Guardrails, such as legal infrastructure to protect individuals' rights to control their own data or processes for monitoring and enforcing labor standards on international hiring platforms, are needed to successfully increase access to opportunity and promote inclusive innovation.

A technical fix to inequality alone will not be enough—it will take a collective and intentional effort to truly democratize learning and employment pathways.

Who is leading the implementation and governance of digital credentials and LERs?

Innovation in the learning and skill signaling ecosystem started outside the formal education system. This section provides an overview of key actors, which we have classified into three broad categories: private and nonprofit initiatives, multistakeholder initiatives, and government-led and multilateral initiatives. For each category, we provide an illustration with examples of each type of initiative (not exhaustive). Although we created these categories in an attempt to make the landscape more comprehensible for those who are new to this field, the typologies are also an oversimplification and should be interpreted loosely. There are instances where a given initiative may fit into more than one category, such as initiatives led by higher education institutions that also might qualify as a national or regional multistakeholder coalition.

Private and nonprofit initiatives
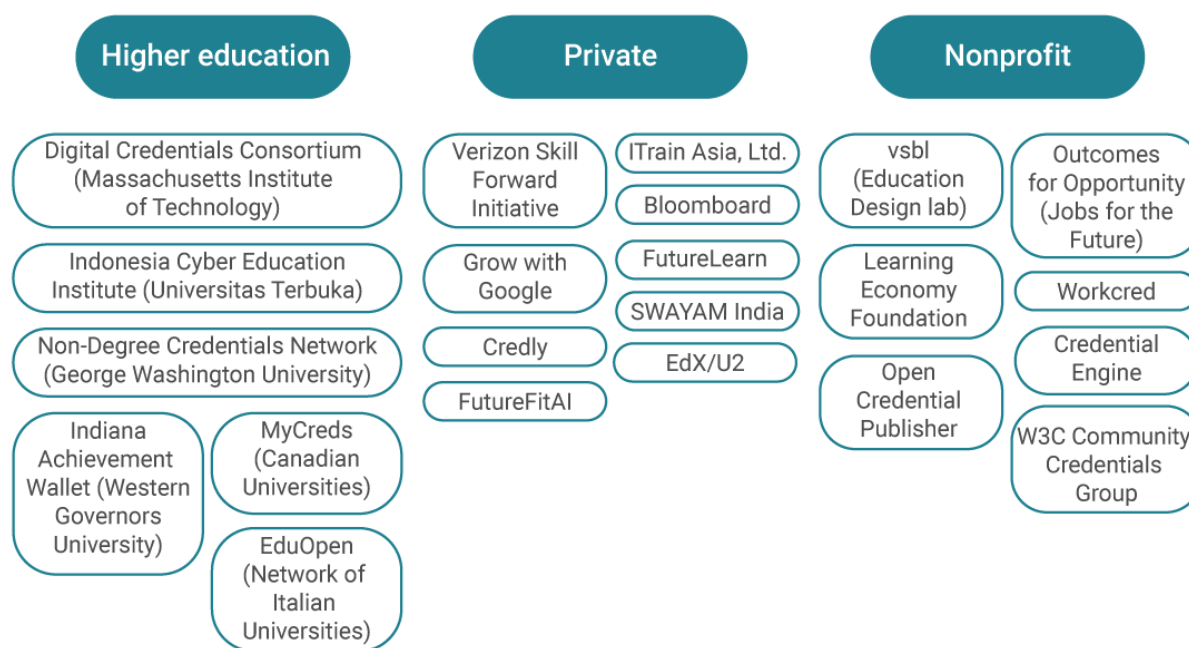
Several private and nonprofit digital credential and skill signaling innovations have emerged over time to address major gaps in the marketplace for education and labor market signals (Figure 3)—especially for career-specific training and labor market signals for workers without a traditional college degree. For example, some of the earliest digital online learning innovators were MOOC

providers such as Coursera, Udacity, Udemy, or edX, which started by putting existing courses online but over time also began unbundling curricula into smaller units of learning.

