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United Nations
Educational, Scientific and
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► The Digitization of TVET and Skills Systems



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► Acronyms and abbreviations

AI	Artificial intelligence
AR	Augmented reality
COL	Commonwealth of Learning
CV	Curriculum vitae
CPD	Continuing professional development
DLT	Distributed ledger technology
ECTS	European credit transfer and accumulation system
EU	European Union
GDP	Gross domestic product
ICT	Information and communication technology
IDB	Inter-American Development Bank
IOT	Internet of things
ISCED	International Standard Classification of Education
IT	Information technology
ITF	Industry Training Federation
ITCILO	International Training Centre of the ILO
ITU	International Telecommunication Union
ILO	International Labour Organization
LL	Lifelong learning
MIT	Massachusetts Institute of Technology
MOOC	Massive open online course
MR	Mixed reality
OBI	Open badge infrastructure
ODL	Open and distance learning
OER	Open educational resources
P2P	Peer-to-peer
PPP	Public-private partnership
R&D	Research and development
ROI	Return on investment
SaaS	Software as a service
SENAI	National Service of Industrial Training (Brazil)
SHRDC	Selong Human Resource Development Centre
SMEs	Small and medium-sized enterprises
STEM	Science, technology, engineering and mathematics
TVET	Technical, vocational and education training
UNDP	United Nations Development Programme
UNHCR	Office of the United Nations High Commissioner for Refugees
UNESCO	United Nations Educational Scientific and Cultural Organization
VET	Vocational education and training
VR	Virtual reality

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It should be noted that this report was finalised prior to the COVID-19 pandemic and as such does not discuss the impact of the pandemic on the digitalisation of TVET and skill systems.

This issue will be taken up in subsequent reports and ongoing work of the ILO and UNESCO.

► Executive Summary

The affordances of digital technologies are such that when deployed in a context of stakeholders with a propensity for change, they will facilitate new opportunities and also create challenges for the technical and vocational education and training (TVET) sector.

This report provides a global, high-level snapshot of the digitalization of TVET and skills systems in a set of countries and international organizations. The primary data are derived from a set of semi-structured interviews with experts and practitioners in the TVET and education sectors, as well as a desktop literature review. The data provide insights into TVET and skills systems in Brazil, Ghana, India, Kenya, Malaysia, Malta, Mauritius, New Zealand, Slovenia, Turkey and the United States. They also include the views of the labour market and representatives from global organizations such as the Commonwealth of Learning (COL), the International Labour Organization (ILO), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the Office of the United Nations High Commissioner for Refugees (UNHCR).

To deconstruct and review technological developments impacting the digitization of TVET and skills systems, we developed a conceptual framework for digital transformation in TVET, using elements of the 2015 UNESCO recommendation concerning TVET and interfacing these with the three core concepts of digital innovation, adaptation and acceleration.¹ We then applied the framework to develop the interview plan and structure the wave of analyses from data generated by the literature review, case studies and interview transcripts.

There exists increasing evidence that while the digitization of TVET comprises multiple policies and actions at all levels of government, it often does not represent a unitary coherent strategy. Much innovation in digital TVET is institutionally driven, with the labour market following innovation pathways that are not filtering into TVET curricula or the operations of TVET institutions. Yet digitization is frequently positioned as the driving force behind lifelong learning and flexible learning pathways. Case studies indicate that technology is also transforming traditional apprenticeships by facilitating more informal variants, as well as internships and other mentored-learning programmes, if the initiatives in many countries continue to be conceptualized, sponsored and driven by governments as opposed to industry.

We argue that low-level or mature digital technologies, when taken globally, still hold the most potential for transformation of the TVET sector in the short term. Digital TVET increases dramatically in cost with increases in the complexity and sophistication of the offering. Moreover, digitization is viewed with scepticism by a significant segment of the educational establishment – and TVET institutions in particular. The overall digital competence of teachers and trainers will continue to be a key limiting factor in the affordances of digital TVET crystallizing over the next five years.

If the affordances of digital TVET are to crystallize, the fundamentals of TVET as a three-way collaboration between employers, students (or employees) and educational institutions have to be improved and, in some cases, kickstarted, with the support of government as the policy-maker. We find that digital TVET increases the strength of – and need for – these interlinkages. In the process, it is also accelerating the hybridization of tertiary education. Yet despite these advances, we find that ethical implications of digitization are receiving insufficient attention.

We strongly believe that the initial evidence generated by this high-level report should be followed by further research from the ILO and UNESCO. We propose a set of recommendations which we broadly group under two headings: 1) programmes to improve the evidence base informing digital transformation; and 2) strategies for digital transformation. In practice, the proposals are inter-linked and need to be addressed holistically as a composite.

We suggest that digital transformation strategies have a better chance of success if they are developed to support tangible pilots that can demonstrate the practical use of emerging technologies with a short timeframe (two to three years maximum) and inbuilt mechanisms to deploy technology that provides ongoing data on what works and what does not to the sponsoring stakeholders.

We propose four directions to improve the evidence base informing the transformation of the TVET sector:

- ▶ commission studies for countries that are digitally and TVET-ready
- ▶ focus future reports on digitization and skills for lifelong learning and meaningful work
- ▶ address research gaps on digitization in TVET
- ▶ support high-profile case studies that will resonate with the labour market and governments

Addendum

This report was finalised prior to the COVID-19 pandemic and the rapid and significant shift to distance and online learning that took place in the first half of 2020.

As such it reflects a useful baseline understanding of how the process of digitalisation was affecting TVET and skill systems prior to the crisis.

At the time of publication, many national systems still grapple with challenges associated with the accelerated digitalisation of learning caused by the pandemic, and unfortunately, as highlighted by this report, few systems have arrived at this point fully prepared.

However, whilst the shift to online or distance learning during the pandemic should be seen first and foremost as an emergency response, the crisis has also provided an opportunity for the development of more flexible learning solutions that make better use of distance learning and digital solutions.

In doing so, three important policy issues must be addressed to create long-term positive impacts and develop greater resilience. First: human and financial resources have to be mobilised to ensure universal access to digital infrastructure, tools and modern learning technologies. Second, college managers, teachers, trainers and learners themselves need training and support to engage in distance and online learning; and third, education and training providers have to revise teaching and learning models to make the best use of digital resources and tools.

Although the outbreak of the pandemic has provided a test bed for distance learning technologies, we must seize this opportunity to use the potential of digitalisation to create long term positive impacts and develop greater resilience for future shocks.

1



► 1. Introduction

Technology-driven transformations are redefining the role of education, the value of knowledge and skills. Non-formal learning, third-space literacies and alternative mechanisms for certification are emerging throughout the world, aiming to prepare youth for entering the job market. If non-formal mechanisms continue to expand, the role of the state, other actors and the G20 in education also need to be reassessed. This includes dimensions such as regional and global articulation, regulation and certification of non-formal education, among others.

► Cobo, Zucchetti and Rivas (2018).

The ILO and UNESCO assert that while raising the demand for new skills, digital technologies are also creating new opportunities and challenges for TVET and skills development systems. Changes in access modalities, learning methods, assessment and certification are taking place alongside massification and internationalization. Moreover, developments such as massive open online courses (MOOCs) are disrupting established operational models in the sector. The use of digital technologies, including open educational resources (OER), machine learning and artificial intelligence (AI) in education and training are also driving change in the development of learning materials, teaching and learning processes, as well as fundamentally changing pedagogies. Real-time data and data analytics are also complementing traditional labour-market information systems by providing a more timely understanding of the changing demand for skills. New forms of certification, including digital credentials and open and online badges, are supporting the recognition and validation of learning outcomes, including non-formal and informal learning, while ongoing efforts to digitize learner records are facilitating student mobility. Combined, these changes present a range of significant challenges for TVET and skills development systems.

In this context, the ILO and UNESCO are producing a collaborative report on the digitalization of TVET and skills systems. This report represents the first phase of a larger project, which will include country case studies on how – and to what extent – education and training policies are addressing this transformation in TVET and skills systems. As part of that broader ILO and UNESCO project, a separate review will also be conducted on the impact of digitization on the economy, the labour market and the skill mix in specific sectors.

In the terms of reference for this study, ‘digitization’ and ‘digitalization’ are used interchangeably, and this report takes the same approach. Digitization is the process of converting information from a physical format into a digital one. Digitalization is the process of leveraging digitization to improve business processes.

1.1 Objectives

This preliminary report provides a global, high-level snapshot of the digitalization of TVET and skills systems in a set of countries and international organizations. In the process, it:

- ▶ outlines the key technological drivers of change and the effect they are having on education and training practice, through a literature review and the experiences of the authors in policy-making, industry, TVET and quality assurance
- ▶ reports on the outcomes of interviews with experts and country representatives involved in this digital transformation
- ▶ outlines policies and policy measures countries have taken to engage TVET and skills systems in the process of digital transformation
- ▶ examines how education and training strategies and policies can best enable these transformations, including:
 - ▶ the use of technology, and how it can enhance the teaching and learning experience
 - ▶ bringing technology to learners, teachers and managers in TVET and skills development systems
 - ▶ the potential of digital transformation to support lifelong learning in different contexts
- ▶ identifies how and under which conditions technology can foster inclusion and gender equality
- ▶ identifies the types of programmes and skills introduced in TVET in response to the digitization of jobs and skills
- ▶ identifies the key issues and challenges facing education and training systems as they undergo the process of digitization

1.2 Structure of the report

The remainder of this report is structured as follows:

Section 2 explains the qualitative research approach, leveraging a mix of proprietary market intelligence, case studies, expert interviews and literature to generate evidence. It also deconstructs the key concepts underpinning the study, identifies the typical stakeholders in a TVET ecosystem that may be impacted by digitalization and introduces the conceptual framework.

Section 3 is a review of technological developments impacting the digitization of TVET and skills systems. It applies the conceptual framework to explain the many variables that constitute these technology developments under two broad groupings: 'Digital adaptation and acceleration relating to the future of work' and 'Digital innovation'.

- ▶ 'Digital adaptation and acceleration relating to the future of work' groups developments such as 'Industry 4.0' and 'Future skills for future jobs'.
 - ▶ The subsets of Industry 4.0 are 'Technologies driving Industry 4.0' and 'Impact of industry on Industry 4.0'.
 - ▶ The subset of 'Future skills for future jobs' is 'Structural changes to virtual education'.
- ▶ 'Digital innovation' groups developments on the basis of 'Technologies driving digital innovation' and 'Technologies driving trends'.
 - ▶ The subsets of 'Technologies driving digital innovation' are 'Ubiquitous computing'; 'Collaboration technologies'; 'Extended reality technologies'; 'Artificial technologies' and 'the Blockchain'.
 - ▶ The subsets of 'Technologies driving trends' are 'Distance learning and assessment'; 'Microlearning'; 'Simulations'; 'Flipped classroom'; 'Gamification'; 'OER' and 'Personalization'.

Section 4 summarizes the main findings under two broad categories: ‘Policies and governance’ and ‘Quality assurance’.

- ▶ The ‘Quality and relevance’ section has four subsets: ‘Learning processes’; ‘TVET staff’; ‘Quality assurance’; and ‘e-Information and guidance’.
- ▶ The subset of ‘Quality assurance’ is ‘Quality assurance of digital learning’.
- ▶ The subsets of ‘e-Information and guidance’ are ‘Tools for flexible learning pathways’ and ‘Tools for collecting and sharing learning achievements’.

Section 5 reflects on the findings and proposes some considerations and conclusions.

Section 6 proposes a set of recommendations for consideration by the ILO and UNESCO in taking the findings of this report to the next stage.

1.3 Limitations of this report

This report does not intend to criticize the ethical, equitable or social merits of digitalization or any underlying technology, nor does it set out to explore politically loaded issues such as the sustainability of industrial development within the context of Industry 4.0, or the need for education and training systems to do much more than ‘serve’ industry if nation-states are to maximize the affordances of technology. Although these areas are of significant research interest, they are beyond the scope of this short study.

The report’s point of departure is that digitalization is becoming an essential component of the global economy, and that narrowing the digital divide remains the objective of nation-states, since it is correlated with improvements to the gross domestic product (GDP). In December 2018, the International Telecommunication Union (ITU) estimated that 51.2 per cent of the global population would be using the internet (ITU, 2018). A 10 per cent increase in internet penetration is correlated with a 1.35 per cent increase in GDP for developing countries. Instead of considering digitalization as a symptom of relentless technological determinism, this study’s point of departure is that digitalization is embedded in the change policies of stakeholders in the TVET sector, from TVET institutions to nation-states, and that the primary focus needs to be on the affordances of various digital technologies to shape the future of work, and whether the TVET sector is in a position to respond to and embrace these affordances. This view was subsequently validated by the case studies and interviews supporting this study.

2



► 2. Our Approach

This study is based on qualitative research methods. It leverages proprietary market intelligence acquired from case studies and semi-structured interviews with policy-makers, experts and stakeholders with an understanding of the digital transformation of TVET and skills systems (Figure 1). The evidence generated from the interviews is supplemented by a literature review.

► Figure 1. Overview of approach



Interviewees were selected after consultation with the ILO and UNESCO based on their expertise and representation across the following broad categories: researchers, innovators, TVET organizations, labour-market representatives, social partners and quality assurance bodies around the world. As such, the study provides insights into a set of ‘lived experiences’, based on the digitization of TVET and skills systems in Brazil, Ghana, India, Kenya, Malaysia, Malta, Mauritius, New Zealand, Slovenia, Turkey and the United States.

Annex 2 features curated transcripts of the interviews. It is an integral component of this report, in that it provides unique insights into the current state of digitization of the TVET sector from people ‘in the field’. The data secured contributed to a deeper understanding of the major issues, opportunities and challenges perceived by stakeholders in the TVET ecosystem.

Annex 3 includes the interview questions.

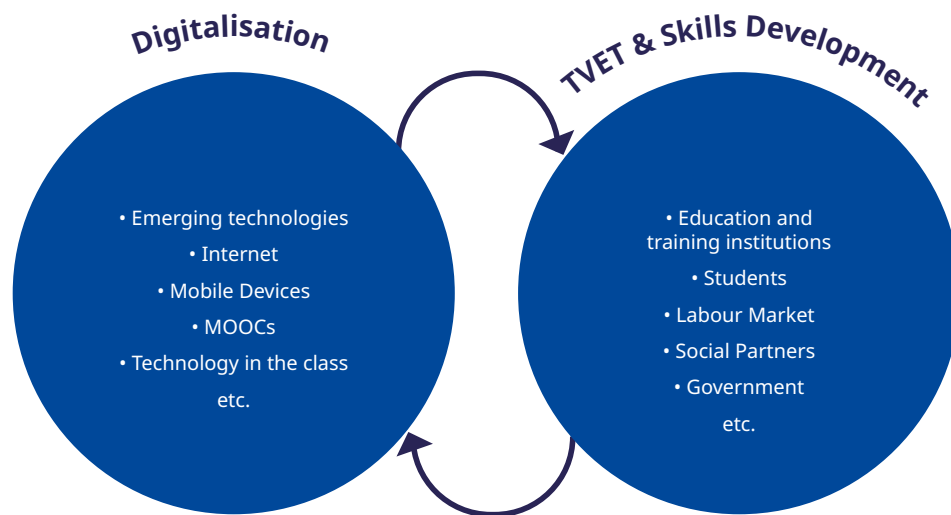
Our review of relevant published literature encompassed:

- research into megatrends affecting education more generally, and TVET and skills development in particular
- new technologies and their application for TVET and skills development
- technologies affecting the future of work
- reports on the digitization of education from international agencies including the ILO, the Organisation for Economic Co-operation and Development (OECD), the European Union, the European Centre for the Development of Vocational Training (Cedefop), UNESCO and the World Bank
- analysis of country-level policies, mainly from secondary sources, with limited primary-source analysis where data were available in languages covered by the researchers

These objectives all point to the digitization of TVET and skills systems within a framework of systemic change. By systemic change, we mean that we need to think of the impact of technology on the different pillars of TVET and skills development, i.e. not just teaching and learning, but also the governance and management of education and training institutions, and the way the labour market itself should be repurposing and repositioning itself to maximize any opportunities provided by technology, and secure a better-skilled workforce.

This report is also founded on a new media theory that there exists a reflexive relationship between technology and the social world (e.g. Couldry and Hepp, 2017; Siapera, 2018). It applies this theory as an analytical lens when seeking to understand the potentially disruptive relationship between digitalization and TVET and skills systems (Figure 2).

► Figure 2. Reflexive relationship between digitalization, TVET and skills systems



Source: Grech and Camilleri (2017).

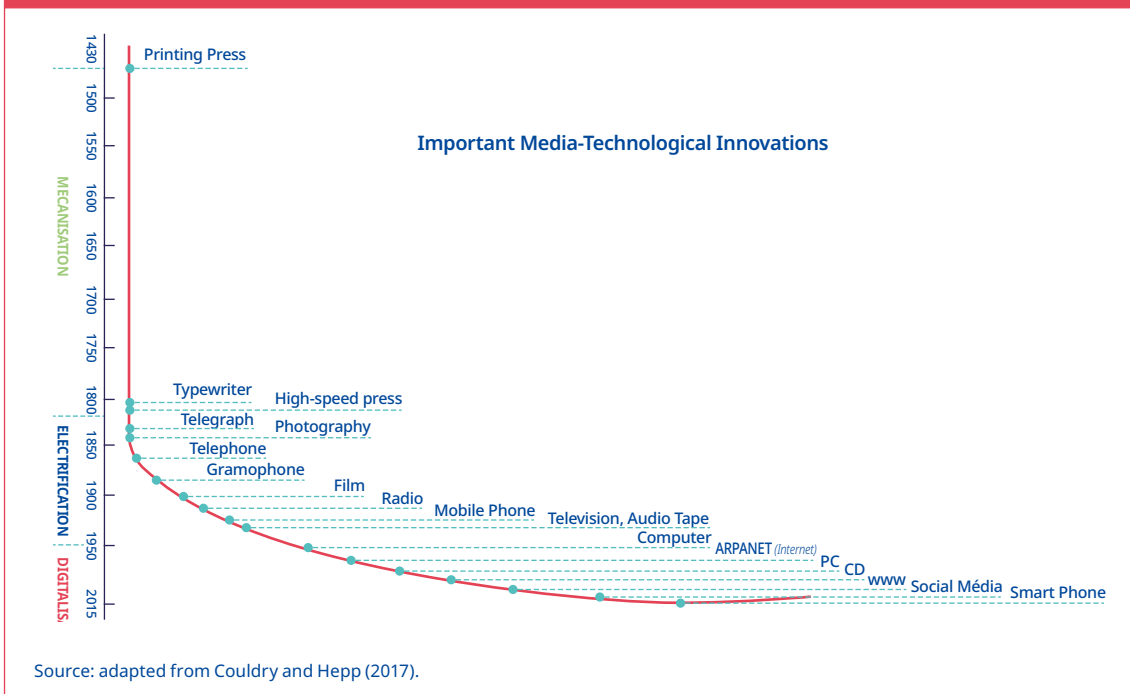
2.1 Deconstructing key concepts

This report addresses the interaction between three key and interlinked variables: digitalization, TVET and skills systems.

2.1.1 Digitization

Digitization or digitalization is frequently associated with transformation, from the micro-transformation of processes to the transformation of nation-states' agendas. It is increasingly associated with progressive societies and modernization. Couldry and Hepp (2017) position digitization as the third wave of innovations in media technology innovations and believe that we are already in the fourth wave – datafication (Figure 3).

► Figure 3. Digitization as the third wave of mediatization



职业培训 Vocational Training

职业培训

Vocational Training

TIANJIN CHINA

创业培训

Business Start-up Training

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2.1.2 TVET

TVET is understood as comprising education, training and skills development relating to a wide range of occupational fields, production processes, services and livelihoods. As a component of lifelong learning, TVET can take place at secondary, post-secondary and tertiary levels. It includes work-based learning, continuing training and professional development that may lead to qualifications. TVET also includes a wide range of skill-development opportunities attuned to national and local contexts. Learning to learn, the development of literacy and numeracy skills, transversal skills and citizenship skills are integral components of TVET (UNESCO, 2015). TVET is associated with training in public and private educational establishments or other forms of formal or informal instruction aimed at providing access to lifelong learning resources to all segments of society.

TVET increasingly focuses on preparing knowledge workers to meet the challenges presented by the transition from the Industrial Age to the Information Age, with its concomitant post-industrial human resource requirements and the changing world of work.

In many countries, distinct systems of TVET and academically oriented education operate side by side, often with different rules for quality assurance, funding, staffing, credits and qualifications. At the programme level it is often harder to distinguish between TVET and academic education, as they both employ similar approaches to teaching, with the same generic aims and methods. Thus, the International Standard Classification of Education (ISCED) recognizes that the traditional definitions used for 'vocational' and 'general' education at European Qualifications Framework levels 1 to 5 may have limitations. ISCED therefore suggests that at the tertiary levels of education, a move towards the terminology 'professionally oriented' and 'vocationally oriented' may be preferable. Nevertheless, ISCED does not currently provide definitions for these terms, explicitly leaving them open to future definition.

For example, a professional programme can be located within an academically oriented institution, and vice versa. In fact, programmes such as medicine, which are developed in close collaboration with the profession and involve long and involved internships, include significant numbers of external lecturers, where much research feeds directly into industry (such as the pharma industry). It is hard to argue that these programmes are not 'professionally oriented', despite having been located within universities for centuries.

Within TVET, strategic collaboration between institutions, students and enterprises is considered the core identity of the educational mode. Such collaboration is operationalized in the form of technical training for students, scientists' secondment to companies, joint courses, research chairs and consultations. Other activities can include contract research and development (R&D) and commercialization activities, such as licensing and incubation, investment in start-up companies, knowledge and technology transfers, and taking R&D outputs to market. All are legitimate activities relating to partnerships.

The TVETipedia Glossary has a comprehensive set of definitions that are pertinent to this report (UNESCO-UNEVOC, n.d.).