The Indonesia Cyber Education (ICE) Institute at the Universitas Terbuka, which launched in July 2021, is Indonesia's national marketplace for online learning. ICE Institute is supported by the Asian Development Bank and aims to improve Indonesia's higher education system as it relates to economic growth and sustainable development (Garcia et al, 2021). As of September 2021, approximately 1,600 online courses were offered through the ICE Institute's 14 university consortium members and edX. Accredible, the digital credentialing platform and provider, provides certificates to students after completion. In upcoming phases, the ICE Institute aims to verify and secure an individual learner's course completion using a multipurpose QR code that contains information about the achievement, credential issuer, and additional details about the qualification level.

Figure 3. Nongovernmental initiatives

Higher education

- Digital Credentials Consortium (Massachusetts Institute of Technology)
- Indonesia Cyber Education Institute (Universitas Terbuka)
- Non-Degree Credentials Network (George Washington University)
- Indiana Achievement Wallet (Western Governors University)
- MyCreds (Canadian Universities)
- EduOpen (Network of Italian Universities)

Private

- Verizon Skill Forward Initiative
- Grow with Google
- Credly
- FutureFitAI
- ITrain Asia, Ltd.
- Bloomboard
- FutureLearn
- SWAYAM India
- EdX/U2

Nonprofit

- vsbl (Education Design lab)
- Learning Economy Foundation
- Open Credential Publisher
- Outcomes for Opportunity (Jobs for the Future)
- Workcred
- Credential Engine
- W3C Community Credentials Group

Note: The above examples are not an exhaustive list; they are examples for illustration purposes.

Source: Authors' analysis.

In many cases, private initiatives focus on solving one aspect of the problem. For example, one challenge that digital wallets try to solve is that learners without degrees often struggle to show an employer a holistic picture of their learning level, since there is no equivalent of an academic transcript. Other times, private initiatives aim to support the growing market for a technical product, such as online Salesforce certifications.

More recently, several private corporations have created their own training credentials and learning platforms, such as Google's "Grow with Google" program of certificates, Verizon's Innovative Learning Schools, and IBM's Open P-Tech platform. Since 2017, [Grow with Google](#) has made tools and trainings available through certificates, scholarships, and workshops for more than 8 million Americans. Notably, students can transfer their Google Career Certificates to their community college and career and technical education high school for tech and STEM training fields ([Porat, 2021](#)). In Asia, a private company called iTrain Asia has created a platform of digital learning options that is available throughout the region. Nonprofit initiatives also arose to help end users, such as learners, gather information about digital credentials and understand which signal quality to an employer, versus a certificate or credential that an employer will not see value in having. For example, Workcred and Learning Economy Foundation are nonprofit organizations that try to help key stakeholders understand the credentialing landscape.

Finally, there are many initiatives that have been launched throughout the world within higher education itself that attempt to diversify and respond to rising demand for shorter-term digital credentials, such as the Non-Degree Credentials Research Network (NCRN) at the George Washington University. Similarly, MIT leads the Digital Credential Consortium, which was founded in 2018 by leading universities in the United States, Netherlands, Italy, Mexico, Canada, and Germany to design a digital credential infrastructure for learners and strengthen trust globally.

Multistakeholder initiatives and networks

It can be difficult to keep track of all the digital credential initiatives due to the sheer number of initiatives, stakeholders, products, and services. Many

stakeholders have started forming coalitions to begin to systematize and harmonize across institutions or countries, such as networks across higher education institutions to pilot competency-based or modularized curricula targeting working learners (Figure 4).

Figure 4. Multistakeholder initiatives

National scale

- Open Skills Network
- SmartResume (iDatafy)
- T3 innovation Learner and Employer Record (LER) Pilots (U.S. Chamber of Commerce Foundation)
- Wellspring Initiative and Comprehensive Learner Record Standard (IMS Global)

Global or multi-country scale

- International Council for Open and Distance Education
- MicroHE (European Distance and eLearning Network)

Note: The above examples are not an exhaustive list; they are examples for illustration purposes.