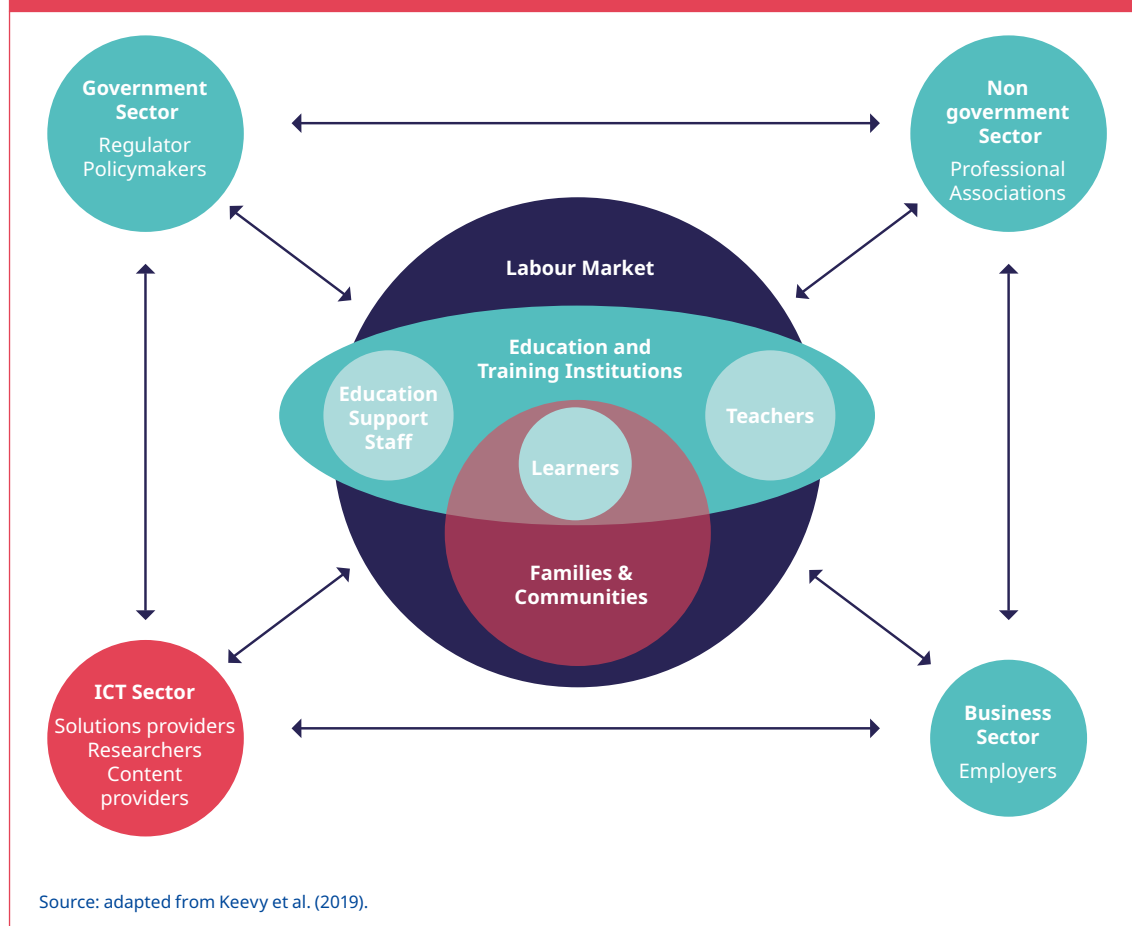
2.1.3 Typical stakeholders in TVET and skills development

A traditional view of educational systems conflates knowledge development with academically oriented education, and skills development with TVET. However, academically oriented education is increasingly expected to show direct relevance to the labour market, while skills development is not just limited to technical knowledge and aptitude, but increasingly focuses on 'softer' skills, such as communication, digital and media literacies, critical thinking, negotiation and teamwork.

In such a context, it is useful to think of the role of digital transformation in skills systems, which involve multi-stakeholder partnerships breaking down competencies into discrete units that are learned, practised and further developed in a lifelong context across formal education, employment and private life.

Several stakeholder groups have a legitimate interest in the digitization of the TVET sector. Figure 4 illustrates a TVET ecosystem that is corroborated by the evidence generated during the course of this review.

► Figure 4. TVET and skills systems



- Under such a model, skills systems are **defined** by the government, professional associations and employers, in collaboration with the labour market. They are then **implemented** by the labour market – in a more formal sense by education and training institutions, and in a lifelong sense through experience gained in communities.
- As a stakeholder, the information and communication technology (ICT) sector has a role in enabling and supporting such skills systems by increasing the efficiency of processes that allow acquiring skills, practising those skills in labour and lifetime contexts, and further developing those skills.
- As a group of technologies, ICT has a far deeper impact on systems as a whole, as discussed in Section 2.2.

2.2 Conceptual framework for digital transformation in TVET and skills systems

Our conceptual framework for the report considers how the elements of the 2015 UNESCO recommendation concerning TVET (UNESCO, 2015) interface with the three concepts of **digital Innovation, adaptation and acceleration**. We illustrate these transversal relationships in the matrix in **Table 1**.

► Table 1. Conceptual framework for digital transformation in TVET		
Digital Transformation → Elements of TVET ↓	Digital Innovation	Digital Adaptation & Acceleration
Policies & Governance (Policy-development, governance, social dialogue, finance, equity)		
Quality and Relevance (learning processes, staff, qualification systems, learning pathways, quality assurance, information and guidance)		
Source: Authors.		

Our study considers the following elements of digital transformation:

- **Digital innovation** describes how technology enables new forms of teaching and learning, including new pedagogies.
- **Digital adaptation** examines how technology requires teaching new skills, to adapt to the changing needs of society and the labour market.
- **Digital acceleration** considers how existing policies or trends, including massification, inclusion/exclusion or (un)employability, may be accelerated thanks to technological developments in society.

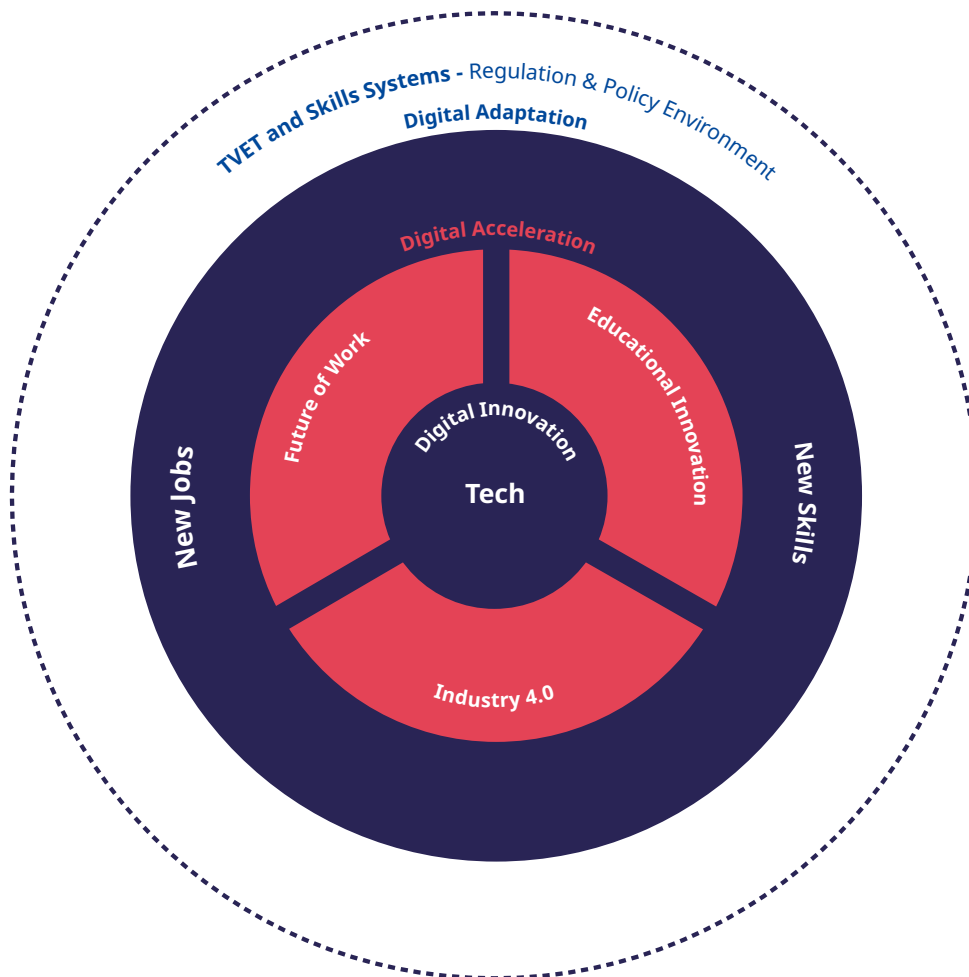
3



► 3. Review of Technological Developments impacting the Digitization of TVET and skills systems

The report engages with emerging trends around TVET, specifically **digital innovation, adaptation and acceleration**. Our analysis indicates that the development of new digital technologies (**digital innovation**) creates new capabilities for education, the workplace and societies in general. These capabilities lead to new skills that enable persons to adapt to and benefit from these transformations (**digital adaptation**), as well as transformations in the nature of education, work and society (**digital acceleration**) (Figure 5).

► Figure 5. Analytical framework



Source: Grech and Camilleri (2017).

Regulation creates a supportive environment for developing new technology and promoting skills education.

3.1 Trends in the wider labour market

3.1.1 Industry 4.0

The First Industrial Revolution started with the advent of steam and water power, enabling the mechanization of production processes, while the Second Industrial Revolution was driven by electric power and mass manufacturing techniques. Information technology (IT) and automation brought in the Third Industrial Revolution (also known as the digital revolution), which is defined by electronics and IT, automated production and advanced globalization. The Third Industrial Revolution has changed how human interactions, commerce and entire communities. The Fourth Industrial Revolution is emerging through a range of technologies that are blurring the distinction between physical, digital and biological spaces. Industry 4.0 transforms how products are designed, fabricated, used and operated, as well as how they are maintained and serviced. As a construct, 'Industry 4.0' is an overarching transformation that covers every aspect of industrial and economic activities, and every aspect of living – it is a total transformation of all sectors into new systems and/or ways of life. The convergence of the physical, digital and biological worlds has much to do with technological advances which are viewed as 'disruptive technologies', including nanotechnology, AI, robotics, bionics, genetics and 3D printing. Under Industry 4.0, the distinction between industry and services becomes less relevant as digital technologies are connected with industrial products and services and transformed into hybrid products that are neither exclusively goods nor services. Indeed, both the terms 'Internet of Things' (IOT) and 'Internet of Services' are considered elements of Industry 4.0 (European Parliament, 2016).

The main features of Industry 4.0 are:

- ▶ **Interoperability:** cyberphysical systems allow humans and smart factories to connect and communicate with each other. Interoperability can also be defined as the ability of independent systems and processes (technical and non-technical) to exchange data and information and communicate using common standards to enhance efficiency and service delivery. Interoperation thus occurs whenever independent or heterogeneous information systems or their components, controlled by different jurisdictions/administrations or by external partners, smoothly and effectively work together in a predefined and agreed upon fashion (Keevy and Rajab, 2019).
- ▶ **Virtualization:** a virtual copy of the smart factory is created by linking sensor data with virtual plant models and simulation models.
- ▶ **Decentralization:** cyberphysical systems have the ability to take decisions on their own and to produce locally thanks to technologies such as 3D printing.
- ▶ **Real-time capability:** cyberphysical systems have the capability to collect and analyze data and provide the derived insights immediately.
- ▶ **Service orientation**
- ▶ **Modularity:** smart factories can adapt flexibly to changing requirements by replacing or expanding individual modules.

Industries face several challenges in the process of adopting Industry 4.0, including:

- ▶ lack of awareness on the concept of Industry 4.0 and its benefits
- ▶ no clear comprehensive policy and coordination on Industry 4.0
- ▶ infrastructure gaps, particularly in relation to the digital infrastructure, as well as ecosystem gaps
- ▶ lack of targeted incentives to incentivize more companies to move towards Industry 4.0

- mismatched skill sets and lack of right talent/human capital
- lack of standards leading to difficulties in integrating different systems, as well as reliability issues

Depending on the size of the enterprise, different challenges can also emerge.

3.1.1.1 Digital innovation driving Industry 4.0

According to the World Economic Forum, twelve technologies are key to the future of production (Figure 6).

► Figure 6. Technologies contributing to the future of production

TECHNOLOGY	DESCRIPTION	TECHNOLOGY	DESCRIPTION
Artificial intelligence and robotics	Development of machines that can substitute for or complement humans, in tasks associated with thinking, multitasking and fine motor skills.	Internet of Things	The use of always-connected sensors to remotely connect, track and manage products, systems and grids.
Virtual and augmented realities	Creation of immersive environments, holographic readouts and digitally produced overlays on the physical world for mixed-reality experiences.	3-D printing	Additive manufacturing, using a widening range of materials and methods, including bioprinting of organic tissues.
Blockchain	Distributed ledger technology based on cryptographic systems that can securely store and manage transaction data without central parties.	Advanced materials and nano-materials	Creation of new materials and nanostructures for the development of beneficial material properties, such as thermoelectric efficiency, shape retention and new functionality.
Energy capture, storage and transmission	Breakthroughs in battery and fuel cell efficiency; renewable energy through solar, wind, and tidal technologies; energy distribution through smart grid systems and wireless energy transfer.	New computing technologies	New architectures for computing hardware, such as quantum computing, biological computing or neural network processing, as well as innovative expansion of current computing technologies.
Bio-technologies	Innovations in genetic engineering, sequencing and therapeutics, as well as biological computational interfaces and synthetic biology.	Geo-engineering	Technological intervention in Earth's climate by removing carbon dioxide directly from the atmosphere or managing solar radiation.
Neuro-technology	Innovations such as smart drugs, neuroimaging and bioelectronic interfaces that allow for reading, communicating and influencing human brain activity.	Space technologies	Lowering access costs to space, including through the use of microsatellites, advanced telescopes, reusable rockets and integrated rocket-jet engines.

Source: adapted from World Economic Forum (2018) and World Economic Forum (2017).

3.1.1.2 Adaptation of TVET to Industry 4.0

Globally, Industry 4.0 is positioned as one of the main drivers of innovation in TVET (Madsen et al., 2016). Policies for digital TVET should therefore be seen through a lens of *adaptation* to this new industrial paradigm.

While Industry 4.0 is not a universally used term,² the technologies and trends encompassed by the term are already visible globally. Although interviews point to a disconnect between the current state of the TVET sector and Industry 4.0, official policies and strategies in several countries indicate that TVET is reacting to:

- ▶ increased automation of simple tasks – and increasingly of mid-level tasks – thanks to technologies such as AI
- ▶ increased complexity and cost of equipment used in technical occupations
- ▶ constantly emerging (new) technologies
- ▶ more complex workflows involving multidisciplinary teams
- ▶ increased flexibility
- ▶ increased productivity, efficiency, quality and reduced time to market
- ▶ more R&D activities
- ▶ development of new skills and talent globally

▶ Box 1. Preparing industry for 4.0: TVET's role in continuing education in Brazil

In Brazil, the National Service for Industrial Training (SENAI) offers consultancy services to small and medium-sized enterprises (SMEs). In 2018, SENAI visited some 3,000 SMEs to determine the opportunities for short-term, quick interventions – essentially, the introduction of lean manufacturing in SMEs. The core lesson learned was that adopting Industry 4.0 methodologies within the SME context first requires organizing core internal processes in the factory line: only then can one start to think about monitoring processes through technology and prepare to move up the value chain into other areas. SMEs could not adopt TVET course offerings without focusing on core processes, despite SENAI being in a position to introduce such courses. Topics such as the IOT and AI require the existence and development of many transversal skills. In direct response to these findings, SENAI has created a committee with sectoral responsibilities to review and gradually introduce programmes in Manufacturing 4.0 as applied to TVET, with a specific website created as the primary delivery platform.

Source: Grech and Camilleri (2017).

3.1.2 Adaptation of TVET to provide future skills for future jobs

Many existing studies identify the jobs and skills most likely to be replaced by machines. However, history suggests this is not a predictable linear development. For example, the advances in natural language processing and self-driving cars of the last decade were due to leaps in technology (sometimes referred to as 'moonshots' in the industry) rather than to incremental advances.

² Different countries use different terms to describe their national strategy related to Industry 4.0, such as: 'Smart manufacturing' in the United States, 'Made in China 2025' in China, 'Manufacturing Innovation 3.0' in South Korea, 'Industrial Value Chain Initiative' in Japan and 'Smart Nation Programme' in Singapore.

Hence, policy work on future skills requires a tri-pronged approach involving:

1. **anticipation of skill needs**, as well as areas of deskilling, by surveying emerging technology
2. **teaching of transversal or generic skills**, particularly learning-to-learn skills, which would allow people to adapt to future changes in the labour market through continued and lifelong learning
3. **improving the responsiveness of educational systems to emerging trends**, which requires close cooperation between education, research and industry to allow TVET systems to provide skills training in emerging areas

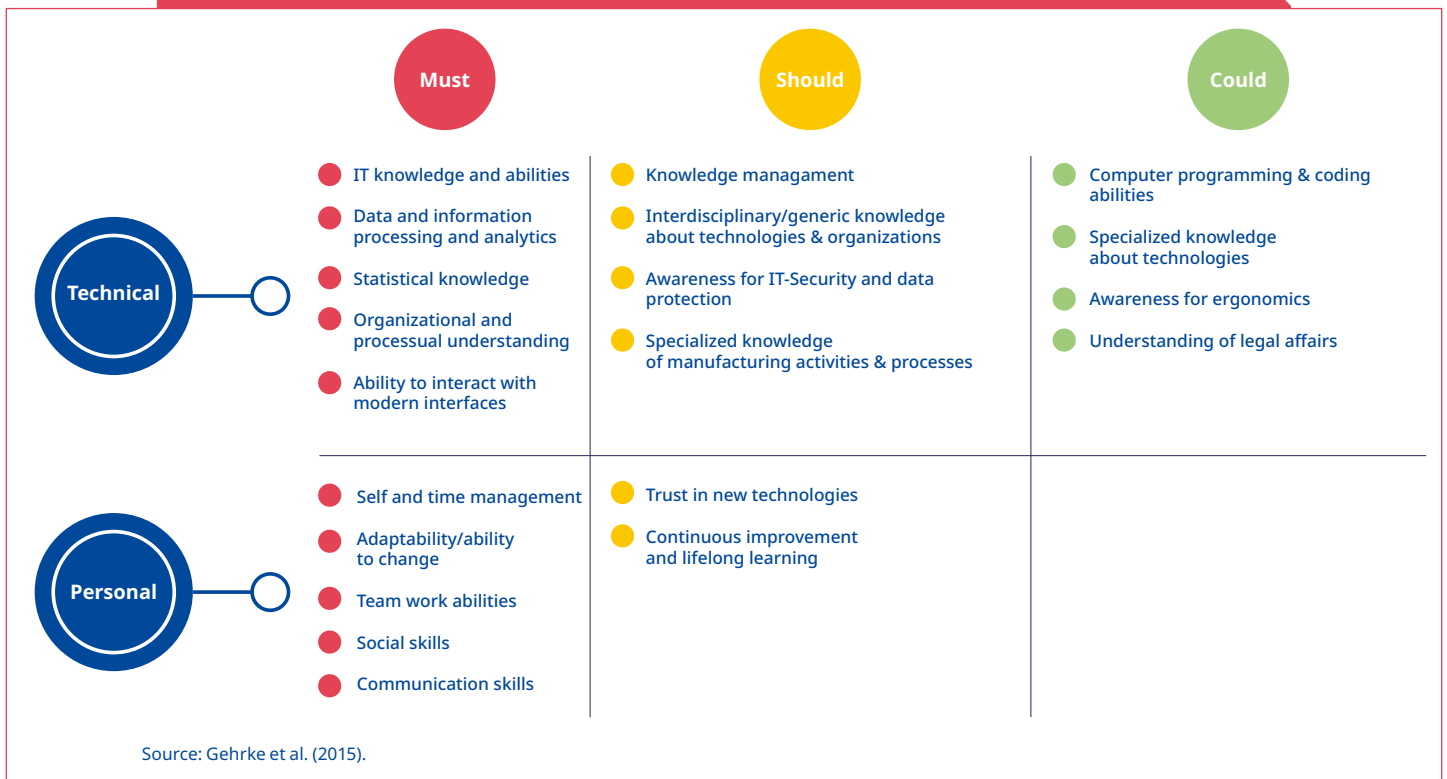
At an extremely high level of abstraction, it is suggested that skills and jobs involving creative endeavours and social interactions are the most likely to show the highest resilience to change in the coming years (Byrnjolfsson and McAfee, 2014).

A study emphasizes the need for a strong emphasis on digital skills at every level of TVET (Gebhardt, Grimm and Neugebauer, 2015), to facilitate:

- ▶ adaptation to workplaces where manual tasks are being taken over by digital tasks
- ▶ servicing digital workplaces, in terms of programming and engineering-related skills

Figure 7 provides a visualization of potential future skills.

▶ Figure 7. Future qualifications and skills required from TVET



While practically every country surveyed has a digital skills strategy, there exists a global problem in ensuring a sufficient number of qualified applicants entering the skills pipeline with the set of skills identified in Figure 7. This appears to be caused by a number of complex issues, including:

- ▶ Limited access to high-quality science, technology, engineering and mathematics (STEM) education – whether by integrating STEM concepts in teaching foundational skills or specialized STEM education leading to STEM professions: in many countries, STEM is more about securing access to ICT careers than securing the composite of qualifications and skills as identified above.
- ▶ The relative lack of enthusiasm of graduates in securing digital skills that are specifically relevant to the needs of the TVET sector, employment and social participation: in some countries, this situation also tends to be exacerbated by gender and racial stereotypes.
- ▶ Lack of adaptation of curricula to a digital world.