Source: Authors' analysis.

For example, the T3 Innovation Network, led by the U.S. Chamber of Commerce Foundation, is a collaboration of more than 500 organizations actively working to expand the use of LERs, data standards, shared education and workforce data, and digital wallets for individuals to use as records of their skills (U.S. Chamber of Commerce Foundation, 2021). The T3 Network is focused on data sharing across systems, competency connections, and privacy for all learners. It supports LERs through the T3 Network Hub, a free community site for stakeholders interested in launching an LER pilot program. The Hub includes best practices and resources regarding interoperability, content, potential partners, evaluations of LERs, and more. The T3 Network Hub is not exclusive to the T3 Network but is available to all parties interested in data infrastructure and LER pilots.
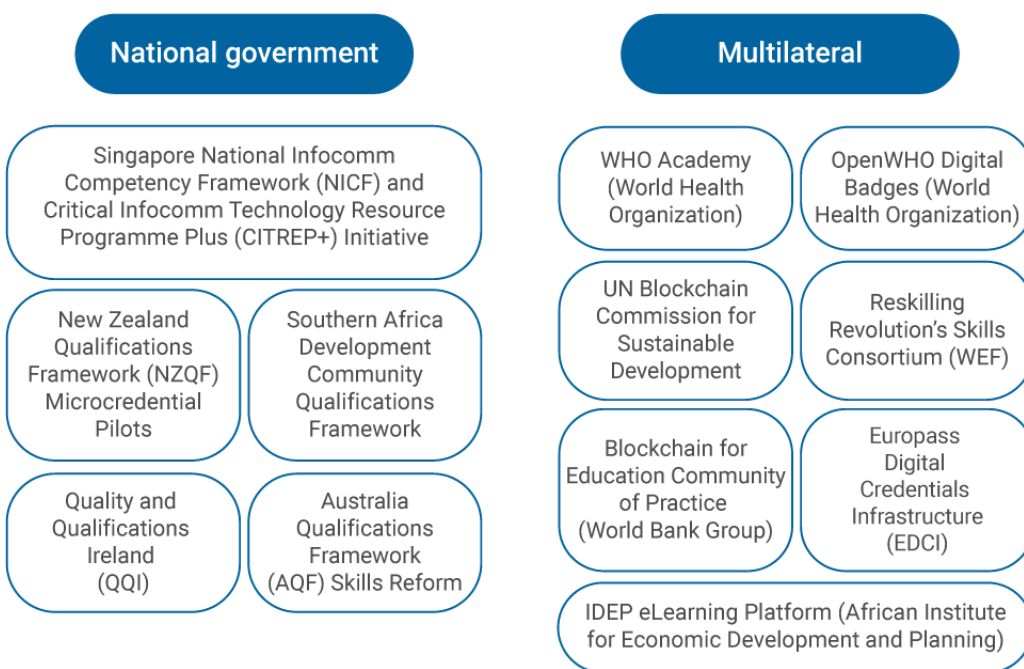
The International Council for Open and Distance Education (ICDE) is a global association of leaders and professionals funded by the Norway government, in

partnership with UNESCO, since the 1960s. The ICDE aims to achieve open, flexible, and distance learning—with the key value that education is a universal right to all. The ICDE has more than 190 institutional members representing 70 countries and over 15 million students across the globe. The related ICDE Knowledge Hub works to identify case studies, tools, and best practices for technology enhanced education.

Government-led and multilateral initiatives

More recently, a handful of government leaders have begun to develop governance and regulatory frameworks to recognize learning and evaluate quality within their existing national education systems (Figure 5).

Figure 5. Government-led and multilateral initiatives

National government
- Singapore National Infocomm Competency Framework (NICF) and Critical Infocomm Technology Resource Programme Plus (CITREP+) Initiative
- New Zealand Qualifications Framework (NZQF) Microcredential Pilots
- Southern Africa Development Community Qualifications Framework
- Quality and Qualifications Ireland (QQI)
- Australia Qualifications Framework (AQF) Skills Reform

Multilateral
- WHO Academy (World Health Organization)
- OpenWHO Digital Badges (World Health Organization)
- UN Blockchain Commission for Sustainable Development
- Reskilling Revolution's Skills Consortium (WEF)
- Blockchain for Education Community of Practice (World Bank Group)
- Europass Digital Credentials Infrastructure (EDCI)
- IDEP eLearning Platform (African Institute for Economic Development and Planning)

Note: The above examples are not an exhaustive list; they are examples for illustration purposes.

Source: Authors' analysis.

New Zealand was one of the first countries that attempted to integrate micro-credentials into its existing education framework, the New Zealand Qualifications Framework (NZQF). Qualifications, which can be viewed as levels of skills and

knowledge, are developed with stakeholders, government agencies, and higher education organizations. Qualifications frameworks are policy instruments that enable a state or region to recognize learning in different forms (informal and formal) and establish equivalencies across academic, blended, and applied (work-based) learning contexts. They enable learners to identify how to transfer their learning into new domains and employers to identify the level of qualification of a candidate even if the learning occurred outside of a formal classroom (ILO, 2007). The NZQF lists all qualifications, certificates, diplomas, and degrees that can be achieved in New Zealand's education institutes and workplaces. Similar efforts to incorporate digital credentials and micro-credentials into national qualification frameworks have since begun in Singapore, Australia, Ireland, and across countries in southern Africa working on the Southern Africa Development Community Regional Qualifications Framework (SADCQF), which was originally established in 2011 and launched in 2017, with the goal of incorporating a wide range of credentials, qualification certificates, and learning modules (Southern African Development Community, 2019).

Multilateral organizations such as the World Health Organization, UNESCO, and the Organisation for Economic Co-operation and Development have also focused more of their work in recent years on micro-credentials and education technologies. For example, the European Commission is currently working on launching the Europass Digital Credentials Infrastructure (EDCI) for organizations to implement and issue digital credentials (European Commission, 2020). The EDCI is a set of standards, services, and software for institutions, employers, and training providers who are looking to verify digital credentials. The European Union has also implemented Europass, an online tool for individuals who want to present their CVs, reflect on skills, and learn about job opportunities in Europe.

The geography of innovation in skills and education

Although demand for non-degree credentials and alternative ways to signal skill is surging in low-income countries, the most sophisticated initiatives and deployment of technologies such as LERs or digital wallets are in wealthy

countries such as the U.S. and Europe. Many of the initiatives in lower-income countries tend to still focus on shifting existing curricula online or into a hybrid online/in-person format. While private initiatives like Grow with Google and IBM Badges can be accessed by users across the globe, some initiatives are purely national, and others may expand their reach across regions. The NZQF and the U.S. T3 Innovation Network exists nationally, whereas MIT's Digital Credentials Consortium is a global initiative with founding universities located in Germany, Mexico, the Netherlands, Italy, and Canada. Regionally, iTrain Asia provides certifications and training across 16 countries throughout Asia. Subnationally, the State University of New York (SUNY) incorporates micro-credentials into their system and offers more than 400 credentials in more than 60 fields of interest (SUNY, 2022). The connectivity to broadband and devices certainly broadens the geography of digital educational innovations despite a strong concentration of initiatives in the U.S. and Europe. At the same time, those without access to broadband, who cannot afford internet service or connected devices, or who lack digital literacy skills—whether in the U.S. or Vietnam —are also cut off from these options.

Digital labor platforms are concentrated in North America, East Asia, and Europe, and they are dominated by taxi and delivery services. Platforms with the largest annual revenue include Uber, Lyft, Meituan, Instacart, Uber Eats, Grubhub, Delivery Hero, and Just Eat Takeaway (ILO, 2021). Although the business model of digital labor platforms generates additional income opportunities for workers, many challenges remain. For instance, contracting and digital labor platforms can span national boundaries, yet they still lack regulatory framework to prevent exploitation and ensure social protections for gig workers. For this reason, these jobs may be susceptible to discrimination, low or unpaid wages, irregular hours, and little to no access to benefits like health insurance or retirement savings.