Despite some countries' concerns about decreasing job opportunities owing to digitization, skilled workers with a high-quality initial and further training oriented towards Industry 4.0 have clear career prospects (Spöttl et al., 2016). German-speaking countries in Western Europe, where TVET systems are already more closely integrated with world-leading companies linked to Industry 4.0, provide a preview of what adaptation to this new paradigm will bring to TVET (Pfeiffer, 2015):

- ▶ an expansion of provision of **higher** vocational education and training (VET), as well as of **professional** higher education (McGrath, 2012)
- ▶ ancillary campaigns to increase the status and attractiveness of VET, particularly as an alternative pathway to higher education
- ▶ an increased role for **quality** apprenticeships – particularly through the mechanism of integrated on- and off-the-job training, to fill the gap of well-qualified workers with target-related technological qualifications and work experience (Graf, 2013; Gennrich, 2017)

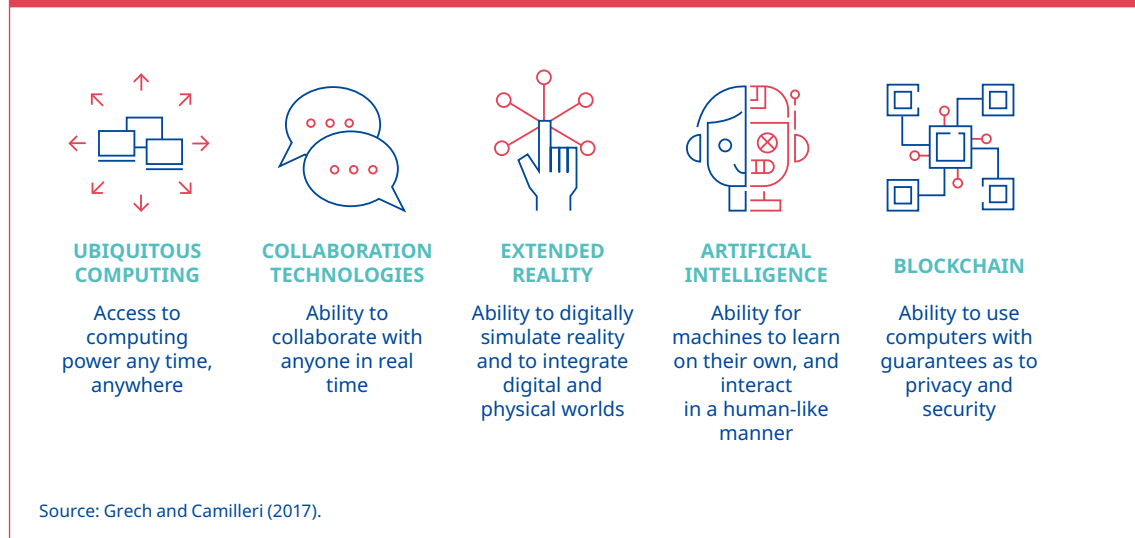


3.2 Trends in digital education

3.2.1 Technologies driving digital innovation

Five technologies in particular are driving innovation in TVET (Figure 8).

► Figure 8. Five technologies driving digital transformation in TVET



By inference or design, the affordances of technology in daily lives are also being explored as new modes of teaching and learning, both in and out of the classroom or training centre, with content delivered interactively and asynchronously, in a blended or totally online format. As an applied construct, technology at first glance also appears particularly suited to TVET transformation agendas.

3.2.1.1 Ubiquitous computing

Ubiquitous computing describes the technologies that give people access to information and computing power through the worldwide web from practically any place in the world. In a learning context, ubiquitous computing infrastructure is a pre-requisite for most applications of digital learning: in places with poor educational infrastructure, it can often be a pre-requisite for delivering *any* educational or training opportunities.

Ubiquitous computing is associated with three technologies:

- **Broadband** describes high-speed internet, typically fast enough to support applications such as video-conferencing and remote control of equipment. Broadband was traditionally delivered to devices through cable and fibre connections, which require massive investments in infrastructure, since they need to be physically passed to each device.
- **Mobile broadband** describes technologies such as 3G, 4G and 5G, each allowing the wireless delivery of broadband to computing devices through radio waves. Each of these technologies still requires the user to be within several hundred metres of a base station, which needs to be connected to a wired network. An innovation in this area is low-cost global satellite internet, which should allow anyone on Earth access to a mobile broadband connection with only a compatible router.

- **Cloud computing** describes the offloading of computing tasks from a local device to a computer hosted in a data centre. Such tasks can involve anything from storing photos to processing large data sets. In each case, cloud computing allows a user to use a small, relatively low-powered device, while at the same time having access to the computing power of hundreds or even thousands of machines. Cloud computing depends on broadband to communicate between the local and remote devices.

Taken together, these technologies allow individuals to have access to practically unlimited information and computing resources, even from low-cost devices such as mobile phones, from anywhere in the world.

► Box 2. Bringing low-cost broadband to schools globally: OneWeb

OneWeb is a private company whose mission is to enable internet access for everyone, everywhere. The company is building a communications network with a constellation of Low Earth Orbit satellites that will provide connectivity to people around the world. OneWeb's network will go beyond the limits of existing infrastructure, enabling connectivity for rural communities and schools using a network of over 600 microsatellites. With the support of Airbus, the company intends to produce around 40 satellites per month and to begin commercial operations in 2020 (OneWeb, n.d.).

The company is explicitly targeting schools through the service, with the aim of:

- connecting schools to the internet
- enabling satellite-based distance learning

allowing big-data analysis of school broadband use to allow better-informed aid and humanitarian policies.

3.2.1.2 Collaboration technologies

Collaboration is the organization of joint efforts among actors to achieve a shared goal. It is a perennial and integral part of human life, given that we are social beings. However, modern life has increased both the necessity for and complexity of collaboration, bringing about complex production and political systems that require highly coordinated efforts to function.

The digital age, driven by the advent of network computing, the internet and mobile devices, has added an entirely new layer of both opportunity and challenges. The ability to communicate, exchange information, and collaborate across space and time has given us new forms of working, new types of (virtual) organization and the reconfiguration of markets. This, in turn, has spurred innovation across different sectors of the economy, enabling heretofore impossible collaboration across national and disciplinary boundaries. Yet all of this comes at a cost. Collaboration online without face-to-face contact is not frictionless; it requires new skills and hidden 'collaboration work', above and beyond the 'actual work'. New, multi-stakeholder, networked forms of organizing come with new coordination costs, sources of conflict and the need to renegotiate the fair distribution of value.

Many technologies with a 'social' element incorporated in the software would qualify as collaboration technologies. Social networks such as Facebook and Google Groups can facilitate collaboration; the same can be said for Dropbox, Google Drive, WhatsApp and Skype. Collaboration tools in 2019 are primarily associated with work efficiency and project tracking, and the integration of a number of tools into one interface. For instance, Slack³ is a smart platform that works on mobile and desktop devices, and allows sending direct messages and files to a single person or a group of employees. Slack also has the ability to organize conversations into different channels (specific projects, general chat, etc.) The app supports video calling, and drag, drop and sharing of files with colleagues directly within Slack. It is also compatible with services such as Google Drive, Dropbox and Box.

3 Other popular collaboration technologies include Asana, Podio, Ryver, Trello and Flock.



Blended learning is the most important systemic trend in teaching and learning being accelerated by digitization. Specific technologies in teaching and learning that are changing the way teachers teach include microlectures, special apps and websites such as Moso Teach and Ketangpai. The technologies that appear to have the highest impact on TVET staff include mobile communication technology, like WeChat and Ding Talk. Almost every TVET staff and student in China has WeChat, and the most important notices are usually sent via WeChat.

► Professor Zhao Zhiqun, Institute of Vocational and Adult Education, Beijing Normal University

3.2.1.3 Extended reality technologies

Extended reality technologies variously incorporate a range of different technologies, including (Intel, n.d.):

Virtual reality (VR): VR is the most widely known of these technologies. It is fully immersive, tricking the senses into thinking one is in a different environment or world outside of the real world. Using a head-mounted display or headset allows the user to experience a computer-generated world of imagery and sounds, manipulating objects and moving around using haptic controllers while tethered to a console or PC. For example, VR allows ‘visits’ to 3D-simulated workplaces.

Augmented reality (AR): AR overlays digital information on real-world elements, either through a headset or a mobile device such as a phone. AR keeps the real world as a central construct, but enhances it with other digital details, layering new strata of perception and supplementing an individual’s reality or environment. In education, for example, an AR headset could be used to overlay educational instructions onto production equipment, indicating indicate precisely which button to press, which screw to unscrew, etc. in a live environment

Mixed reality (MR): MR brings together real-world and digital elements. It allows interacting with and manipulate both physical and virtual items and environments, using next-generation sensing and imaging technologies. MR allows people to see and immerse themselves in the world around them even as they interact with a virtual environment using their own hands. Examples of MR include dedicated simulators, such as those used in aerospace.

These terms cover a set of methodologies whereby students can control software and systems remotely. These may include:

- Shared remote control of equipment: a single model of an expensive piece of equipment is located within a lab or work context, and students from different locations can log on and use it for specific periods of time. Examples of such a setup might include shared custody of a 3D printer or shared use of computer resources in a cloud.
- Simulations of industrial control systems: students can ‘operate’ industrial machines by using the same software that is used by the machines, but is connected to virtual machines. Examples include anything from flight simulators to control systems for factory production lines.

3.2.1.4 Artificial intelligence

AI is a group of technologies and techniques, notably those linked to deep learning, natural language processing and signal recognition, which allow computers to learn and interact similarly to humans. Traditionally, a computer would only be able to recognize an image of a cat as being a cat if that specific image has been labelled as a cat. If shown an image of a similar cat, it would not be able to recognize the image. Using AI, once trained with images of thousands of cats, a computer would be able to recognize an image it had not previously seen as representing a cat. Furthermore, the computer would not need to be given rules to determine what constitutes a cat – the mere act of giving it thousands of labelled images would allow it to deduce these rules on its own.

Three conditions currently apply to any and all AI applications:

- ▶ The design of AI applications depends on the existence of massive databases of coded material on which to train machines, thus limiting its applicability in many sectors that do not have access to such data sources. In the example above, to recognize a cat, an AI need to be fed thousands of images labelled as 'cats' in order to work.
- ▶ AI does not provide definite answers to any queries – it only provides probabilities. For instance, an AI would state that it is 94 per cent sure that an image is a cat.
- ▶ AI requires significant computer resources for training – it is typical to require hundreds or even thousands of special computer cores for AI applications.
- ▶ AI is not a universally defined term – many applications that claim to be based on AI have no link to machine learning.
- ▶ We imagine that the most immediate applications of AI to TVET would therefore involve the following items:

3.2.1.4.1 Natural language processing

This is a subfield of deep learning, i.e. the ability to train computers based on large data sets. Using large data sets of typical standardized conversations (for example, students asking questions linked to a topic), translations or conversations, computers are increasingly able to simulate and understand natural speech, accept natural speech as an input to queries and even translate text between languages.

Natural language processing has a broad range of applications within education, including:

- ▶ powering search engines, chatbots or help forums that can answer student questions phrased in natural language
- ▶ translating educational materials
- ▶ providing artificial mentorship, or step-by-step instructions in practical contexts

3.2.1.4.2 Recommender systems

Recommender systems use massive data sets of user preferences to intuit what users might need or prefer to consume next. For example, they might be used to recommend books to users based on the books they have read, the topics of interest to them (as stated in their profile) and the ratings they have given those books. Combining these factors with a database of millions of data points about what other users have read, liked and rated allows the system to make reasonable guesses concerning what to recommend.

In a TVET system built out of hundreds of distinct units, AI could be used to recommend (a) educational/training resources; (b) learning opportunities; and (c) personalized career pathways, based on aptitude, educational goals and past performance.

► Box 3. Recommender systems enhancing student performance: Geekie

Geekie Lab is an application with machine learning capabilities developed in Brazil that is helping students cope with lessons at their own pace. The AI in Geekie's education software constantly learns about each student's progress on individual level through tests and sends the analyzed performance data to the student's teachers. These reports identify students' learning gaps in real time. Geekie Lab then recommends interventions and extra activities for each student. The activities and interventions proposed use an application of Item Response Theory. The system monitors which learning activities students are undertaking, the time spent on each activity and the completion success to decide what materials and activities to suggest. Geekie is currently used in over 5,000 schools in Brazil and has served over 12 million students.

Source: Geekie (n.d.).

3.2.1.4.3 AI for teaching and assessment

An extension of the two capabilities described above consists in using AI programmes to teach material by presenting content to each student in a different way, based on the student's learning preferences, as well as to grade assessments.

While both applications exist, they suffer from a lack of sufficient training material to adequately train sophisticated AI. Therefore, most applications have been used to assess standardized tests applied to large volumes of students.

Many grading systems that claim to grade using AI are actually grading-assist systems, which might run tests such as keyword searches, word counts, and spelling and grammar checks on essays, present the results to the grader and then allow the grader to concentrate on higher-order skills, such as context and sense.

► Box 4. AI for automated assessment: Standardized testing in the United States

Several states, including Utah and Ohio, already use automated grading on their standardized tests. While the State of Utah began very cautiously, initially making sure every machine-graded essay was also read by a real person, it now assigns machines as the sole judges of the vast majority of essays. In about 20 percent of cases, when the computer detects something unusual or is on the fence between two scores, it flags an essay for human review. The automated scoring system has been a boon for the state, not only because of the cost savings, but also because it enables teachers to get test results back in minutes rather than months. This ability to secure almost real-time feedback is a major advantage of AI and of significant interest within the TVET sector.

3.2.1.5 Blockchain

Blockchain, more formally known as distributed ledger technologies, is predicted to offer significant opportunities to disrupt traditional products and services thanks to the distributed, decentralized nature of blockchains, features such as the permanence of the blockchain record, and the ability to run smart contracts. These features significantly distinguish blockchain technology-based products or services from previous internet-based commercial developments. They are of particular interest to the education sector – although education, with some minor exceptions, is not currently perceived as high on the agenda of countries with national blockchain initiatives.

Blockchain technology is forecast to disrupt any field of activity that is founded on time-stamped ledgers. Within education, activities that could be impacted by blockchain technology include certification, management of student records, intellectual property management, issuing of payments and student information system architecture.

From a social perspective, blockchain technology allows (Grech and Camilleri, 2017):

- ▶ **self-sovereignty**, i.e. users can maintain direct control over the storage and management of their personal data
- ▶ **trust**, i.e. the technical infrastructure gives people enough confidence in its operations to carry through with transactions such as payments or the issuance of certificates
- ▶ **transparency and provenance**, i.e. users can conduct transactions with the knowledge that each party has the capacity to enter into that transaction
- ▶ **immutability**, i.e. records can be written and stored permanently, without the possibility of modification
- ▶ **disintermediation**, i.e. there is no more need for a central controlling authority to manage transactions or keep records
- ▶ **collaboration**, i.e. parties have the ability to transact directly with each other, without the need for third parties



► Box 5. Case study: Malta blockchain credentials for TVET

In September 2017, the Ministry for Education and Employment signed a one-year contract with Learning Machine to deploy a nation-state pilot and issue digital credentials notarized on the Blockcerts open standard.¹ Blockcerts focuses on every aspect of the credentials value chain: creation, issuing, viewing and verification of the certificates, using blockchain technology as the infrastructure. The pilot was initiated to create a verifiable proof of credentials – including TVET credentials for citizens – with participating institutions, including the Malta College for Arts, Sciences and Technologies ([MCAST], the TVET institution), the Institute for Tourism Studies, and the National Commission for Further and Higher Education. The pilot provided three main functionalities: 1) issuance and registration of academic certificates (using the Learning Machine certificate issuance environment); 2) storage and presentation (Blockcerts application); and 3) verification (third-party verification web-page).

Credential recipients could receive, verify, store and share their academic and TVET credentials on a blockchain through a digital wallet that also installs the Blockcerts application. By adding their academic institution as an issuer, citizens could receive verified digital records from their institutions that are verified by that institution. Recipients could share these credentials with others, and these third parties could in turn use Blockcerts to verify the credential.

What the recipient sees is the record itself, the content of the record and the signed hash of the content, which is stored on the blockchain. The content of the record contains the public key of the recipient of the record, presenting the ownership of that record.

For issuing institutions, Learning Machine created functionalities that allow institutions to:

- import/manage recipient lists
- easily collect recipients' public keys
- design templates for digital records (content, layout, metadata)
- issue records to entire cohorts
- track aggregate analytics of how records are being used online
- view profiles that show all records issued to an individual

Over 2,000 certificates were issued during the pilot stage. In early 2019, the Maltese Government announced that it had extended the contract with Learning Machine for a further two years to enable the pilot to extend to all academic and TVET institutions in Malta, and to explore how the technology could be deployed for public records (CryptoNinjas, 2019). At the time of this study, all academic, TVET and private schools in Malta for learners up to age 16 had joined the pilot.

Source: Grech and Camilleri (2017).

3.2.2 Adaptation and acceleration of TVET pedagogies to digitization



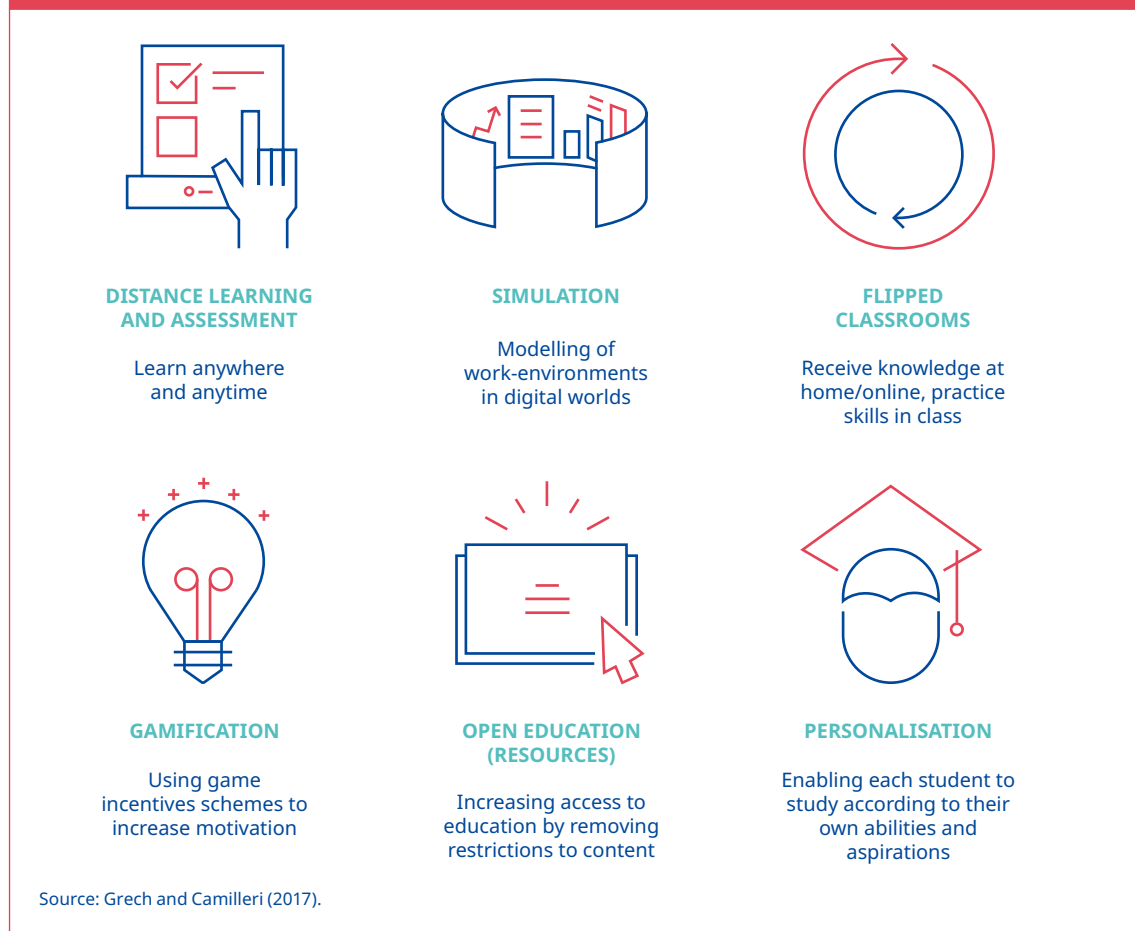
Openness and OER are becoming increasingly important. Digital technology needs to be deployed in ways that stimulate young people's interest in joining technical/ technology courses. SENAI is working on this with UNESCO, having deployed a free education programme with slow-drip information to prospective students to create attractiveness. It is vital to employ technologies – particularly mobile phone and gaming technologies, such as 3D components – for TVET to be valued as an attractive training proposition for young people. The message should not be a top-down, one-way option: TVET can form the basis of fantastic engineer programmes, and SaaS works with high school education. Health and safety can benefit from structured TVET. We need to focus more on science, technology, engineering and mathematics (STEM), but also on science, technology, engineering, **arts** and mathematics (STEAM). We need to have more critical and entrepreneurial students in the future. High school reform is a great opportunity for SENAI to create applications that are more attractive to students. TVET is expensive, and funding is always a challenge. Public-private partnerships (PPPs) are constantly being developed to expand student numbers in TVET. There is a large dropout rate in high school – only 50 per cent of students conclude high school. This also means there are students already in the marketplace who did not conclude high school and are looking for jobs; we need training to resolve this. These statistics need to be one of the stimuli of reform.

► Frederico Lamego – Executive Manager of International Relations, SENAI

Learners can learn individually or collaboratively through a multitude of technology-enabled methodologies, including writing activities, game-like learning environments, simulations and AR. The combination of school and work-based actors (teachers and supervisors) and actions (intertwining learning activities at both locations) is what makes TVET unique. However, current research and practice often neglects the possibilities of investigating the role of collaboration in vocational education, where the interaction between people in different locations is fundamental to the systems' effective functioning (Schwendimann et al., 2018).

Given these limitations, six areas of learning hold promise for TVET: distance learning and assessment, simulation, flipped classrooms, gamification, open education (resources) and personalization. Figure 9 provides a brief description of each.