Key obstacles and critiques of the new technologies in learning and employment pathways

Although there is a rising tide of innovation in many aspects of education and career pathways, governance frameworks and state institutions have been slow to adapt. And while the zeal of technology innovators to scale their services and tools may be well intended, the development tends to happen in highly resourced and privileged spaces that are typically not well grounded in the realities, experiences, and priorities of marginalized communities. This section discusses the emerging risks, debates, and ethical questions regarding the deployment of new technologies in learning and employment pathways. Below are the key concerns and challenges that emerged from our interviews and review of the literature.

- **Innovations in education and skills pathways may increase the digital divide.** One billion new users have been added to the internet since 2016, and yet 3.7 billion people remain offline with no access to internet, devices, or digital literacy skills ([UN-Habitat, 2021](#)). Many people and entire communities lack access to information and communication technologies, even in wealthy countries. Evidence suggests that the COVID-19 pandemic exacerbated inequities and disparities that already existed in education systems, with 191 countries affected by school closures and 1.5 billion students transitioning into online learning platforms ([UNESCO, 2021](#)). High-income countries have double the amount of internet access, at 70-98 percent of the population, compared to lower- and middle-income countries with an average of 40-42 percent ([Jan van Dijk, 2020](#)). This stark difference is commonly displayed when an individual can use a smartphone but does not own a computer with high-speed internet. Although advocates argue that digital innovations can democratize learning and labor markets, skeptics have highlighted that connectivity and digital literacy are equally, if not more, important determinants of whether these new technologies ultimately enhance economic mobility and security or leave marginalized communities even further behind.

- **The impact of digital innovations in learning and employment pathways remains unclear.** Beyond the promise of digital credentials, less is known about disparities in access to, experiences of, outcomes from, or impacts of these options and technologies. Multistakeholder initiatives to pilot LERs and digital wallets are just beginning, so it is too soon to conduct rigorous research on many of these initiatives. Digital Promise, a nonprofit organization, is trying to assess the equity implications for marginalized groups who use LERs by gathering qualitative information directly from frontline workers, those in the gig economy, and higher education leaders to develop inclusive design principles and tools that incorporate the experiences and perspectives of marginalized communities in the workforce (Cacio et al, 2022). In their review of digital credentials and their potential to remedy labor market failures and structural inequities, Cardenas-Navia and Jyotishi (2021) recommended that LERs be developed through processes shared with community organizations, educational institutions, and employers from companies of different sizes. Early studies and surveys also indicate that learners who already have a postsecondary degree are more likely to continue learning through micro-credentials compared to those without a postsecondary degree (Strada, 2021). More than 60 percent of individuals with tertiary or post-secondary education participated in informal education within the last year, compared to the 30 percent of adults who participated but did not have the upper-secondary education (OECD, 2019). Therefore, despite the promises that digital credentials can increase opportunity, in practice the early evidence suggests that they are more often providing additional learning opportunities to more highly educated workers.

- **Digital technology may increase gender disparities without deliberate interventions.** Globally, women and girls are less likely to use digital devices and technologies to the same extent as men (UNESCO, 2019). Women and girls are 1.6 times more likely to report lack of internet use skills and 25 percent less likely than men to know how to use the internet to search for a job. Women are widely underrepresented in science, technology, engineering, and math (STEM) occupations worldwide, and female entrepreneurs have unequal access to venture capital and other

forms of financing for technology startups (Stoet & Geary, 2018). These existing gender disparities at all levels of technology access, digital education, technology jobs, and access to capital may translate into a widening gender gap in access to opportunity if countries or regions increase their focus on digital tools for accessing learning and jobs without an explicit focus on gender (UNESCO, 2017).

- **Algorithmic bias in learning, job matching, and hiring platforms needs to be intentionally monitored and addressed.** Machine learning technologies are increasingly used in candidate screening, job matching, and learning platforms such that the technology is trained on a pool of existing users to identify patterns and make predictions for an individual based on the previous outcomes of users with similar characteristics. However, as these technologies are increasingly deployed in different ways in the labor market or education ecosystem, many critics are concerned about biases that are embedded in algorithms (Raghavan et al., 2020). Although machine learning can make hiring processes and learning management more efficient, they are often difficult to monitor and regulate to reduce discrimination, such as racial bias or discrimination against people with disabilities. The EdSafe AI Alliance is a global network of education and tech leaders that encourages collaborative innovation and develops common frameworks and models that provide a safer and more equitable AI ecosystem and industry (Paykamian, 2021). To fully address algorithmic bias in learning technologies, those deploying machine learning technologies in education and skills pathways must be intentional about inclusive design and monitoring for bias, access to appropriate expertise, and regulatory frameworks, to address claims of discrimination.

- **International learning communities will require interoperability across systems.** Interoperability is the ability to securely and accurately exchange information and data across systems—in this case, digital credentials, skill assessments, and learner records across agencies, sectors, or systems (Gasser, 2015). Pilots have created interoperability and data standards across platforms where credentials can be accessed by multiple institutions, but international learning communities will require different

systems and standards that best suit their context and access to electricity, digital infrastructure, and connectivity. To ensure value across systems, digital micro-credentials need to be assessed in similar ways and prove identifiable skills—regardless of where a learner resides. This ambitious task presents another challenge to less wealthy countries that want a stake in innovative learning techniques but are not equipped with the tools to ensure that products are interoperable and assured.

- **Standards must be open source to maintain affordability, transparency, and the potential to achieve scale.** An open-source standard is accessible and widely available for adoption, implementation, and redistribution. The most well-known open standard comes from the World Wide Web Consortium or W3C, famous for standardizing the internet and webpage codes. Without these standards, the early internet would have had little consistency between different company (proprietary) browsers and software. For this reason, scalable open-source standards are required to solve the challenges of communicating information and data across digital platforms and digital wallets. The W3C is currently developing a standardized structure for the W3C Universal Wallet, which packages draft standards and frameworks for verifiable credentials and digital identification incubated by the Digital Credentials Consortium, Transmute, Learning Economy Foundation, and others. The Universal Wallet would provide users convenience and access in organizing their digital assets in one place ([W3C, 2022](#)). In 2021, Learning Economy Foundation deployed a version for young children in partnership with the LEGO Foundation, called SuperSkills! ([Learning Economy Foundation, 2021](#)). Without open-source standards, proprietary actors tend to monopolize the development of their own data standards and multiple, incompatible ecosystems are likely to emerge, which would limit the capacity to scale quality learning opportunities and likely inflate prices.

- **Governments have been slow to clarify and protect rights to data privacy and data ownership.** As cloud-based data systems, software services, and platforms grow in prominence, there are rising concerns about data rights

such as whether individuals owns their own data or under what conditions the platforms have the right to share or use individuals' data for their own financial gain (Ondarza, 2019). There are also growing challenges with data security and privacy, and many countries have not kept regulatory frameworks up to date to reflect current risks, technologies, methods of verifying user identities, and data uses. If the end user is not well educated in the technology or how data are being used, the individual may not be capable of making informed decisions about consenting to data sharing or may be excluded from valuable learning or employment options if consent to share data isn't given.

- **It is difficult for learners, employers, and the general public to make sense of the growing number of options, solutions, and platforms.** Private companies and nonprofits have experimented with a wide range of technology-enabled solutions to labor market failures and learning barriers noted earlier. Many new services, training programs, and hiring solutions address specific needs (Credential Engine, 2021). As these innovations proliferate, however, end users such as employers and learners often struggle to make sense of all the different products and platforms or differentiate their value. For example, digital micro-credentials, online training programs, badges, and bootcamps may be difficult for workers or employers to differentiate among identifying quality candidates or understanding the skillset that those credentials signal. In addition, the history of stigmatization of unaccredited learning—for example, non-credit programs in the U.S.—may lead employers to devalue someone's learning credential because it did not come through a more formal higher education pathway. This leads to the issue wherein micro-credentials are inadvertently competing in a two-tiered system and valued as the second-best option for learners.