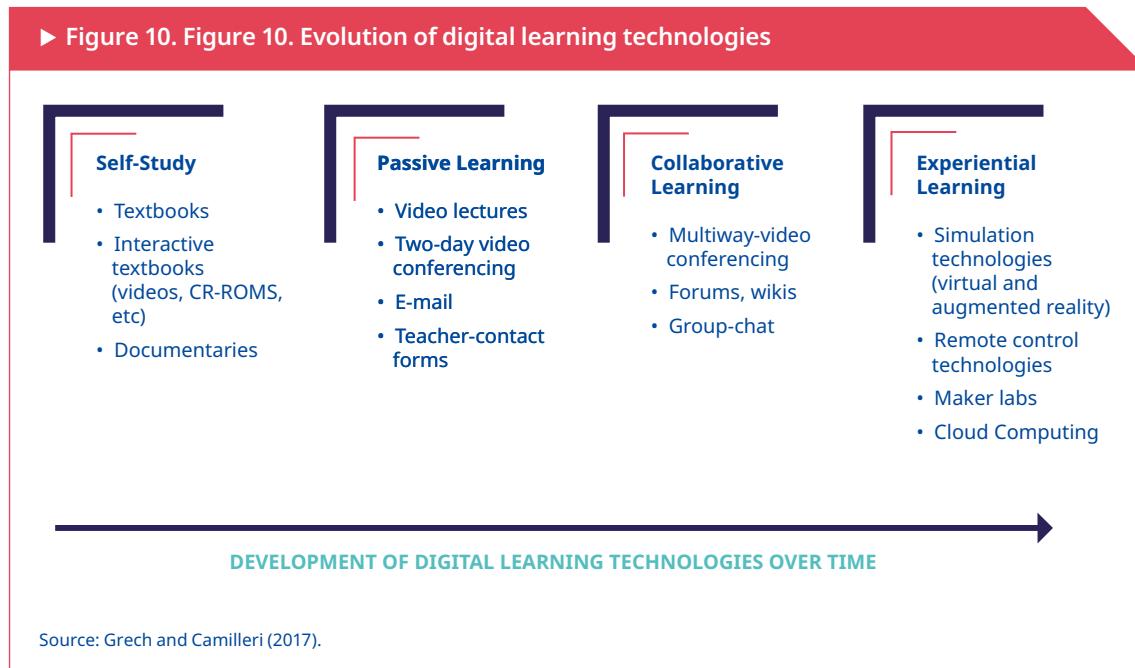
► Figure 9. Six areas of learning holding promise for TVET



3.2.2.1 Distance learning and assessment

Distance learning (or **distance education**, also open and distance learning [ODL]) is a field of education that focuses on the pedagogy, technology and instructional systems design that deliver education to students who are not physically 'on-site'. Distance learning is the process of creating an equally qualitative educational experience that best suits the needs of learners outside the classroom. Rather than attending courses in person, teachers and students may communicate at times of their own choosing by exchanging printed or electronic media, or they may use technology that allows them to communicate in real time. Distance education courses that require a physical on-site presence for any reason, including for taking examinations, is considered a hybrid or blended course of study. MOOCs are considered part of distance learning.

The main strength of distance learning is that it allows students who are not able to participate in a classroom at a fixed place and at fixed times to still follow courses. This is strongly linked to improving student equity through improved opportunities to learn. Figure 10 shows the evolution of learning technologies from self-study and passive learning to collaborative and experiential learning.



The simplest applications of distance learning involve self-study and passive learning, and are suitable only for conveying theoretical knowledge to students. Due to their technological simplicity, these forms are also the cheapest and most widespread; however, they also have limited applicability to TVET, owing to their lack of a practical focus. The Web 2.0 revolution has led to the commoditization of communication and collaboration technologies. Group work and peer assessment are now realistically conducted online at low cost among geographically dispersed teams, and communication and interpersonal skills are taught remotely.

MOOCs have received significant attention as an evolution of distance learning. McAuley et al. (2010) define a MOOC as a class that integrates the connectivity of social networking, the facilitation of an acknowledged expert in a specific field of a study and a freely accessible course, designed to be offered at scale through the internet.

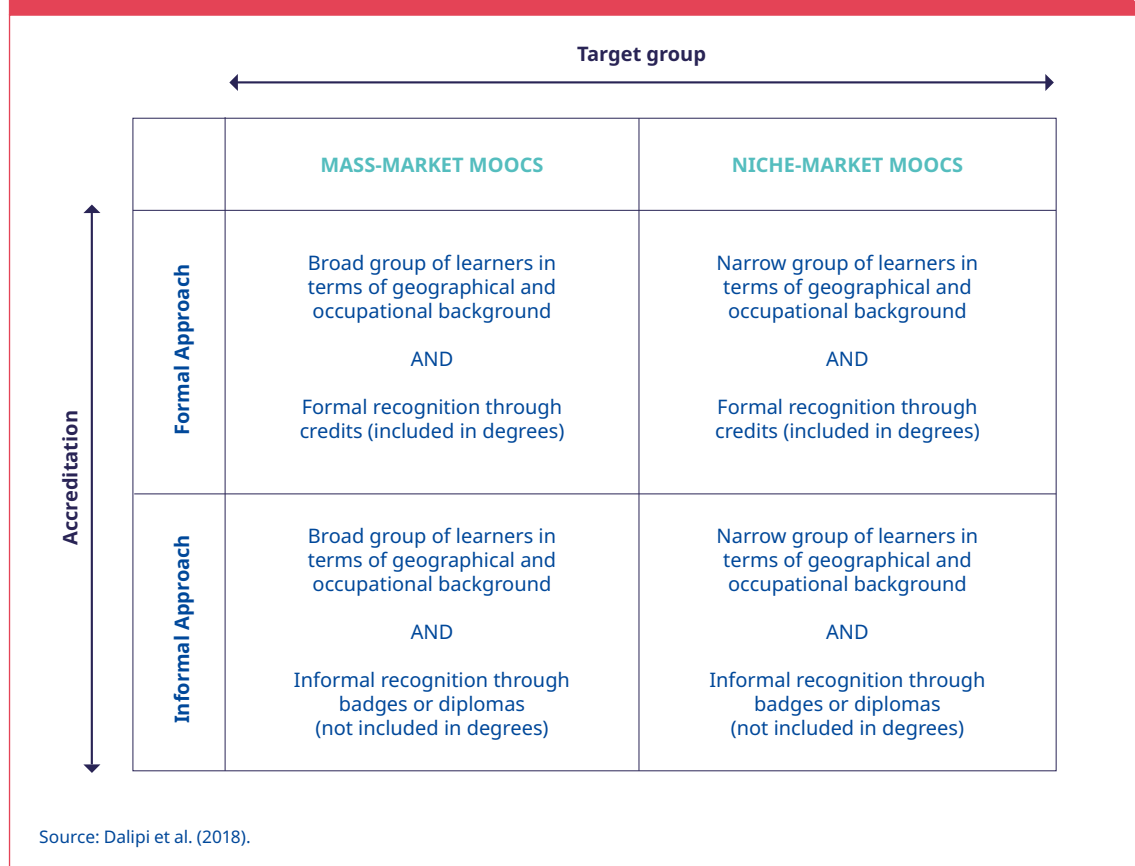
The acronym 'MOOC' refers to its main characteristics, as follows:

- Massive: it sets theoretically no limits to enrolment.
- Open: it allows anyone to participate, usually at no cost.
- Online: learning activities typically taking place over the web.
- Course: it is structured around a set of learning goals in a defined study area.

MOOCs have been traditionally classified as xMOOCs and cMOOCs: xMOOCs resemble a 'traditional' course, with predefined learning outcomes for learners, syllabi and structured OERs – or to some extent also proprietary material – as well as homework and assessment; cMOOCs emerged as examples of connectivism, where learning is distributed, social and explorative (Camilleri and Tannhäuser, 2013).

As the market develops, MOOCs are finding a niche in the provision of microlearning through distance learning at scale (Figure 11).

► Figure 11. MOOC typology framework



The current wave of technological development focuses on commoditizing the technologies for experiential learning, making technology that used to cost millions of dollars available for amounts in the hundreds or low thousands. This is leading to the next frontier in the evolution of distance learning, whereby practical skills can be taught remotely.

Distance assessment is also increasingly complementing distance learning through a mixture of technologies, including:

- use of technology to detect plagiarized texts in long-form assignments
- remote proctoring to allow students to take examinations from home
- identification technologies using biometric signature

3.2.2.2 Simulation

By allowing trainees to learn and make mistakes in a realistic yet risk-free environment; providing memorable, immersive experiences that evoke emotion; and overcoming the practical barriers associated with traditional education, VR is beginning to prove its worth as a valuable training tool. VR-based training removes the costs of traditional training, such as venue hire, travel, consultant fees or simply time spent away from work. Sessions can be delivered remotely by mentors or through software housed within a shared platform. VR-based training is more engaging than listening to a talk, reading a manual or watching a video demonstration. Trainees who can explore virtual environments with their own eyes and (digital) hands are less likely to get bored and have a better chance of retaining what they have learned. Memory recall with immersive VR training can be up to 300 per cent higher than with traditional training (British Safety Council, n.d.).

For instance, Tyson Foods uses VR to train employees to safely use complex machinery, allowing them to practise and learn at their own pace before they even enter the company's physical plant (Tyson, 2018). VR enables users to 'walk in someone else's shoes'. The Moment's VR HCP Interaction Lab is part of the training of medical sales teams to better understand the interactions between healthcare professionals and patients (The Moment, n.d.). Stanford University researchers are working with the National Football League, using VR that helps employees 'feel' how colleagues experience racial and sexual discrimination. A VR experience has been used to deliver studio training to radio presenters and producers. As well as providing studio inductions, the technology presents trainees with a series of real-life challenges – such as system failures, breaking news events and unplanned silences – so that they learn to react positively and quickly to keep the station live and on air. By using VR to create an environment where users can make mistakes and try again without real-life repercussions, operator errors in live broadcast decrease by one-third.

The technology also helps overcome other barriers associated with traditional training: VR is being used to livestream surgical procedures with a 360-degree perspective, enabling surgeons to personally train surgeons all around the world during real procedures, without the challenges associated with having students physically present in the operating theatre with them. The visual and practical nature of VR training helps overcome language barriers and makes it suitable for individuals with different learning styles.

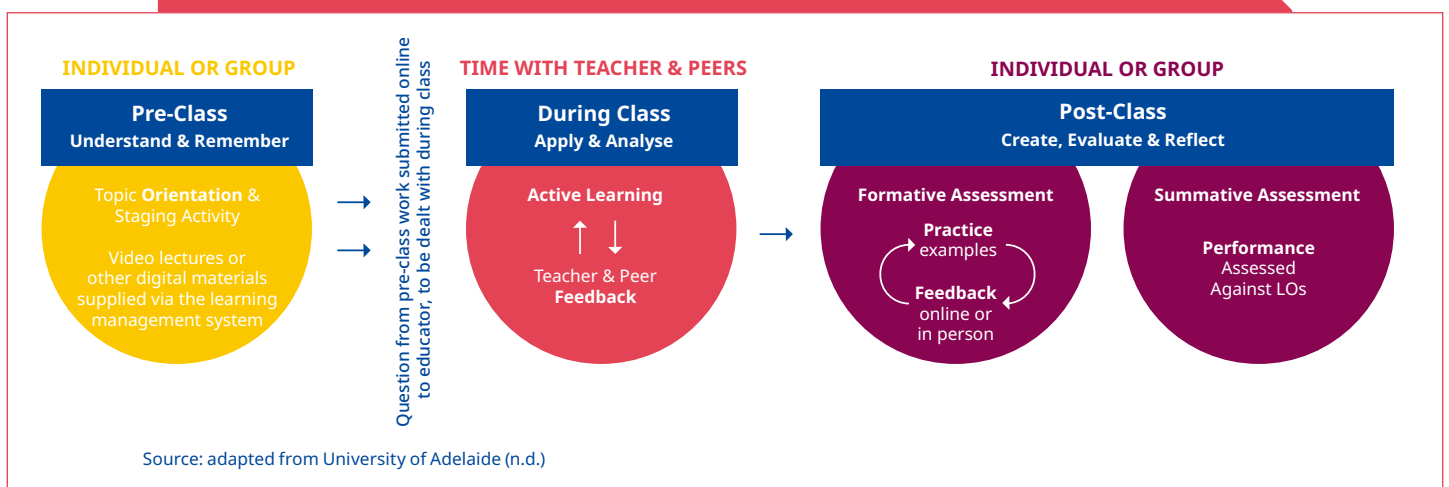


3.2.2.3 Flipped classrooms

Flipped classrooms were originally invented for a high school chemistry class in Colorado (Bergmann and Sams, 2009). The Flipped Learning Network defines them as a pedagogical approach whereby direct instruction moves from the group learning space to the individual learning space, and the resulting group space is transformed into a dynamic, interactive learning environment where the educator guides students as they apply concepts and engage creatively in the subject matter.

Figure 12 shows an example of a typical flipped classroom approach, adapted from that used at the University of Adelaide.

► Figure 12. Elements of a flipped classroom approach



Technology is particularly important to the pre- and post-class elements of the flipped classroom, in that:

- Video and other interactive media provide an equivalent or superior information delivery mechanism to 'lecture-style' information delivery, especially as they allow students to study at their own pace.
- Integration with learning management systems allows educators to ensure that students have actually followed the pre- and post-course materials.
- Integration with instant messaging or e-mail allows students to communicate with the educators throughout the process.
- Online assessment allows applying formative assessment to individual learning outcomes to ensure mastery of the subject.

Statistics on the use of flipped classrooms in TVET are hard to come by, although studies from China show widespread use in the country. One meta-study of nursing schools was able to identify twenty-nine academically reviewed reports of nursing schools across China using the technique, concluding that it helps nursing students improve in knowledge, skills, self-learning, study satisfaction and enthusiasm (Tan, Yue and Fu, 2017).

► Box 6. Building competence for flipped classrooms in TVET: Flip-IT

Flip-IT is a consortium of ten vocational schools in Hungary, Ireland, Spain, the United Kingdom and the Czech Republic that have been using or investing in flipped classrooms for specific use in vocational education. The institutions claim that flipped classrooms are especially useful in vocational education for trades that require mastering a wide range of practical skills, since the approach allows an educator more time in a face-to-face setting to concentrate on elements such as the context and application of the learning. In-class time can be spent on learning a practical work-oriented scenario. To facilitate implementation, Flip-IT has produced a guide on implementing flipped classrooms in TVET contexts, along with an online course.

Source: Flip-IT! (2018).

3.2.2.4 Gamification

Gamification is defined as the introduction or application of elements of games to non-game contexts. It is a relatively new concept, but an old practice. Games and the elements that make up games have been incorporated into other areas of life throughout history. This is particularly true of education, where the need to ensure student interest and participation has meant that game mechanics – such as rewards and group tasks – have become core teaching tools.

According to the World Government Summit, all games share three fundamental characteristics (Oxford Analytica, 2016):

- a clearly defined set of rules
- a rapid feedback system
- a well-established goal

With few exceptions, participation in games is voluntary and primarily for enjoyment. Among the many elements comprising games, the three of particular relevance to education are:

- mechanical elements, such as incremental progression, onboarding and instant feedback
- personal elements, such as status and visibility, collective responsibility and leader boards or rankings
- emotional elements, particularly the psychological state of flow

► Box 7. Studying warehouse management and logistics via a gamified approach

At Shijiazhuang Posts and Telecommunications Technical College in China, a teaching reform aims to integrate comprehensive gamifying into the teaching of the entire curriculum.

Specifically, small games are designed in each class during the early period to help students learn the corresponding knowledge in games. The reform was piloted in a course on the layout and management of distribution centres.

The games integrated included:

- ‘Business Card Go Home’: here, the teacher prepares a business card for each student, distributes the cards randomly among the class and asks students to exchange business cards freely from the beginning of the activity up to a certain time limit, until each student has his or her own business card.
- ‘Distribution Centre in Classroom’: here, students can experience and summarize the processing procedures in a distribution centre. The teaching design is as follows: first, an order processor, an order picker, a warehouse manager and a replenishment worker are selected from among the students, and the other students role-play as managers of storage locations. Second, students simulate the entire processing procedure in the distribution centre, including order reception, inventory inquiry, order picking, replenishment and the distribution of storage locations.
- ‘Crazy Delivery’: this game is designed along a distribution route planning programme. One distribution centre and nine distribution sites are chosen according to a certain rule on an online map. Learning groups are asked to deliver commodities from the distribution centre to nine distribution sites according to the given orders under certain constraints, while maintaining the minimum total cost of distribution.

The results demonstrated that gamification of teaching reform achieves outstanding effects. Students participate in classroom activities positively, and all evaluation indexes improve year by year.

Source: Wang et al. (2017).

While gamification is well embedded in tertiary education, gamification in TVET is not a well-researched area (Surendeleg et al., 2014). Our literature review was also only able to generate a handful of papers in this area. That said, it is possible to make some assumptions on its use, in that all major learning management systems and MOOC platforms contain significant implementations of gamification.

3.2.2.5 Open educational resources

UNESCO defines OER as teaching, learning and research materials in any medium – digital or otherwise – that reside in the public domain or have been released under an open licence that permits no-cost access, use, adaptation and redistribution by others, with little or no restrictions.

Although the issue of OER is perceived primarily as one of ‘licensing’, the uptake of OER on a global scale has been enabled by technology:

- ▶ Repository technology and cloud computing allows storing vast amounts of OER at low cost.
- ▶ Search engines, as well as advanced metadata tools such as JSON-LD, schema.org and OAI-PMH, allow OER to be appropriately labelled as such, distinguished from closed-licence content and discoverable by the public at large.
- ▶ Traceability technologies, such as hashing, digital signatures and blockchain, allow asserting intellectual property rights, including open licensing.
- ▶ Open-source courses and OER platforms allow OERs to be parcelled into open courses.

Open provision of these course materials has become more widespread, particularly thanks to MOOCs, and many institutions have adopted this approach. This might be described as concluding the first phase of OER development and diffusion, which focuses on access to and the availability of OER. Phase 2 is currently emerging in the debate, literature and policy discourse. This phase is about using OER in a way that improves learning experiences and generates innovation in educational scenarios. This next phase in OER development will shift from focusing on resources to focusing on open educational practices (Camilleri et al., 2014).

Aside from open educational practices, open education has also come to encompass (Hodgkinson-Williams and Gray, 2009):

- ▶ **Social openness:** the degree to which pedagogy is didactic or participative, through sharing, collaboration, participation and contribution. This might be enabled through tools such as constructivist MOOCs.
- ▶ **Technical openness:** the degree to which software/platforms on which OER are based are themselves open or closed source. The best-known example here is MediaWiki, which is fully open-sourced by the Wikipedia Foundation.
- ▶ **Financial openness:** the use of financial models that enable the widest access to the largest number of students. This might include offering free education, sponsored education, vouchers, pay-as-you-go systems and other innovative financial models.

► **Box 8. Hybrid content provision powered by OER – Alison**

Alison is a growing Irish for-profit social enterprise that offers online courses free of charge. The company mainly targets anglophone and developing countries. During its 7 years of existence, the company has reached 6 million learners (defined as all the individuals who have ever registered on the Alison website).

Alison claims that it exploits a market niche by adapting courses designed by various online publishers and universities into targeted work-related skills training. Their stated goal is to fill the gap where there is a perceived lack of workplace skills in their target audience. Alison courses are short, ranging from 2.5 hours to 10 hours, and cover a range of vocational subjects, including health. All the courses offer the option of obtaining a (free or paid) Alison certificate. Although the company provides courses free of charge, it has developed a profitable business model based on low-cost content integration and revenue generation. The revenue comes from advertisements, certificates and paid premium services for learners, educators and employers, although the model appears to be evolving.

The content of Alison's courses comes from three different sources: 1) content owned or acquired by Alison, available exclusively on the Alison platform; 2) OER produced by third parties and made available under various open licences; and 3) content produced on Alison's initiative through partner agreements.

OER produced and made available online by higher education (and other) institutions indirectly supports Alison's activities. Often, these OER are licensed for 'non-commercial use'. Charging for indirectly related services, such as certificates, is therefore part of Alison's business model. Alison argues that it adds value to these resources by reorganizing them into smaller, modular learning chunks; making them easier for the learner to use; and creating a new learning experience. Furthermore, it charges not for the content, but for the structure enabling its free study.

Source: OER World Map (n.d.).

3.2.2.6 Personalization

The last century of education policy might be termed the 'massification of education', whereby education grew from a niche pursuit for the well-off and the elites into a basic commodity, provided as a human right for all. Within the context of a Fordist economic paradigm, education for all meant mirroring and reflecting the efficiencies of the predominant industrial model, providing the same education in the same manner at low cost and at scale to masses of students. Educational literature has long indicated that different students learn in different ways and that a more personalized approach, with learning customized to the learning needs of each student, would bring about greater individual benefits. However, until now, it has been impossible to scale such techniques for an affordable cost

Personalized learning can be looked at through a variety of lenses (Järvelä, 2006):

- **Use of technology:** technology can be used to automate any task that is repeatable – particularly information delivery and standardized assessment. Doing so radically lowers the cost of these processes and allows delivering different information to different students according to their needs and preferences.
- **Levelling the educational playing field through guidance for improving students' learning skills and motivation:** in a personalized learning environment, students' preference to follow a vocational or academic career is determined based on their needs and aspirations.

- ▶ **Encouraging learning through a 'motivational scaffolding':** this uses technological tools to help students envisage the careers they would like to follow, and then suggest a personalized learning pathway comprising relevant theoretical and practical components to reach this goal.
- ▶ **Development of domain-specific key skills:** rather than a standardized curriculum for all students, all students receives training in the vocational skillset for which they have shown propensity.
- ▶ **Collaboration in knowledge building:** rather than merely 'consuming' information, students are active constructors of their own knowledge, often through collaboration with peers.
- ▶ **Teachers' new role in better integrating education within the learning society:** with technology freeing teachers from the task of information delivery, they can take on a new role as guides to help students identify and travel along their chosen personalized pathways.
- ▶ **Freedom to determine time and place of learning:** students get far greater choice about the mode, place and time of learning, thanks to technology allowing them to receive information and collaborate at any time, from nearly any location.

One of the largest expressions of personalization in TVET is **microlearning** – which consists in mastering a limited set of skills or competencies rather than broader and interrelated sets of skills, like full qualifications.

Complementing students' participation in at-school programmes, microlearning allows students to participate in programmes outside of formal regulatory frameworks, which offer unaccredited certificates that do not count towards an award course. However, these micro-credentials and badges provide employers with a well-rounded picture of employee competencies, skills and other important verifiable information. Consequently, Hurst (2015) proposes that **digital badge** use in workplace settings and in TVET may emerge as the most prominent area of adoption. Employers can use micro-credentials to overcome skills gaps within their workforce, as part of training programmes that better fit the needs and constraints of employees.

Digital badges can be used as a dynamic response to local priorities and labour-market needs, helping to streamline upskilling processes while making progress more tangible. Individuals gain valuable digital badges that demonstrate their learning, while managers and organizations can better measure the impact of workforce development activity.

Multinational corporations like IBM, Microsoft, Ernst & Young, Bosch, Daimler, Adidas and Amazon are making major commitments to micro-credentials as part of their professional development programmes and are developing partnerships with educational institutions to leverage credentialing programmes. The advent of alternative credentialing, like micro-credentials, is therefore a major game changer for TVET institutions. It places the reins of composing an educational experience back into the hands of the learners.

► **Box 9. Microlearning for new skills: International Business Machines Corporation (IBM)'s Digital National Africa**

In 2017, IBM, in collaboration with the United Nations Development Programme (UNDP), announced its cloud-based learning platform 'IBM Digital – Nation Africa', designed to provide free skill-development programmes for up to 25 million African youths over 5 years to promote digital competence and innovation in Africa. This is part of IBM's global push to build the next generation of skills needed for 'new collar' careers. 'New collar' is a term used by IBM to describe new kinds of careers that do not always require a four-year college degree, but rather sought-after skills in cybersecurity, data science, AI, cloud computing and much more.