- **Regulatory and social protections are a challenge for work across borders or outside of regulated forms of employment.** Most modern social protection and labor rights frameworks are based on a model of traditional full-time and long-term employment. This results in workers with non-traditional forms of employment, such as those in the gig

economy or informal economy—falling outside the scope of existing social protections ([World Bank Group, 2019](#)). Compounded by the cross-border nature of digital work, these issues are particularly pronounced in jobs where benefits such as health insurance, social security, and workers' compensation are rare. Across the world, less than 50 percent of such workers have health insurance, while under 20 percent have access to pensions, workers' compensation, or unemployment insurance through their work ([ILO, 2021](#)). These types of employees also face high levels of discrimination and harassment due to the design of digital platforms and lack of regulation. Racial, ethnic, and linguistic minorities and women are particularly affected by these issues ([ILO, 2021](#)). While some countries have individually taken steps to clarify regulation in cases of employees and employers located in different jurisdictions, there is not yet a clear international framework.

Conclusion and next steps

In a rapidly changing economy and skills landscape, some individuals are using digital credentials and micro-credentials to differentiate themselves in the job market and advance their learning. Many employers, academic institutions, and policymakers have also begun to explore these new education and labor market technologies because of their potential to support ongoing learning, inclusive innovation, and access to opportunities. Although it can be challenging to keep track of all the initiatives and innovations, many show promise for helping workers and learners who are often overlooked gain access to new networks, experiences, and livelihood options.

At the same time, the proliferation of digital credential initiatives and other tech-enabled platforms for learning and hiring also presents new challenges, ethical dilemmas, and risks. Education institutions and governments have been slow to adapt, and we lack regulatory infrastructure to assure quality, protect vulnerable workers and learners, and minimize discrimination, exploitation, and bias.

Perhaps the greatest risk is that the rapid proliferation of new technologies in education and employment will increase the digital divide. Lower- and middle-

income countries are already at a disadvantage in terms of infrastructure and digital literacy, and end users from marginalized communities have not been very involved in the piloting and design of these new systems and tools.

This report aimed to help decisionmakers understand the nature of these changes in education and hiring technologies, as well as the urgent need to build governance frameworks that support equal access, reduce confusion, and protect against exploitation and abuse. However, the specific ways in which these regulatory frameworks and institutions are designed and implemented will vary widely from one country to the next.

The United Nations Secretary-General's 2020 "Roadmap for Digital Cooperation" (United Nations, 2020) presents ambitious aims to achieve universal connectivity, digital inclusion, capacity-building, human rights protection, and an equitable digital world. Achieving the eight goals in the roadmap will require fostering digital skills and learning by explicitly engaging rural populations, indigenous communities, young women, and others who have largely been excluded from access to quality jobs and education. Without active participation from all types of learners, digital credentials may only be available to individuals who are already privileged.

To date, very little is known about the long-term effectiveness and impacts of digital micro-credentials and other innovative approaches to education and employment. Each credentialing initiative appears to have its own method of standardization, data interoperability, and service delivery. More harmonization is likely necessary to develop consistent ways of assessing effectiveness, quality, and equity. Different populations vary in how they perceive the value of digital credentials (Strada, 2021), but the lack of research makes it difficult to measure outcomes and tangible benefits. Engagement and user input are essential for ensuring that the value proposition is clear upfront and ultimately pays off in terms of outcomes and opportunities.

The goal of this paper was to begin to provide leaders in education and employment with the language and frameworks needed to make sense of what has become a messy and fast-changing area of educational innovation—and

ultimately to support the development of new policies and governance systems to assure equity, access, and quality. A subsequent report will examine governance and equity questions through case studies and present recommendations for global education and labor policymakers.

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