The initiative is providing access to thousands of resources, in English, free of charge, including:

- ready-to-use mobile apps
- guides – web guides, demonstrations, interactive simulations, video series and articles
- online assessments – a range of self-assessment tests to track the progress of individuals, together with industry-recognized 'open badges' aligned to digital competencies. The badges can then be shared with prospective employers
- volunteers – creation of a volunteer programme to support and promote digital literacy within their communities
- app marketplace – provision of a platform on which new applications can either be made freely available or sold.

Learning from these sources is then certified using industry-recognized open badges aligned to digital competencies. The badges can then be shared with prospective employers.

Source: IBM Developer (n.d.).

► **Box 10. Recognition of micro-credentials in New Zealand**

Micro-credentials are being recognized as part of the New Zealand Qualifications Framework. This is in direct response to industry looking for new and more flexible ways to recognize skill sets developed in response to changing technologies, employment structures and work requirements. It is also a direct response to the need of the workforce to upgrade skills throughout their careers, or as they change careers. While qualifications remain important, New Zealand is positioning micro-credentials as top-up and additional skills that need to be recognized to encourage take-up of short courses. The industry training sector is brokering more flexible learning pathways, and micro-credentials are at the core of this new approach to lifelong learning.

Source: NZQA (n.d.)

4



► 4. Findings

This section presents the key findings of the report under two broad headings: 'Policies and governance' and 'Quality and relevance'.

► There is a hybrid 'marriage' between technology, the formulation of policy and praxis – it is a veritable reflexive relationship, with these variables pushing the others. TVET is becoming a complex sphere which encompasses technology ranging from MOOCs to the blockchain. It is vital that the discourse on TVET moves away from old debates such as accessibility: policy-makers are looking for more pragmatic solutions. We need to be pragmatic about technology if it is to be put to meaningful use.

► Tom Wambeke – Chief Learning Innovation, International Training Centre of the ILO (ITCILO)

4.1 Policies and governance

The linkages between TVET and skills systems and digitization policies are, at best, inferred. In most cases, they are weak. Sometimes, they are contradictory.

► Today, the digital world is the nerve system for our society – it connects different parts of the body; indeed, it is diffused throughout the body. Digitization also means surveillance or different notions of what constitutes a citizen's 'social credit' or social right. Take China, where if you travel on a high-speed train without a proper ticket, your citizen social credit score is decreased. This notion is based on advanced digitization. Digital TVET systems will work and fail in different cultural contexts on the basis of whether there is buy-in or otherwise from political leaders.

► Balaji Venkataraman, COL

Government TVET policies tend to be associated with change and transformation agendas. Many countries also associate digitization by inference or by design as a driver of modernization and positive changes in society. However, the huge disparity in the socio-economic and cultural contexts of nation-states means significant differences exist in the relative importance attributed to TVET and skills development in government agendas.



In Malaysia, responsibility for policy development related to TVET and digitalization is shared between two main bodies that take care of TVET: the educational academic stream, which runs polytechnics; and the skills arm, run by the National Skills Council and led by the Ministry. The result is not optimum, with occasionally conflicting agendas. The government is aware of these lacunae and is now trying to streamline the process through the establishment of a TVET agency to drive the process. The policy paper has yet to be published for public feedback. Eventually there will be two distinct streams: academic and skills-driven. Nevertheless, the government's efforts at policy direction are rarely matched by seamless implementation. There has always been the belief that an efficient TVET system can resolve youth employment – but in a technology-driven world, all new jobs require ICT literacy at a higher level than that currently provided in foundation schooling.

► Tan Beng Teong – Selong Human Resource Development Centre (SHRDC)



The Industry Training Federation (ITF) represents New Zealand's recognized industry training organizations, with an Independent Chair. It takes a lead in promoting the merits of digitization as a means of increasing the profile of the TVET sector. Digital TVET is positioned to encourage young people to follow industry training as a means of securing meaningful and rewarding employment and responding to New Zealand's skills shortages in the process. In New Zealand, the history of distance learning has always been about access – for people in remote places and islands in a rural context. The Open Polytechnic was created as a technical correspondence college for access for people in small towns who needed to build up skills. There is a legacy of second-chance learners, people who want to consider a job change, etc. Lifelong learning is enabled because of distance learning, which is increasingly technology enhanced.

Learning materials in the TVET sector are increasingly delivered in an online context. There is also significant investment in distance learning in prisons, using multimedia to overcome literacy challenges. This is a way of getting people to re-enter the labour market. There is an opportunity for multimedia to get over the obsession with literacy.

► Terry Neil – Education Specialist, Technical and Vocational Skills Development, COL

The digitization of TVET cannot be identified as a single area of government strategy: in the countries surveyed during the course of this study, no single ministry or body was responsible for taking ownership of the implementation of such a strategy or any underlying programmes. Interviewees report that the digitization of TVET and skills systems is covered by a host of different policies and regulatory frameworks. Thus:

- ▶ Core infrastructure required for TVET provision, including provision of (mobile) broadband, is typically covered by telecoms policies and regulators. Although this is a key pre-requisite for digital TVET, education only features as a second-tier rationale (if at all) for deploying these services.
- ▶ Industrial and economic policies typically set the pace of digitization across the whole economy, often with a country picking certain sectors (such as automotive and nanotechnology) where it will be a winner. TVET and skills systems then typically react to these decisions, by teaching the applied skills required to meet these demands. In some countries, TVET is considered a key partner in defining regional development policy, but its role is still typically subsidiary to that of industry.
- ▶ Regulation of specific education and training institutions – including the approval of new digitally enabled pedagogies and decisions on funding for digitization of VET institutions – are typically handled at the level of the education or labour ministries, or related agencies.
- ▶ Policies on digital-skill development are often shared competencies between ‘digital’ ministries, together with education and training strategists.
- ▶ Opportunities for work-based learning will also involve job agencies and employment ministries.

This segmented approach to policy-making and implementation leads to pressure from several sides for TVET to modernize in response to a changing world and changes in industry, reflecting TVETs role as service provider to the labour market. However, the fragmented and complex nature of skills systems works against integrated approaches (ILO and UNESCO, 2018).

▶ Box 11. Digital and online learning in VET in Serbia

From 2007 to 2013, the responsibility for developing digital education for TVET in Serbia was shared between seven separate national institutions and bodies:

- Ministry of Education, Science and Technical Development
- Ministry of Trade, Tourism and Telecommunications
- Institute for Improvement of Education
- Institute for Education Quality and Evaluation
- National Education Council (NEC)
- Academic Network of Serbia (AMRES)

Nevertheless, none of these institutions has had a clear responsibility or a dedicated department for this policy area, nor has a steering body been established at the national level.

Source: Broplito et al. (2016).



The lack of a single entity with the responsibility for digital TVET and skills policy also means there is no clear allocation of responsibility for designing strategies to harness digitization to increase the scope, quality or impact of TVET and skills development.

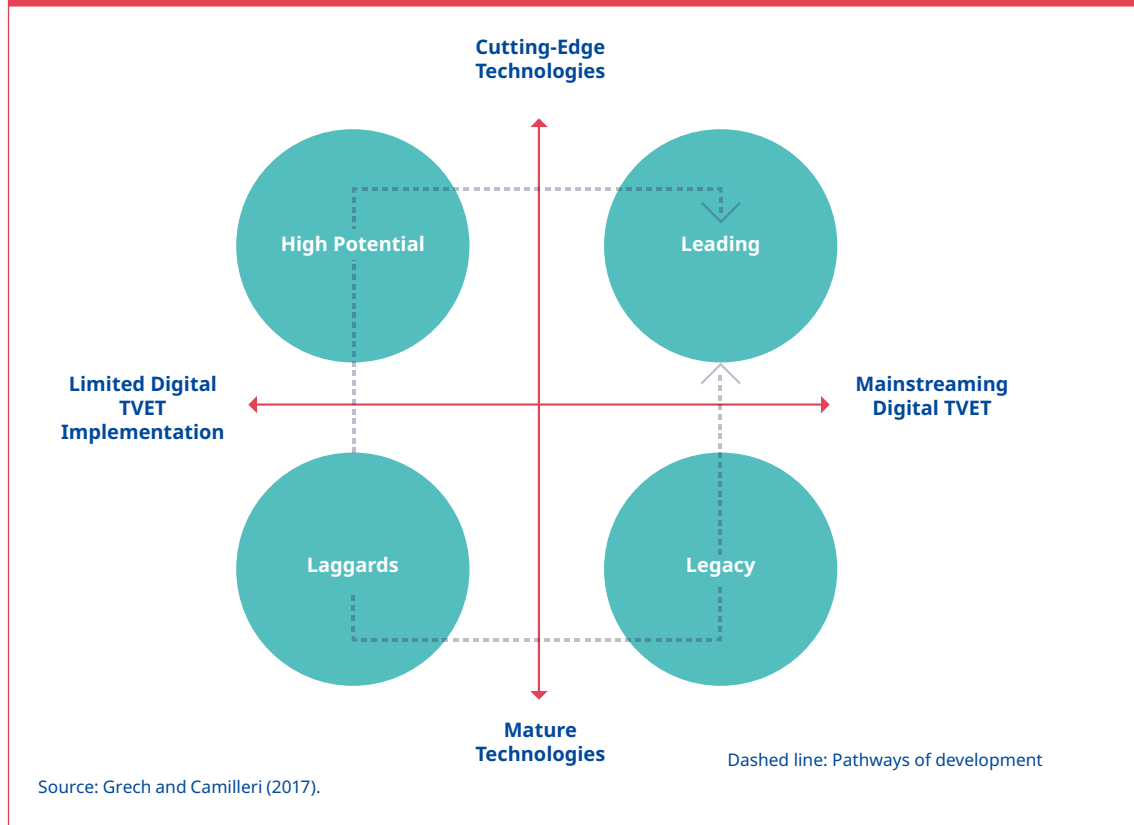
The transcripts in Annex 2 highlight disparities in policies and perception of the links between TVET, skills development and digitization. The differences are also not just a question of size or restricted to a particular continent: countries like South Africa, Ethiopia, Kenya and Ghana have a very different approach to TVET and digitization than, for example, Mauritius. These divides in perception and approach to TVET, skills development and technology are palpable – even if they are not necessarily articulated in policy documents, they are clearly perceived by local experts. There exists a gap between the political proclamation and vision in the policy documents, and their operationalization. Digitization is creating new demands for new programmes. The scenarios are different for each country, but contexts are inevitably becoming digital. TVET and skills systems have either to react or risk being left behind as a twentieth-century construct – and hence increasingly redundant.

On the basis of the literature review and as confirmed by the interviews, our analysis shows that four country typologies regarding the digitization of TVET and skills systems:

4. **Laggards:** these countries continue to operate outdated TVET and skills systems, usually owing to policies that significantly hinder innovation, either due to corruption, excessive bureaucracy or lack of finance. There are high risks that their digital TVET and skills policies will limit the opportunities available to their students.
5. **Legacy:** these countries are deploying older digital TVET and skills technologies at scale. While these countries may not be cutting-edge, they are often using low-cost commoditized technologies to modernize their systems at scale in an environment of limited resources.
6. **High potential:** these countries or regions typically have a strong resource base and policies that encourage innovation, allowing them to test the use of the latest technology in already highly digitized systems. These actors are typically subnational regions, or small countries that may face difficulties mainstreaming these technologies at scale.
7. **Leading:** these countries benefit from high resources and will typically deploy cutting-edge technologies at scale, but only once effectiveness has been proven. Adoption of technology typically leads to its commoditization and mainstreaming a few years later in other 'legacy' countries.

This foundation model in Figure 13 could be applied to future waves of research to determine the state of digital readiness in different countries' TVET and skills systems.

► Figure 13. Country typologies regarding TVET digitization



4.1.1 Financing

Financing concerns vary dramatically according to the level of development of the country surveyed, particularly countries in the legacy and laggard segments of our typology. In these countries, financing for technology is limited, and equipping students with adequate digital tools depends on the commoditization of those tools. Thus, video in teaching or messaging as a communications tool were widely adopted in education only when their cost dropped to near-zero. This is due to a triple phenomenon, whereby:

- The cost of content production dropped thanks to the diffusion of OER, allowing creators to re-use and re-purpose content to create new content, rather than have to create content from scratch every time.
- Content production tools improved in terms of usability, to the point that teachers can produce high-quality media that might previously have required teams of professionals.
- The infrastructure required to run such services was offered for free (or near-free) by large technology companies.

Our interviews indicate that OER on its own has limited development impact, but when combined with locally produced content (e.g. in Mauritius), it can significantly lower the complexity and cost of producing new materials.

On the other hand, at the higher end of our typology, the complexity and cost of equipment and infrastructure – such as industrial control systems or additive manufacturing equipment – means that students are being trained on specific software packages or equipment models rather than simply securing generic technical skills. In game design, for example, many vocational courses focus on teaching Epic Games’s ‘Unreal Engine’, rather than more generic game design. Similarly, in additive manufacturing, students are typically taught how to use a specific set of 3D modelling software that interfaces seamlessly with a specific set of 3D printers.

The cost of equipment means that institutions are often not able to secure the requisite ICT infrastructure: even when they are, these investments depreciate very rapidly, creating the need for ongoing waves of investment cycles. These additional costs lead to two interlinked phenomena:

- ▶ There exists chronic underinvestment in TVET facilities, limiting digital take-up. TVET institutions need to develop collaborative PPPs, which may lead to funding for improved premises, specialist equipment, consumables, learning factories, etc. TVET institutions increasingly rely on employers or infrastructure providers, who may subsidize or lend equipment for training purposes. The need for students to use equipment on employers’ premises also demonstrates the continued importance of various forms of work-based learning. For example, the game development company Unreal makes free education licences available for its software and offers textbooks through a partnership with Pearson. However, computers that run the software optimally can cost several thousand dollars, often meaning that practice is done in production environments. In Ghana, TVET institutions rely on equipment donations from mining companies.
- ▶ Advances and changes in equipment means that students need to be constantly retrained as the equipment is upgraded or changed. Such training is typically organized by employers, in conjunction with equipment vendors.

Evidence indicates that although OER are associated with the provision of unlimited free educational content to any person with access to an internet connection, in practice, their impact on formal TVET or skills development is limited. At this juncture, their primary benefit is that they lower the overall cost of creating content for formal TVET, which may have some indirect effects on equity.

Digitization in the form of distance learning does appear to show benefits in two narrow scenarios:

- ▶ students who are disenfranchised owing to geographical access restrictions to education, such as those living in very rural areas, providing they do not also suffer from other deprivation factors
- ▶ workers who already have limited digital skills and are looking to acquire other higher-order skills for purposes of social mobility, by allowing learning to take place more flexibly, in times and place of a learners’ choosing, through e-learning

Increasing demand for higher-order thinking skills from industry is also increasing the opportunity cost of not entering or continuing education, increasing the value TVET can offer to persons from low educational backgrounds while at the same time exacerbating social divides for those who are not able to access the system.

An increasing concern for TVET is addressing the digital divide, particularly among adults already in employment. Providing opportunities for such persons to re-enter TVET and acquire new, relevant digital skills is a major focus of policy development in practically every country surveyed, particularly through the introduction of active labour-market policies and support for the adult learning and education sector.

4.2 Quality and relevance

4.2.1 Learning processes

At a society level, there is no parity of esteem for TVET in terms of academic pathways: the latter carries more status. This is not through a lack of awareness at policy level: the Malaysian TVET committee has developed its own documents and makes frequent reference to World Bank and World Economic Forum guidelines. But the social lack of recognition of TVET as a viable alternative to academic pathways inevitably means that TVET is not the learner's first choice. Neither will industry pay for TVET: TVET graduates invariably earn less money than their academic counterparts. This leads to a continuous cycle that cannot – but must – be broken.

► Tan Beng Teong, SHRDC

At its core, TVET and skills development involves a pedagogical approach based on a mix of theory, practice and work-based learning. The interviews conducted with global practitioners for the purposes of this study indicate that the greatest innovations in learning processes as a result of digitization come from the 'practice' segments of this paradigm.

Traditionally, practice would involve performing the same actions expected in a workplace within the confines of an educational institution, typically in a lower-risk, lower-cost and lower-complexity scenario. For example, learning welding would involve learning the theory of welding, practising welding within the confines of a school workshop and finally refining those skills on a real project at a workplace.

Traditional learning in TVET is also characterized by some level of fragmentation. Students typically alternate between intense periods of classroom or workshop activity with a teacher/instructor, work-based learning with a mentor and self-learning. The emergence of always-on, free and easy-to-access communication technologies, particularly mobile messaging, is leading to a new model, which might be called persistent learning. Here, students stay in near-constant contact with each other, their tutors and their mentors via messaging apps – thus bridging the gaps between learning periods that are typical of the traditional model.

► Box 12. Plug-and-play learning in Malaysia

SHRDC in Malaysia is working on digital apprenticeships by supporting the launch of a two-year master's higher apprenticeship level. Using technology as part of the process, it is developing a plug-and-play curriculum students can access remotely. The technology can be set up in a common location, with students dialling and logging in from anywhere to learn. Resources and assessments are also shared and available 24/7. SHRDC believes the plug-and-play mode of small chunks of learning may become the future – bearing in mind that the curriculum is digital but also blended, with a hands-on learning component. Apprenticeships in Malaysia on average require about twenty per cent of training to be classroom-based instruction. SHRDC brings mentors from industry to combine all the technology learned into an application based on performance and user experience.

Source: Grech and Camilleri (2017).

► Box 13. Flexible TVET system in Ethiopia

Ethiopia has a TVET system with strong pathways to higher education, whereby students who attain Level 4 at TVET can then go on to follow a Bachelor of Arts/Bachelor of Science at a higher education entity. In this instance, TVET and traditional academic institutions interlink. Ethiopia's system is similar to the German system, in that learners can start even with short-term courses and work up to Level 4 TVET. At this level, students have attained the credentials to open a business or supervise others in the workplace. The pathway allows students to slide from one route to another. With a digital TVET system, in theory, the content of all courses can be digitized; the overriding view is that courses such as an engineering programme are more suited for blended learning approaches and are never going to be 100 per cent delivered online. In Ethiopia, the student normally needs to have reached Level 1 (completed secondary education) to join a TVET course, but in the absence of that can still join the TVET pathway by starting with a short-term course. The system enables students to enter at different levels and is flexible enough to facilitate all potential learners, even if the entry level is not reached or if there are issues with proving prior accreditation, as may be the case with refugees and displaced populations.

Source: Grech and Camilleri (2017).

Increased flexibility in programmes and institutions implies an irreversible structural shift towards lifelong learning. In mature markets such as the United States and New Zealand, interviewees said that the value of degrees and qualifications is decreasing, while new, flexible models of TVET, skills development and higher education are thriving. Nevertheless, traditional degrees remain the gold standard of employment, irrespective of socio-economic variables.

Students and workers tend to get their first contact with TVET and/or skills development from dedicated (often state-run) institutions, which provide a foundation of skills, usually in close collaboration with industry. Technological advances require continuing education and/or retraining. This tends to be offered in a wider range of contexts (such as the workplace) and by private training organizations and TVET institutions – which are now increasingly focused on delivering retraining and upskilling programmes.

Continuing training requires workers to balance their professional, home and study life. Here, distance learning technology provides major benefits in increasing the potential for employees to upskill and fit learning in their life.

► Box 14. Continuing training through e-learning: LinkedIn Learning

In 2015, LinkedIn, the social network for professionals, bought Lynda.com, marking its entrance into the corporate training field. It has quickly grown to be one of the largest TVET providers in the planet, offering over 13,000 courses, and numbering 12,000 enterprise customers and millions of users.

Under the LinkedIn Learning model (<https://www.linkedin.com/learning/>), companies buy access to the platform for their employees. They can view their individual employees' skills on the social platform and assign courses to them to upgrade their skills in specific areas. Employees follow the assigned courses online, together with interactive exercises. They can take tests to confirm their knowledge acquisition and receive certificates, which are then added to their online platforms. Employees may also be allowed to follow additional courses at their own discretion.

All learning happens through distance, with employees completing the continuing training either at their workplace or from home.

Just-in-time learning is gaining increasing value. Training providers of all kinds are producing microlearning modules, which teach a discrete skill and can be followed at any time. Thus, when individual workers need specific skills for their job, they can quickly undergo the training for that unit.

This also has implications for TVET institutions – which, rather than offering monolithic programmes leading to pre-set professions, need to adopt a ‘plug-and-play’ approach whereby different skills units are bundled in different configurations for different stakeholders and different purposes.

While not a mainstream development, the gig economy is increasingly serving as a platform for effective virtual apprenticeships. Through gig economy platforms, inexperienced employees can offer a lower-than-market rate while refining their skills with paying clients, who also evaluate their work. These are then leveraged as experience for paying positions with larger companies.

► Box 15. Work-based learning from home: Virtual apprenticeships

‘Virtual apprenticeships’ or ‘virtual internships’ are conducted remotely, with learners interacting with their mentors and collaborating with the rest of the teams at the company solely through digital communication tools. Typically, these kinds of arrangements lend themselves to jobs which themselves can be performed in this manner, e.g. programming, digital marketing, journalism and media production.

Acadium (former GenM) is a company offering virtual apprenticeships in marketing, which has paired over 20,000 students with around 5,000 businesses. Under this programme, students first follow an online digital marketing curriculum. They then audition various employers through a messenger app and sign a contract that pairs them with their chosen employer. For the next three months, the employer mentors and employs the student on individual production tasks. After a three-month period, employers may hire the learner or gain access to another (Acadium, n.d.).

The student may seek employment with the employer, look for employment elsewhere or sign up as a free-lancer on a platform operated by Acadium (former GenM) itself.

4.2.2 The TVET and skills workforce



There is a need for new learning methodologies – but it requires a different type of person from the traditional TVET teacher. We cannot necessarily reboot and reskill teachers; we need to take learning to the next level through a more collaborative, multidisciplinary approach. This will require a different mindset and approach – this is the foresight approach. It needs to be direct, easily visualizable. There is a higher degree of intelligence which is underestimated. Getting things from other contexts and putting them into others is always a good way of getting people to consider change. Interdisciplinarity will help people think critically of how technology can really add value to learning and reskilling.

► Tom Wambeke – Chief Learning Innovation, ITCILO

Digital tools can change the dynamics of teaching. They also make students more aware of what constitutes good teaching, and what does not. Digital natives have the experience to become more critical of the quality of TVET and the potential return on investment (ROI) of their learning pathways.

Digitalization has increased students' awareness of quality, with the result that they demand more from service providers, institutions and the labour market.

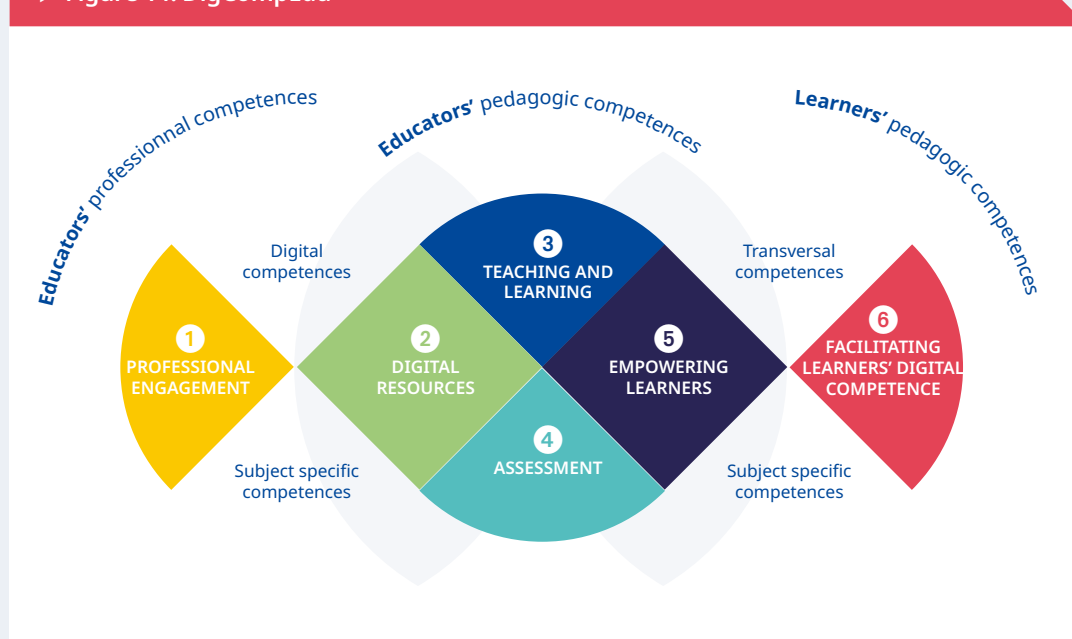
Many teachers do not have the requisite level of digital knowledge and digital skills. This has a direct impact on the potential for digital TVET to take root in curricula and classrooms. Teachers' digital knowledge and skills are a key limiting factor in the development of digital TVET. Interviewees reported that the relentless emergence of new disruptive technologies requires TVET staff to be supported by robust continuing education programmes to ensure constantly updated skills. Resistance to change from teachers' unions can also be a major stumbling block to the impact of digitization on the TVET sector.

More complex and involved digital workflows in industry require these workflows to also be reflected in TVET institutions. Increasingly, positions that were typically covered by a teacher or instructor are evolving into systems that require a team of specialists (teachers, media designers, programmers and subject matter experts) to design and deliver training.

► Box 16. Case study: European Framework for the Digital Competence of Educators (DigCompEdu)

The joint research centre of the European Commission has developed DigCompEdu, a scientifically sound framework describing what it means for educators to be digitally competent (Figure 14). It provides a general reference frame to support the development of educator-specific digital competences in Europe. DigCompEdu is directed towards educators at all levels of education, from early childhood to higher and adult education, including general and vocational education and training, special-needs education and non-formal learning contexts.

► Figure 14. DigCompEdu



Source: Redecker (2017).

A host of different approaches are being deployed worldwide to:

- ▶ develop skills frameworks and curricula to map the digital-skill needs of teachers in education and training, and integrating them in their initial training
- ▶ develop MOOCs focusing on specific digital teaching competences, as teachers are the highest consumers of MOOCs (in any topic) at the global level
- ▶ introduce continuing professional education programmes focusing on digital skills for teaching, ranging the level of single institutions to the level of entire nations
- ▶ calibrate incentive/disincentive schemes for teachers to encourage digital-skill uptake
- ▶ promote exchange/return to industry programmes to ensure a supply of teachers who have developed digital skills in a work-based context

▶ Box 17. Case study: 'Visual Literacies: Exploring educational practices and technologies' MOOC

This MOOC explores the educational practices and technologies associated with visual communication and visual thinking. The course covers the transformative power of photos, mind maps, comics, infographics and data visualization; how educators use video and animation, and why it works; game-based learning, AR, VR and MR; and synchronous video communication and holography. It is specifically targeted at educators in TVET and higher education.

Source: ViliProject (n.d.).

4.2.3 Quality assurance



TVET pedagogies and technology systems demand a similar attention to quality assurance as that paid to higher education, for the benefit of the key stakeholders – learners and the labour market.

▶ Balaji Venkataraman – Vice-President, COL

Quality assurance can operate through different models in TVET and skills institutions:

- ▶ Quality control: the purpose of quality systems is to ensure that service meets a minimum acceptable limit, and bad or harmful practices are identified and mitigated.
- ▶ Promotion of quality culture: the aim of quality systems is to promote a sense of joint responsibility for quality among internal stakeholders within the institution.
- ▶ Quality management: the purpose of quality systems is to capture the requirements set by all internal and external stakeholders and ensure that institutions are actually meeting these expectations.

► Box 18. Apprenticetrack: Quality management of apprenticeships via an online tool

The umbrella organizations representing higher vocational institutions in Slovenia, Croatia and the Czech Republic have launched the Apprenticetrack project to improve the quality of apprenticeships through better management of data (Apprenticetrack, n.d.). Through the tool, TVET institutions will be able to:

- manage the details of students doing apprenticeships
- design apprenticeship opportunities
- record placement details
- assign and document learning activities during placement
- evaluate and provide feedback to students
- evaluate the performance of the apprenticeship scheme as a whole

Apprenticetrack will be used to provide a near-real-time dashboard of the progress of every student's apprenticeship, detect issues or problems early, and mitigate them appropriately.

Quality systems in TVET have traditionally been organized around quality control rather than quality management; the types of metrics typically collected include admission or graduation rates, or overall student satisfaction rates. Digitization can facilitate the collection and analysis of such structured data, particularly through digitized feedback forms.



In Latin America, countries tend to work with a standardized TVET skills framework. In the Caribbean in particular, technical skills councils are also in the business of creating and/or validating standards per industry requirements. As industry evolves, the Inter-American Development (IDB) is providing support in various manners: developing frameworks for industry standards; investing in quality assurance mechanisms; providing funding for the creation of digital platforms for feedback on the quality of training providers and student learning outcomes; and occasionally funding the creation of training material from the ground up. About 40 per cent of investment efforts are rendered obsolete unless digital transformation can directly contribute to upskilling and reskilling the labour force. Digitization is a game changer, since it enables the IDB to have better, more updated feedback and information about macro trends, which then results in better interventions in the labour market. Digitization can be associated with the democratization of the entire funding process, since it allows transparency through quality assurance, with ratings on specific interventions becoming increasingly transparent through an ever-improving feedback system.

► Fernando Pavón – Specialist Labour Markets, IDB, Jamaica

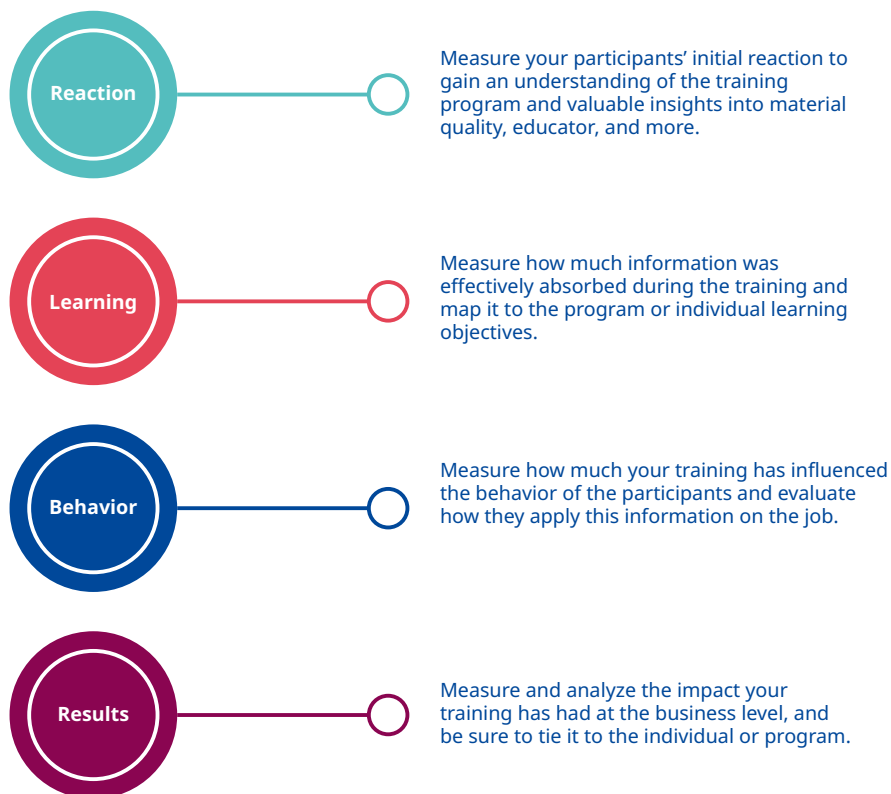
Our interviews indicate that stakeholders are aware of the significant affordances of digital technology to improve the quality of content through waves of direct feedback to teachers while courses are ongoing. Real-time learner feedback systems allow teachers to secure instant feedback on lessons, even for large classes. Tying quality assurance data to the burgeoning field of learning analytics promises to give valuable insights to personalize education and provide granular performance data for students and teachers. However, our study does not indicate widespread adoption of such tools at this stage.

► Box 19. Digital support of the Kirkpatrick Model of evaluation at the ITC/ILO

At the ITCILO campus in Turin, technology is used to enhance each level of quality assurance, in line with the Kirkpatrick model (Figure 15).

► Figure 15. The Kirkpatrick Model

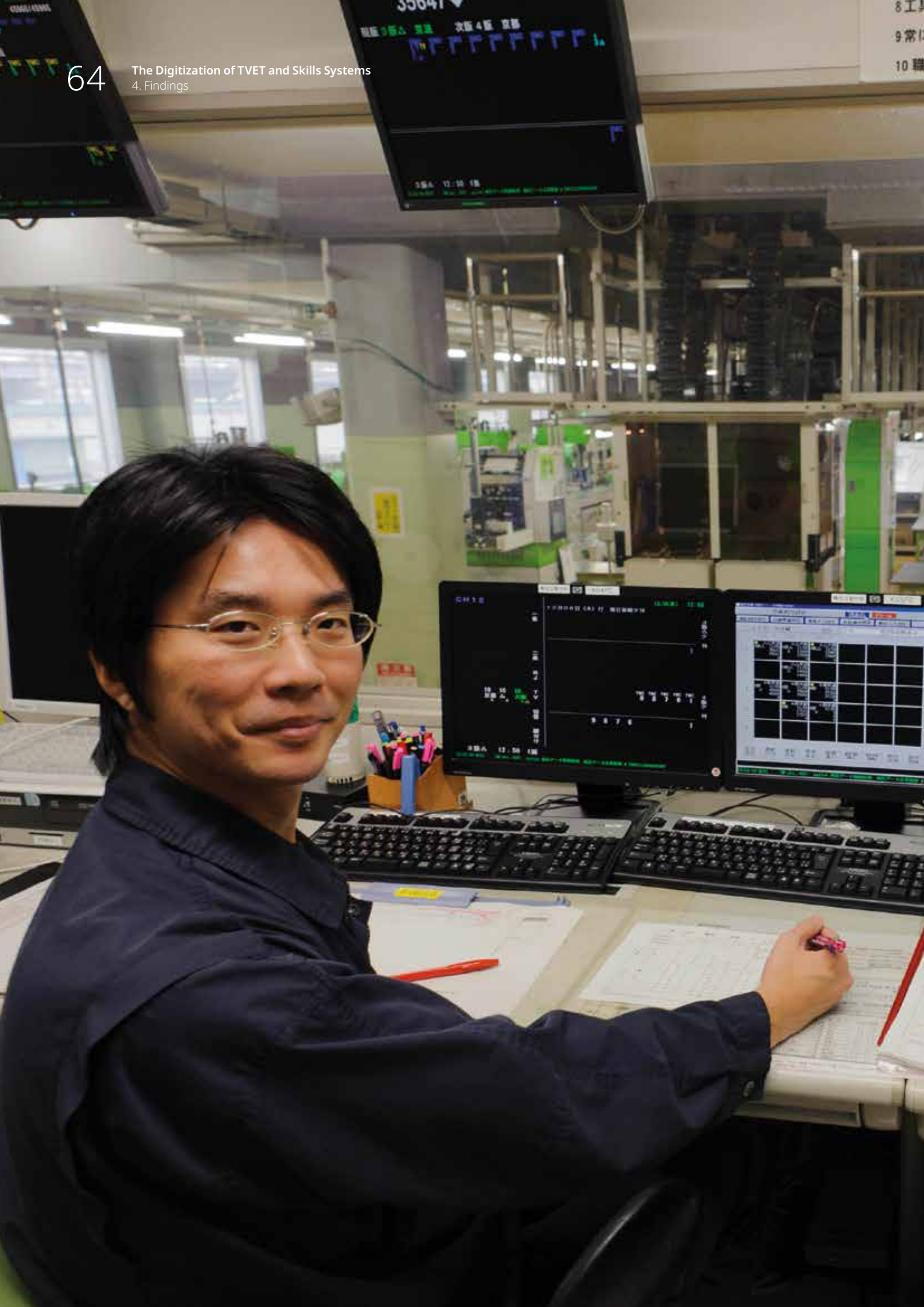
THE KIRKPATRICK MODEL



Using technology provides the following benefits:

- Reaction is gauged via tablet computers distributed to each student during a course. These can be used to participate in polls during the lessons and ask questions during the lessons, which the facilitator will address either immediately or the next morning.
- Learning is gauged via a student questionnaire administered digitally on-site at the end of each course. Students can instantly see their personal feedback benchmarked against that of the rest of the class, against other instances of the class, and against the institutional average performance indicators
- Behaviour is gauged by follow-up questionnaires administered via online forms several months after the students have returned home.
- Results are analyzed via the adoption of key performance indicators for each of the centre's activities, which are monitored and integrated into an overall performance report for the institution as a whole.

Source: Kirkpatrick Partners (n.d.).



To some extent, the power of learning analytics is being used to democratize quality assurance evaluations through the creation of transparent quality assurance rankings, based on open data and with customizable weightings, and crowdsourced programme ratings. While no comparable example yet exists for TVET, the U-Multirank tool is an example of such a customizable ranking system for higher education (Multirank, n.d.).

4.2.3.1 Quality assurance of digital learning

A 2015 study of quality assurance schemes for digital learning (Ossiannilsson et al., 2015) found that seventeen active quality systems focused on digital learning, which variously covered diverse roles, including certification, benchmarking, accreditation and advisory functions.

At the national level, governments and quality assurance agencies often work closely on issues surrounding recognition, accreditation and quality assurance. With respect to quality assurance and accreditation in particular, four approaches to dealing with the challenges posed by e-learning and distance education have been identified:

- ▶ Creation of specific criteria: several countries have specific, comprehensive sets of criteria for e-learning providers and/or distance teaching institutions.
- ▶ Mainstreaming into overall quality assurance: several other countries have updated or reviewed their existing quality assurance criteria and found that a single set of criteria can cover all types of institutions. A notable example is the United Kingdom, which moved from advisory guidance in its code of practice to a mainstreamed system that does not specify delivery modes.
- ▶ Hybrid/personalized system: while currently only partially implemented or under discussion, quality assurance systems can have a standard 'core' applicable to all kinds of education and organizations, with add-on 'modules' specific to distance or e-provision.
- ▶ No approach: other systems have not considered the impact of e-learning on their criteria, sometimes creating perverse results, such as limitations on the size of classrooms or requirements for physical facilities that are not necessary for e-learning.

4.2.4 E-information and guidance

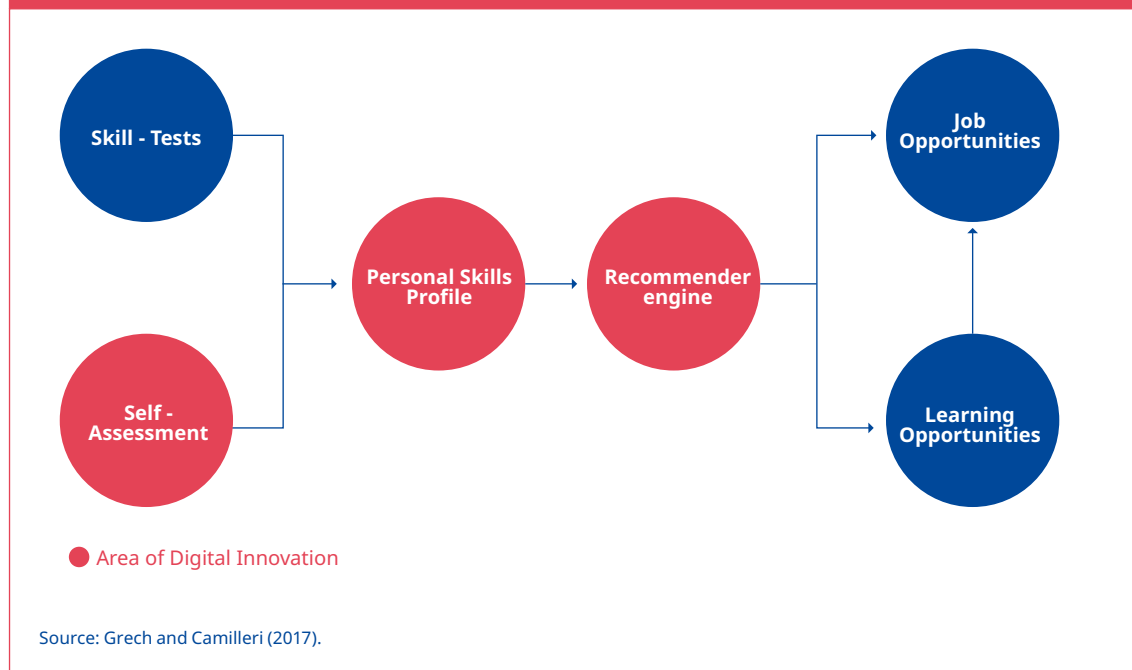
Our research overwhelmingly indicates that digitization is crucial to ensuring continued relevance of TVET in an Industry 4.0 labour market. While some educational institutions and individual programmes within institutions are adapting to workforce changes, the broader sector remains far too unresponsive to the shifting needs of students and workers. The issue of misalignment between education and training systems and the labour-market needs also continues to persist; and is exacerbated by the pace of change inherent to Industry 4.0 developments.

The future of work involves automation of manual repetitive labour and growth in digital jobs. In particular, workers will be expected to use technology to work alongside, manage or instruct machines. These new labour-market requirements emphasize higher-order knowledge and skills. As a result – and owing to shifts in young people's aspirations – we are seeing a policy focus on higher technical skills for the labour market, which represents a generational challenge for educational institutions.

However, these skills are not necessarily always located within the TVET and skills policy domain. In fact, higher technical programmes increasingly focus on providing entrepreneurial and transversal skills, while academic programmes increasingly include a more explicit professional element, blurring the distinctions between these two modalities of education (Graf, 2013).

Multiple efforts are underway to automate guidance and improve information delivery to graduates. Traditional guidance involves guidance counsellors administering skill or aptitude tests and advising students on possible next steps in their learning pathway or potential job opportunities. Figure 16 illustrates a digitally enabled guidance pathway.

► Figure 16. Digitally enabled guidance pathway



While these efforts are not specific to TVET, the approach typically involves:

- self-assessment tools, which allow learners to conduct online tests to discover or verify their skills profiles
- personal skills profiles, which allow learners to ‘collect’, display and share their skills, typically using e-portfolio software
- recommender engines, which can suggest suitable employment opportunities based on a certain skills profile or appropriate learning opportunities that will strengthen a curriculum vitae (CV) to allow students to reach employment targets

Activating such tools to ensure a ROI requires a deep understanding of which learning opportunities teach which skills, and which jobs require which skills. To this end, the development of skills frameworks that provide a semantic layer of understanding for these concepts is currently a major area of activity worldwide. Such frameworks include the European Skills, Competences, Qualifications and Occupations (<https://ec.europa.eu/esco/portal/home>) qualification in the European Union, O*NET (<https://ec.europa.eu/esco/portal/home>) in the United States, the Skills Framework in Singapore, and similar systems in Germany, France, Canada, Korea and Australia.

As a composite, these tools portend a future where students can receive real-time guidance for any career pathway of their choice throughout their lifelong learning pathways.

► **Box 20. Skills frameworks for planning flexible vocational pathways: the Singapore Skills Framework**

The Singapore Skills Framework was co-created by employers, industry associations, education institutions, unions and the government for the Singapore workforce. It aims to create a common skills language for individuals, employers and training providers, further facilitating skills recognition and supporting the design of training programmes for skills and career development. The Skills Framework was also developed with the objective of building deep skills for a lean workforce, enhancing business competitiveness and supporting employment and employability. The framework is made up of five components:

- **Sector information** describes the sector and employment landscapes, and includes statistics on the sector's manpower and occupational requirements.
- **Career pathways** show how the occupations' roles in the sector are structured progressively based on sectoral norms, helping users identify vertical and lateral advancement opportunities.
- **Occupational descriptions** describe the skills requirement, work context and expected profile of the worker performing an occupation.
- **Skills descriptions** describe the set of skills relevant to every occupation in the framework. Each skill captures both the occupational/job and personal skill domains for holistic development and assessment.
- **Training programmes** link the skills in the occupations to academic qualifications, continuing education and training programmes, apprenticeships, recognition of prior learning and other skill-based programmes.

The Skills Framework is then used to power the MySkillsFuture framework as a one-stop online portal that enables Singaporeans to chart their own career and lifelong learning pathways through access to industry information and tools to search for training programmes that broaden and deepen skills. The portal includes self-assessment tools that allow persons to analyze their employability, as well as a job bank, a training exchange and e-portfolio functionalities (MySkillsFuture, n.d.).

5



► 5. Conclusions

5.1 The affordances of digitalization require the TVET sector to become more proactive

Very few countries have a coherent strategy to digitize TVET and skills systems. From a policy perspective, TVET and skills strategies tend to focus on **digital adaptation**, with varying degrees of emphasis on:

- modernizing TVET and skills development, so that it teaches ‘new skills’ (both technical and transversal) required by the labour market
- increasing the responsiveness of TVET and skills development to the labour market, notably by improving labour-market intelligence and the timeliness of programme responses
- better equipping students for the labour market
- to a lesser extent, equipping students with entrepreneurial skills to find or create jobs themselves

Despite multiple readily available technologies for improving TVET and skills development, our study only found limited evidence of explicit macro-level strategies to increase efficiencies and/or the impact of TVET through the **use** of digitization – nor has digitization of TVET or skills development been mentioned as a potential accelerator for desirable social changes.

Part of the reason for this seems to be that initiatives to digitize TVET may be driven variously by institutions themselves, by industry, by employment or industrial policy, or by education ministries. Thus, the multiplicity of different actors involved in a potential high-level digital TVET and skills strategy adds complexity to the formulation of any such document.

Notable exceptions to this approach can be found in Ghana and New Zealand, which have managed to deploy system-wide modernization strategies for TVET.

5.2 Much innovation in digital TVET is institutionally driven

A corollary to the lack of policy focus on digital TVET and skills development is that much digital innovation is taking place at the institutional level. Such innovation tends to iterate and improve on existing processes through the use of technology. Essential prerequisites for such grassroots innovation include:

- institutional management that keeps abreast of technological developments and is open to change
- availability of basic infrastructure, such as electricity, broadband and equipment
- sufficient institutional autonomy to invest in technology
- ability to create a culture of innovation encompassing all institutional staff
- close connection with students and industry to respond to demands for digitization

Our findings also indicate that institutional innovation is not typically vendor-driven, in that decisions on investing in technology are driven by business objectives rather than by a push for educational and training institutions to adopt specific technologies.

We also find that in many countries, organizations that work directly with institutions, such as associations of institutions or government agencies set up specifically to support institutions, are often powerful vehicles for change.

5.3 Digitization is becoming the driving force behind lifelong learning and flexible learning pathways

The evolution of technology is driving two associated trends. On the one hand, distance learning technologies, microlearning and evolution in support technologies, such as scheduling software, are significantly expanding institutions' capacities to offer flexible learning opportunities at times and places that are driven by learner needs, rather than institutional needs.

On the other hand, continued digitization of processes within industry means that workers need to return to education or training at several stages across their working careers to remain relevant. Indeed, the notion of a single 'career' over a worker's lifetime is gradually eroding. Typically, workers and companies prefer that such education or training is either seamlessly integrated into the workplace or can take place simultaneously to workplace demands, without disrupting normal workflows.

Taken together, these two trends are increasing 'just-in-time learning', whereby an individual will take initial training with a dedicated education and training institution to provide access to the labour market, and then continue to undergo additional trainings provided by employers or other educational and training institutions as career goals and job requirements evolve. These trainings might be integrated into an individual's job as microlearning courses or take the form of evening classes, online courses or online trainings.

These lifelong education and training pathways are also significantly increasing the complexity of workers' CVs. Innovations in digital credentials, e-portfolios and CV software are aiming to ensure that CVs can still be presented concisely, while providing verification and visibility of the full lifelong learning pathways.

The requirements of just-in-time learning are also leading to significant innovation in the areas of skills assessment, with multiple companies and governments developing tools that can assess a student/worker's current skills and suggest new skills which may assist career development.

5.4 Digital TVET is driving a positive transformation in the quality, quantity and type of apprenticeships

Industry 4.0 is driving an explosion in the use of software to drive hardware used by staff at all levels of organizations, across all sectors of industry. Most of these software packages tend to be specific or heavily customized to the needs of specific industry segments, and as such do not lend themselves to generic training programmes.

Since it is often only cost-effective to provide students with adequate training on these technologies at the workplace, they are further strengthening the value proposition for apprenticeships and other forms of work-based learning.

Technology is also facilitating the management of apprenticeships, notably by assisting in:

- ▶ discovery of placements, by providing matching platforms and 'job portals' for apprenticeships
 - ▶ monitoring of placements, through technologies that allow sharing of live logbooks between multiple parties
-

- ▶ evaluation of placements and wider apprenticeship schemes, through technologies that allow benchmarking evaluation results and matching with specific apprenticeship providers

Additionally, technology is allowing the creation of new types of less structured virtual apprenticeships. Similar to new arrangements associated with the gig economy, these typically involve students taking on a project from a remote location – sometimes in a different country – to learn a set of relevant the skills.

The demands of digital adaptation and the possibilities afforded by digitally powered apprenticeships have led to a major policy push to increase the quantity and quality of apprenticeships in practically every country and region surveyed.

5.5 Low-level/mature technologies still hold the most potential for transformation in the short term

▶ In Bangladesh, coming up with a repository for interactive resources – H5V or Adapt – means that low-tech software can be just as effective as more expensive variants – sometimes more. What is more important is how to design systems where the teacher is no longer locked in old broadcast teaching model – when it comes to tech, most people are still just watching a video. There is huge scope for improvement.

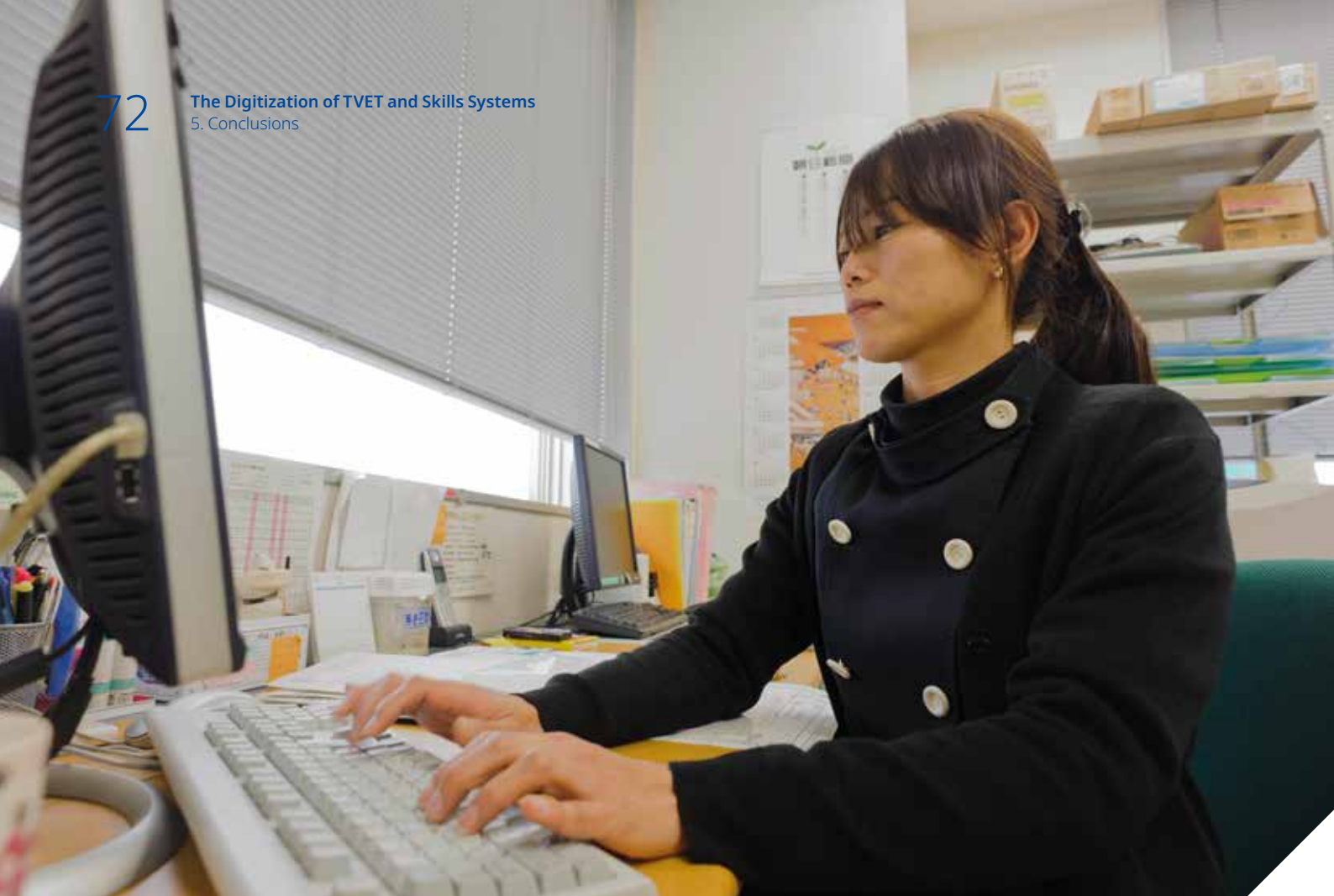
▶ Tom Wambeke – Chief Learning Innovation, ITCILO

Our research indicates that in most countries – even in advanced economies – basic pedagogies, such as those enabled by distance learning or by digitally enhanced classrooms, have not yet been mainstreamed across the entire educational system and labour market. In many cases, this is due to basic infrastructural issues. Thus, relatively unsophisticated interventions – such as ensuring that all classrooms and students have access to broadband, and making available tools to produce digital resources (such as authoring tools and OER repositories) – can make a significant difference.

The value proposition for such interventions is strengthened by the fact that:

- ▶ As infrastructural investments, they provide a basis for introducing more advanced digital learning pedagogies further down the line.
- ▶ Their use in education has been tried and tested successfully in a variety of contexts across the world. This provides benefits in terms of:
 - ▶ Scale: these technologies have already been commoditized, leading to low implementation costs.
 - ▶ Expertise: there are settled methodologies on how to adopt and make the best use of these technologies in educational contexts.

Even in corporate training, the largest growth comes from the growing adoption of relatively simple distance learning technologies involving video lectures and online quizzes.



5.6 The cost of digital delivery and assessment increases dramatically as the complexity and sophistication of the offering increases

The frontier of digital TVET aims to promote experiential learning, i.e. 'learning by doing'. Two categories of such simulation technologies exist:

- ▶ simulation of basic skills, such as welding or use of customer service software
- ▶ simulation of advanced and specific skills, such as use of specific industrial control systems

While investing in such systems carries lower risk and lower costs than creating workplace scenarios, creating and maintaining such simulations requires significant investments in manpower as well as equipment, often in cutting-edge technology that has not yet been standardized and may be considered outdated within mere months. Failure to secure such upfront funding to develop and install such technologies is a major limiting factor for the growth of digital TVET in most economies.

As such, the role of educators as creators is changing. Educators may still create educational materials to simulate basic skills – particularly when such simulation packages are licensed as OER and can be repurposed for different training environments at low cost.

When it comes to simulating advanced skills, it often happens that resources can no longer be created by educators. Rather, it is up to manufacturers of the live systems to create training or simulation modes, which educators then guide students through – or in which students can be trained during apprenticeships.

5.7 Digitisation is viewed with scepticism by a significant segment of the educational establishment

The motivation for digital TVET in some countries such as Slovenia is to associate it with standards for practical education as a more efficient, transparent, comparative system that is equal to academic tracks.

There exist struggles with infrastructure and teacher training, as well as fear of greater workload and more bureaucracy, rather than greater efficiencies. There also exists scepticism as to whether digitization will actually translate into tangible benefits for citizens, as a culture of bureaucracy may still dominate. Most institutions with staff capacity are still optimistic, unlike smaller institutions, which clearly need external help and perceive this as tantamount to increased costs.

The challenge is to get human beings to change their ideas about technology when it comes to TVET, as they do not spend enough time thinking about the way technology can solve current problems. Nobody is talking about the real potential for technology within the context of demand-driven competencies, and it is very difficult to define what these standards are within industry. Once defined, they become redundant. One example is collision repair in the context of driverless cars – panel beaters are going to be impacted by these new technologies.

5.8 Teachers' digital competence is a key limiting factor for digital TVET

In all the countries surveyed, a direct link was drawn between the availability of initial and continual digital education for teachers and the capacity of the TVET systems for innovation. Irrespective of their level of development, all countries underlined an urgent need for strengthening and expanding education on digital TVET.

Digital TVET requires a broad range of professionals to be involved in its creation and provision. The landscape is currently the domain of lone professionals attempting to provide high-quality digital TVET on their own, but these efforts are unlikely to be effective or sustainable.

Our research indicates the need for the following roles:

- ▶ Instructional designers: these professionals design learning pathways that may involve a mix of school- and work-based learning. Their role also involves commissioning and managing learning components, such as distance learning and simulation-learning experiences.
- ▶ Teachers: these professionals mainly guide individuals through a set of learning experiences. With digital technology, their role is increasingly not to *deliver* information, but to assist in *interpreting* information. In larger courses, teachers may be supported by *community moderators* or *teaching assistants*.
- ▶ Media creators: these professionals assist in the creation of digitally enabled learning experiences. Media design may include photography, web design, filming, 3D modelling or any other creative works that may be required when providing the courses.
- ▶ Assessment and skills experts: just-in-time learning requires unbundling courses into distinct skills and creating assessment tools that allow assessing these distinct skills.

Matching these profiles involves expanding the range of skills available to TVET providers beyond pedagogical and industry-specific knowledge.

To this end, there exists a clear need to widen the pools of expertise within TVET, and to better train teachers to work in a digital-first, student-centred educational environment. It is also necessary to ensure a constant 'revolving door' of experts between academia and industry. This finding is true for every country surveyed; the only differences among countries lie in the specific technologies that should be included in such trainings.

5.9 Digital TVET reinforces the fundamentals of TVET as a three-party collaboration requiring the buy-in of policy-makers

As discussed in Section 4, the success or failure of TVET is very much dependent on close collaboration between employers, students (or employees) and educational institutions and – frequently – the support of government as the policy-maker. We find that digital TVET increases the strength and need for these interlinkages, in that it requires:

- ▶ close collaboration between all three parties in designing learning experiences that realistically simulate workplace scenarios and eventually give access to real-life scenarios
- ▶ tighter feedback loops between educational institutions and the workplace, to allow quicker detection of emerging skills needs
- ▶ the adoption of student-centred teaching and learning approaches by the workplace, in collaboration with educational institutions, particularly the design of education around skills frameworks matched to microlearning units
- ▶ continuous rotation of staff of TVET institutions in and out of industry, to ensure experience in the latest practice and on the latest equipment

Modern collaboration platforms facilitate interaction between these groups, whether through real-time monitoring of apprenticeship placements, online surveys of employer needs or the creation of virtual workplaces that can be used by students and teachers.

5.10 Digital TVET is accelerating the hybridization of tertiary education

Traditionally, so-called 'intellectual' work was often contrasted with 'manual' work. There existed a stark difference between the popular perception of what constituted white-collar (office) professions and what would be recognized as the work of traders, technicians, etc. Nowadays, such a distinction is no longer possible.

A number of features associated with digitization and education, such as competence-based education, personalization and microlearning, as well as the infiltration of technology into practically every discipline, are leading to a breakdown of the traditional silos between technical and vocational education, skills development and academic education, particularly within tertiary education.

Pressure from the labour market is leading to more career-centred programmes, with industry dictating the necessary fields and expertise to fill the gaps being created by the transformation of the labour market.

However, stakeholders in TVET and skills systems still feel there exists a gap between the (negative) perceptions of the sector and its actual contributions to society. A TVET career is not necessarily equated with social, cultural or economic capital.



5.11 The ethical implications of digitization are receiving insufficient attention

Wider discussions on the role of digitization include a focus on the ethics of introducing various technologies. However, our research was able to uncover practically no discussion of the ethics of digitization in TVET. Areas that are missing from conversation include:

- ▶ the role of digital TVET in reinforcing or addressing digital divides
- ▶ the pitfalls of algorithmic bias in AI, reinforcing social stereotypes
- ▶ the implications of competence-based learning for professional values
- ▶ the tensions between academic autonomy and digital performance surveillance
- ▶ the shifting power dynamics between employers, public and private educational providers, and students enabled by technology

While it is beyond the scope of this study to enter into a detailed analysis of each of these issues, the lack of literature around these areas implies a sector that is ill-prepared for the full effects of digital transformation.

6



► 6. Recommendations

We believe that the evidence generated by this high-level report provides sufficient ground for the ILO and UNESCO to take the research to a more granular level, ideally the nation-state level. This set of recommendations, proposed as strategies and programmes for consideration, constitute in practice a set of proposals that are very much interlinked.

6.1 Design programmes that improve the evidence base informing transformation

6.1.1 Commission studies for countries that are digitally and TVET-ready

This study reconfirms the OECD (2018) assertion that there exists a huge disparity in countries' preparedness to benefit from digitization on TVET on the basis of adult skills. Many of these disparities are due to unique socio-economic and cultural contexts that remain impermeable and resistant to technologically deterministic concepts of change.

ILO and UNESCO should identify a set of **nation-states** with a set of conditions that indicate that they are receptive to driving pilot programmes of change within TVET where digitization is a fundamental component of change.

By a 'set of conditions', we mean specific countries where:

- a. The basics of digitization are already present and there is strong government and labour-market support for modernizing skills through technology.
- b. TVET is not deemed to be necessarily inferior to higher education.
- c. ILO and UNESCO can collaborate with **international organizations** that already have a strong presence on the ground and therefore have access to technical know-how about specific niches or **sectors**.

On the basis of this preliminary study and the limited number of interviews conducted, we find that:

- a. The nation-states that appear to be both digitally and TVET-ready are Ghana, Kenya and New Zealand.
- b. The most promising niche programme areas where further investment in digital technologies may result in positive social change are those targeting refugees and youth unemployment.
- c. The most promising international organizations that participate in and support further research are UNHCR, the Mastercard Foundation (based on previous commissioned research on digital credentials for unemployed people in Africa), the Massachusetts Institute of Technology (MIT) Media Lab and the IDB (based on its ongoing research on accreditation frameworks for online learning targeting vulnerable and marginalized groups).

6.1.2 Focus future reports on digitization and skills for lifelong learning and decent work

A concentrated effort must be made to steer away from historic tensions between the relative merits of higher education and VET, which continues to be considered inferior – including in those developing countries that would at first glance have the most to benefit from the impact of digitization on skill sets and the labour market. In places like China, a more digitally literate generation continues to prefer higher education pathways over TVET, despite the government's ongoing investment in the sector.

It is time to find a vernacular that avoids these tensions. **Focusing on digitization as a prerequisite for meaningful lifelong learning and twenty-first century skills, which in turn will lead to labour mobility and employment, is more likely to resonate with policy-makers and learners.**

Digital technologies are particularly effective when used as blended learning tools that can be operationalized in social practices (such as teamwork, peer-based learning and collaborative problem solving), particularly when they are linked with real problems or project-based learning. They can also bridge the perception gaps between the key stakeholder groups of government, TVET institutions, learners and the labour market.

At the nation-state level, it is vital to coordinate policy efforts around education, TVET and skills policies (OECD, 2018). Lifelong learning for all needs to be at the core of the policy response to digital transformation. Specifically, policy needs to recognize the uncertainties and disconnects around what will constitute skills needs and knowledge in the future. The skills mix must be updated and adapted in consequence.

Digital transformation differentially affects regions within countries, and regions' skills endowment tends to exacerbate these performance gaps. Policies must therefore focus on gaps, to ensure the benefits of digitization on TVET are more equally shared. Inevitably, that means digital learning. In a similar vein to the labour market, the hope is that citizens will apply pressure on key stakeholders to modernize the TVET system in nation-states.

6.1.3 Address research gaps on digitization in TVET and skills systems

Our literature review identified a number of areas where the literature and evidence of effectiveness in TVET are sparse. In particular, these lacunae are strongest in the following areas:

- ▶ gamification in TVET and skills systems
- ▶ use of technology for institutional management
- ▶ effectiveness of technological interventions in enhancing access and participation in TVET and skills development
- ▶ ethical implications of digitization in TVET and skills systems

We would therefore recommend supporting specific research in each of these areas.

6.1.4 Support high-profile case studies that will resonate with labour markets and governments

There exist opportunities to leverage the mass uptake of mobile technologies and social media, and focus on case studies in target countries and institutions as a means of reinforcing the potential ROI in supporting institutions and learners engaged in lifelong learning.

In their study on big data and the labour market in the United Kingdom, Brown and Souto-Outero (2019) consider big data as a powerful tool for sociological and policy research on TVET when it is combined with other data-collection methods, such as biographical data from job applicants and qualitative studies of the recruitment process. As new questions emerge regarding the mechanisms for social reproduction and change, such research will further contribute to our understanding of the opportunities and limitations of credentials in relation to reducing social inequality.

6.2 Enact strategies for digital transformation

When implementing the different national training programmes offered to teachers, facilitators or supervisors, technology needs to facilitate coordination and collaboration between the professionals who work in the TVET sector.

Pedagogical training on delivery, assessment, certification and competence-based curriculum/continuous improvement of trainers in and out of service needs to include exposure to industrial skills and the realities of the workplace. TVET trainers should be required to have prior industry experience.

Rather than purely technological expertise, the main proficiency to be secured by TVET educators is the ability to engage with learners on the various affordances of technology. This also requires **the ability to help learners apply a critical approach when adopting technology**: the negative implications of datafication have received much media and academic attention, from concerns about surveillance capitalism by online platform owners to concerns about surveillance societies adopting cutting-edge technologies under the guise of security and social engineering (such as China's social credit system) (The New Economy, 2019). It is vitally important for the TVET sector to not simply embrace technology as a goal per se, but as a fundamental component in enhancing the individual and collective capacities of the current and future labour market.

Teachers and learners need to be encouraged to work with peers to conceive learning as a social experience. Alternative pedagogical approaches remain the domain and initiative of individual teachers. Outliers, such as Lambda School in the United States, need to be explored, supported and adapted to specific nation-state contexts.

TVET and skills systems need to invest heavily in market intelligence and forecasting, to prepare and build courses for emerging digital skills. Data-driven TVET and skills systems are likely to become the norm in the coming years.

Governments need to be supported to qualify and register all trainers to ensure an adequate supply of better-skilled TVET trainers who are capable of developing and adapting skills systems that are relevant to the needs of the labour market in specific contexts. Digital credentials for quality assurance and anti-fraud for regulatory bodies are short-cuts to ensure that third-party training providers are providing a quality product.

These recommendations rest on the key assumption that the ILO and UNESCO are interested in supporting research that is likely to resonate with the labour market and governments in the short term, i.e. three to five years. They primarily focus on improvements to TVET and digitization research, as opposed to systems.

6.2.1 Develop strategies to support tangible pilots that demonstrate the practical use of emerging technologies in TVET

The governments, businesses and institutions deriving the most benefit from emerging technologies are those who test their applicability on the basis of pilots, sandboxes and case studies whose costs can be controlled and that promise lasting value in the short term.

Whether the technology is emerging – such as blockchain and AI – or relatively mainstream – such as VR – the case studies reviewed demonstrate that the digitization of TVET needs to be demonstrated through projects developed to solve a particular problem or address a specific issue, as opposed to a technologically deterministic approach.

► SHRDC in Malaysia has developed assessment systems for its apprenticeship schemes to determine the effectiveness and impact of apprenticeship initiatives based on data. Pilots that work are rapidly scaled up and supported to ensure sustainability. The last ten to fifteen years of experience in Malaysia are replete with examples of apprenticeships in industry and curricula that are developed together with industry, as opposed to delivered by TVET professionals in ideological silos.

► The impact of digitization on TVET needs to focus on seemingly change-resistant but very tangible sectors that resonate with citizens and the labour market. COL reports that in India, the sector benefiting most from digitization is agriculture, even though the majority of farmers are not literate, let alone technologically literate. Nevertheless, there remains a need for a supply of academically literate trainers and change agents to understand how technology can be used to achieve sustainable change in the sector. Most people believe that using a phone is not the same as being able to use mobile technologies strategically. A farmer interested in the affordances of digitalization will inevitably need assistance from people and institutions outside the farmer's peer group.

► Culture remains both a barrier and an opportunity to maximize the opportunities of technology in niches within the TVET sector. For instance, even if the ILO were to subsidize applications and specialized online content for specific areas such as agriculture, the chance of success would still be very much dependent on culture and social norms, i.e. 'doing things a certain away'.

► Digitization should be used as a pilot for online assessments. Online assessments are already becoming standard practice in TVET. Assessments are rooted in the 'old world' practice of needing to prove credentials and learning outcomes. Investing in digital-assessment pilots can become a primer for reconsidering long-standing practices such as textbooks for online courses, and also helps reduce the costs of study for both TVET institutions and learners.

► The recognition of credentials across nation-states is vital, and there is much that digital technologies can contribute in addressing a long-standing problem. The future of credentials and connected learning is dependent on countries recognizing each other's TVET qualifications and giving digital education parity of esteem. TVET needs to collaborate with professional unions and the labour market to ensure such recognition takes place – there needs to be a process of TVET equivalence in different nation-states. Refugees have to work around national government policies on higher education to have their existing credentials recognized. Canadian academic institutions are offering credentials that are a stepping stone for admission to a local university (as in Ethiopia's example) and to the next level of learning. Partnerships between local and overseas universities need to look at entrance-level policies.

These are clear examples of connected learning helping at the local level. We recognize a lot of scepticism at the policy level about the quality and rigour of online programmes. In Lebanon and Jordan, UNHCR has been bringing together actors to achieve cooperation and consensus. Government knows they need to link to other actors, like unions and employers or labour representatives.



Consider initiatives by TVET colleges that are interested in using digitization to re-engineer their business models as research pilots. Technology can compress the cycle time and take steps out – that is the real revolution. Lambda School could not have existed five years ago. We had to first get SaaS in place and recognize that we did not need a Ph.D. to go and work for Google, or a bachelor's degree for IT roles. All of these social and tech advantages had to come together; someone put risk capital on the line to create a whole new way of creating computer science in a totally new way. Tech and social change together condition innovation. The more interesting thing here is the way that mobile, internet and decentralized technologies are coming together to enable institutions to collect fees and empower the end user (the student) in the process by taking out the middleman. People can advertise what they want globally; cash app or crypto currency without having to deal with incumbent predatory fee structures in traditional arrangements; focus on practical pilots that can be supported, where technology provides real-life benefits to those in the TVET cycle; work with institutions and labour markets to develop accredited online training programmes; and finance the training cycle to ensure that young people do not end up in debt.

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► Annex 1: Institutional Observations on Digitization of TVET and Skills Systems

The following extracts from interviews represent a curated set of institutional and country-specific insights. They are included to provide substance and context to the findings and recommendations of the report. They also highlight the stark disparity in sociocultural, political and economic contexts, which in turn impact the state of readiness of TVET to digitization.

Commonwealth of Learning (COL), Vancouver

Dr Balaji Venkataraman, Vice-President, COL⁴

There is no shortage of TVET policy documents in Commonwealth countries – but there is a great disparity in terms of scope. OECD countries such as Australia, Singapore, Canada and the United Kingdom have advanced policies and organizations focusing on TVET. Non-OECD countries will have boards charged with skills development and tasked to develop some sort of policy. Small Commonwealth countries (with a population of less than 2 million) will not have much in terms of policy.

The most important social and economic outcomes to be managed today are employability and climate change. By inference, most countries are focusing on the need to increase skill sets. In the past, this used to be teaching languages. Commonwealth countries with huge populations have to keep young people occupied: parking them in tertiary education systems is no longer helping to address the employability issue.

Quality assurance policies remain the preserve of higher education alone, although TVET pedagogies and technology systems need similar attention to quality assurance for the benefit of the end users/learners.

At the Fiji Commonwealth Ministers meeting in 2018, it was agreed that we badly need two systems and to bridge TVET into higher education. The challenge is to find a consensus on how to bridge. There are no clear solutions at present. While we remain in a situation where policy-makers need to be assured that technology can provide quality and facilitate learning outcomes that are acceptable to employers, there remains a need for process- and paper-based solutions. Until we have trusted tech-enabled solutions that guarantee integrity and quality outcomes, we will have to rely on hybrids. Many policy-makers still have to be persuaded.

Micro-credentials and subcredits are open issues. Between now and 2021, we have to have some clarity and final statement on this.

Identity – particularly reassuring and confirming the identity of a person going through a credential-based learning process – is a key issue where the blockchain can contribute to a solution. The joke in India, where the practice of degree mills is widespread, is that to run a university all one needs is an excellent printer. Breaking this element of cynicism is a challenge for higher education and TVET. There are intricate processes at the heart of what constitutes 'identity' that would make a deep difference to the TVET landscape. Governance is dependent on digital identity and governments are therefore not averse to deploying this within education and TVET systems, so we may expect quality assurance and digitization to go together.

⁴ Dr Venkataraman is an Indian national based in Vancouver. The interview includes views on Commonwealth countries supported by COL and makes specific references to India.

Today, the digital world is the nerve system for our society: it connects different parts of the body; indeed, it is diffused throughout the body. Digitization also means surveillance or different notions of what constitutes a citizen's 'social credit' or social right. Take China, where if you travel on a high-speed train without a proper ticket, your citizen social credit score is decreased. This notion is based on advanced digitization. Digital TVET systems will work and fail in different cultural contexts on the basis of whether there is buy-in or not from political leaders.

TVET can make a big difference if we focus on portability. An electrician from Fiji will find a job in Australia because this person's TVET credentials are recognized in both countries. TVET skills are far more mobile than higher education degrees – and mobility is very much part of the wave of global migration.

There is a concept in organic farming that may be of relevance to TVET – that there is a risk of pollution from the soil all the way to consumers. Even water that is used in farming should not be polluted. In the past, all interventions were based on paper approaches and ISO standards. Now people are using sensors. Farmers have to be certified in skills in particular areas. These sensors are unique to a particular plot. Farmers will be certified for operating sensors and particular techniques.

In some countries – i.e. large South Asian countries – there is financial provision to varying levels. The same goes for South Africa. These are countries that want to commit money.

Blockchain governance will also come into the equation. Who really wants these technologies? In the case of technologies such as WhatsApp and Telegram, for instance, people are wondering if even these technologies are subject to surveillance. Out of politeness more than anything else, politicians are looking at datafication as a means of state control. The internet has created a field where access is easy – but who manages the back end is possibly another reason for caution.

Numerical skills are on the upswing. A data operator today has to have a much better sense of technology. How much this is recognized by polytechnics, for example, is debatable.

OER and AI together could become an interesting mix. Measurement will help demonstrate ROI in TVET. Open-source software is being made available for draughtsmanship, to try and get people away from pen and paper. Yet many polytechnics do not have access to this software.

Credentials are key. Any technology that facilitates credential transfer will spur economic development by widening the opportunities for employment and lifelong learning, particularly to those individuals who through choice or necessity choose to migrate within regions and to other countries.

Employment is still available in manufacturing, plumbing, electricity – these are areas where people are looking towards major changes in teaching and learning, but where access to tech is extremely fragmented. This is where the European Union and other organizations can have a major impact. This will be a long-term investment. Money is available, but teaching technologies are very limited. If the European Union were to make tech and money available to these countries, then this might also make sense in terms of the migration challenge.

Digital skills that contribute to manufacturing, such as 3D printing, seem very remote from people's daily lives in poor countries. But this is the case in specific labour contexts. Singapore and Taiwan are at the cutting edge of using tech to scale up TVET.

The unions in some countries may be suspicious of digitization. Resistance to change from teachers' unions can be a major stumbling block to increasing the impact of digitization on the TVET sector. What unions fear most is flexibility, not the onslaught of digitization.

Open access is enabled by digitization – but we need to question whether digitization necessarily increases access. COL focuses on open access, which we assume is enabled by digitization. Yet when we look at research on the impact OER may have on people who may not have access to the education system, the evidence is limited. There is a theory that is never challenged that digitization increases access – but can we prove this? The power of openness and its impact is probably still more visible in open-source software and open-access research than in OER.

This implies two questions: 1) what is the impact of OER on TVET?; and 2) does digitization improve access?

We do not yet have a solid evaluation framework for the impact of digitization on TVET – or education, for that matter. Perhaps we can blame academics for having conflicting views on how to measure access.

Although most banks in developing countries today have played a major role in facilitating daily lives, using open-source software such as Drupal or open-content management software or open-education certificates, people have not yet found a way to calculate all these benefits.

It is the same way with open education. Only now is there a US survey of 4,000 higher education faculty members that shows that 70 per cent of the faculty are using OER on a daily basis. It has taken a generational change from 2001 to 2017 for people to recognize this.

Digital impact and improved access are interlinked with engagement. For instance, in India, developers resisted messaging apps being integrated into MOOC systems to facilitate links between students, and between students and trainers. Using digital systems can improve engagement, but there are no universally recognized framework or standards in place. Merely increasing access is not as effective as actually using open software.

There is clearly a reflexive relationship between digitization and the TVET sector.

It is not the latest technologies that become most effective, but repurposing old technologies because of new ones. Since the 1980s, different countries have pursued different pathways, even in terms of generic technologies. Just look at China's digitization is fundamentally different to that in the European Union or the United States.

Digitization and learning pathways are linked. Digitization in TVET learning and flexibility should go together.

The approach of 25-year-olds to learning and learnable things is very different. Think of the erosion of the power of librarians, who used to control access to information before the emergence of the internet. A mediated digital society, plus greater flexibility in teaching and learning, is a must – and this will force people to use the new approach, unless you have political resistance and commitment to resisting digitization.

You have to look for advantages, so people start to embrace digitization. Governments are key. Engage with them.

About learning pathways: software as a skill is too closely associated with higher education. Yet in India, TVET produced enough people to get into IT. Produced several software developers who could not obtain admission to formal education institutions. The degree in English literature was not as useful, even for higher education graduates, as the software course.

We can respond to the labour market better than highly structured systems. This is the flexibility digital systems are capable of. When this debate happens on how only those with high skills can get job, we have seen the opposite happen in many countries like India. You can build digital systems and if you manage them well, they can respond better to labour needs than current systems.

What we miss in the transfer to digitalization is the opportunity to work with community. A clever technician has a community to fall back on. Digitalization makes skills more transient, yet at the same time you can build backward links with technologies. People who are taking particular MOOCs in Vancouver are meeting in person at a café on Sundays and talking about some aspect of their MOOCs.

That community feeling is great for people not to feel isolated in the digital world; it is a MOOC getting people together. How can we foster and mentor this? Can we leverage virtual communities and virtual communities? How can the TVET sector mentor these people so that they become multipliers? The opportunities for digitization to morph into real change also have to leverage the opportunities for networked individualism to create a MOOC facilitating face-to-face interaction between people.

Inter-American Development Bank (IDB), Washington

Fernando Pavón – Specialist Labour Markets, IDB⁵

The Caribbean region has TVET policies, but these differ from island to island. Some have regulations based on wage levies, such as Jamaica. In the Bahamas, TVET is more responsive to the financial structure that sustains it, where TVET is trying to scratch through a wall to find some funding.

The policies in place inevitably need to be updated to address the impact of digitalization; moreover, many countries are not responding quickly enough to the needs of the labour market.

There are attempts to get a regional digital platform to facilitate regional training – that is, training that works and can be recognized and accredited on more than one island. Right now, it is difficult to get parity of esteem for training originating from one island compared to another, which goes directly against the principles of labour mobility.

MOOCs are not being recognized because of a predominant way of thinking. There is a need for a major cultural shift for digitalization to be embraced, not just within the TVET sector. Before this can happen, countries need to make a seismic shift in thinking of what constitutes training within the digital age. We have to go back to simple online training modules that can be delivered in short bursts. Some of these need to be culturally constructed to be recognizable and valid within specific sociocultural contexts.

When you engage with governments, they know that a wave of disruption is coming – but maybe not within policy-makers' lifetime, so the instinct is to stagnate rather than make progressive policy changes. We need external forces to get policy-makers out of their stasis. Industry in the Caribbean, however, is also not setting the tone for change. The TVET sector is disconnected from Industry 4.0 and is not linked with the private sector. The private sector in the region is already experimenting with technologies – not necessarily with AI and digital automation, though a lot of firms are looking at these – but also adopting bots and chat bots. Conversely, key players in the TVET system appear to be totally disconnected from the needs of the labour market.

The gap between the private labour market and the TVET sector is replicated in the higher education sector. There are few attempts at creating a bridge: as an example, it takes eighteen months to prepare a course. This is not acceptable in the labour market, which is constantly innovating and changing.

The most effective training programmes are organized by industry and specialized private training providers as work-based learning. The IDB supports such programmes financially to try close the gaps. The skills development system has to be dynamic enough to be adapt. That is the challenge for the IDB – to keep speaking in different tones to sectors that are meant to be working together. The IDB also works with sector skills councils, where for decades in the region there has been a disconnect between stakeholders.

The region's practices include the payment of wage levies, yet there is little benefit from these outputs, since industry trusts what it knows. What is being done is to enable the private sector to become proactive in designing courses. Private firms get funding from the IDB, and training providers have to connect with private firms to get access to these funds. This is a strategic decision: the incentives are on the demand side, not the supply side.

5 Mr Pavon was based in Jamaica and in charge of the Caribbean region at the time this interview was conducted.

Governments are IDB clients. The bank creates the dialogue to get people round the table. You cannot just train people and then hope they land a job – this is simply not a good use of funds. Governments need to enhance skill-development systems, because firms cannot find the skills they require. The IDB is starting to look at digitization as a way of maximizing economies of scale, validating standards and enabling the transferability of skills from one country to another, beyond borders. Technology enables policy-makers to generate more granular information before decisions need to be made. In the case of studies and specialist industry reports or when using consultants to interview stakeholders, the IDB is using industry-specific platforms and then analysing big data to identify those skills that are most sought-after more quickly, more cheaply and more accurately, almost generating real-time information.

The IDB sees a trend where most citizens in the region have a smartphone that is underutilized – mobile should be the means of delivery for TVET to a new generation that engages differently. Young people do not want books – they want digital content. The way they learn is very different; it is the challenge of policy-makers and TVET operators to determine how to reach a generation that learns differently.

MOOCs like Udacity and EdX are gaining more recognition by industry; the associated low costs contributing to making these solutions more accessible. Technology and the available OER content are creating a demand for learning. The real challenge is how to get online learning into modular, stackable approaches to certification, and then determine how people can keep learning while employed. Lifelong learning is still a novelty.

The IDB's primary focus is to engage with the labour market and government, not with TVET colleges. Nevertheless, there is concern about the overall quality of content, since the labour market perceives a disconnect between its needs and what TVET institutions are producing. In Latin America, countries tend to work with a standardized TVET skills framework. In the Caribbean in particular, technical skills councils are also in the business of creating and/or validating standards per industry requirements. As industry evolves, the IDB is providing support in various manners: developing frameworks for industry standards; investing in quality assurance mechanisms; providing funding to create digital platforms providing feedback on the quality of training providers and student learning outcomes; and occasionally funding the creation of training material from the ground up.

Digitization opens up totally new ways of quality assurance through metrics and new quality assurance processes. A regime of continuous assessment is made possible because of digitization. For instance, the IDB has to ensure that its funding regime is inclusive but also sustainable: the IDB estimates that about 40 per cent of its investment efforts will be rendered obsolete unless digital transformation can directly contribute to upskilling and reskilling the labour force. Digitization is a game changer, since it enables the IDB to have better and more updated information about macrotrends, which then results in better interventions in the labour market. Digitization can be associated with the democratization of the entire funding process, since it allows transparency through quality assurance, with ratings on specific interventions becoming increasingly transparent through an ever-improving feedback system. In the past, money was frequently channelled to projects with a poor performance history.

The new platforms enable feedback from both students and employers on the quality of TVET interventions. They vary according to the sociocultural and economic needs of the particular country. Increasingly, the IDB is moving away from a strategy of developing platforms from scratch and looking at the affordances of existing digital platforms. This means the IDB is more of a system integrator, as opposed to supporting bespoke development, which poses problems such as proprietary software lock-ins and expensive support. In the past five years, significant progress has been made with SaaS, providing new opportunities for the labour market.

Strategically, however, this is not just a matter of what is available but of an analysis of existing digital solutions that meet the standards and requirements of the end client. Trying to keep up with the client is a challenging process, since the IDB has to be as compliant as governments with its own procurement policies.

International Trading Centre of the ILO (ITCILO), Turin

Tom Wambeke – Chief Learning Innovation, ITCILO

The ILO and the Italian Government established the ITCILO in 1964 as an international vocational training institute, based in Turin (<https://www.itcilo.org/en>). It employs around 200 staff, who set up training and learning for around 15,000 students. The learning innovation unit employs twenty staff members, charged with designing sustainable learning solutions through participatory learning methodologies and learning technologies. The ITCILO develops both proprietary and co-designed programmes with international partners.

The ITCILO's objective is to facilitate the meaningful integration of technology into TVET. As an example, it is working in Bangladesh with the national TVET system to see how it can set up virtual learning solutions in classes in developing countries. Culture has much to do with the issues the development team will face.

There is a hybrid 'marriage' between technology, the formulation of policy and praxis; it is a veritable reflexive relationship, with these variables pushing the other. TVET is becoming a complex sphere, which encompasses technology ranging from MOOCs to the blockchain. It is vital that the discourse on TVET moves away from old debates, such as accessibility: policy-makers are looking for more pragmatic solutions. We need to be pragmatic about technology if it is to be put to meaningful use.

Accessibility and inclusion are now associated with the open-source movement. In Bangladesh, coming up with a repository for interactive resources (i.e. H5V or Adapt) means that low-tech software can be just as effective as more expensive variants – sometimes more. What is more important is how to design systems where the teacher is no longer locked into old broadcast teaching models – when it comes to tech, most people are still just watching a video. There is huge scope for improvement.

The ITCILO avoids using labels when it introduces technology in a specific cultural context. The focus has to be on new forms of learning that add value to a culture and a context – increasingly, that means blended as opposed to isolated programmes.

Thinking on infrastructure has shifted attention and investment to mobile. We are almost in 2020, and the future predictions on smartphones were correct – including their use in rural places. We are still looking at broadcast models, while now we are looking at meaningful community pedagogy – advancing informal learning with formal content through mobile technologies. 'Pragmatic' is the key word: how can we improve interaction with participants through group chat, for instance, in a similar fashion to the way we use WhatsApp? Can we use a decent messaging system and incorporate this in teaching and learning?

When a new technology is introduced, it often has a disruptive impact – but it does not necessarily mean that existing technologies, or practices that are empowered by those technologies, are made redundant. Such technologically deterministic views are not helpful. The same applies to problematizing the digital divide – are we using this to go back to the past, or do we create parallel scenarios to keep everyone updated?

The mass uptake of the internet is also due to the proliferation of mobile technologies, so the digital divide has to be closed in creative ways. Online versus offline scenarios are no longer as relevant as determining how to put mobile technologies to good use. In Indonesia, when the ITCILO ran workshops in rural communities, participants had Blackberrys. The ITCILO had a mobile learning programme around communities and a fantastic set up that required a basic short messaging service (SMS) system. The programme participants came up with a creative workaround solution which avoided expensive connection fees by connecting mobile with a Twitter account (at the time, you could connect SMSs to Twitter free of charge). The digital divide is always presented as being related to disenfranchisement stemming from a lack of infrastructure, but in many cases it is due to a lack of basic ICT and digital literacy: workarounds can work for the digital divide! If you look at the history of technology adoption, it will accelerate so much in the next ten years that the internet must be considered like electricity for TVET

solutions, and we do not have to keep talking about the cost of bandwidth. In Tanzania, until recently, the access costs via satellite were prohibitive (around €6,000 for monthly bandwidth). Nevertheless, it is vital for policy-makers to look beyond the statistics and look at the complexity of the entire TVET picture. There are questions to be answered.

Is digitization creating a need for more TVET? Is digital TVET enabling more people to follow TVET? One of the surprising things with TVET centres, such as those in Bangladesh, is that they were preparing people for old-school trades – very mechanical trades (cars, air conditioners etc). Yet the new equipment that people are buying is entirely digital. The national TVET system is not up-to-date, because it fails to recognize what is happening in real life.

Digitization is creating new demands for new programmes. The scenarios are different for each country, but there is an inevitability, in that contexts are becoming digital. TVET either has to react or risk becoming a 20th century construct, and hence increasingly redundant. As an example, many TVET organizations operate in a one-dimensional environment of manuals when trying to engage with 3D machines. When you see simulations that are more accessible than before, that is a game changer for TVET students – think AR, VR and 3D simulations. In Vietnam, the ITCILO ran a virtual application for fire and safety, and people found this inspirational. What also inspires are tools and hand learning and MOOCs – we always looked at MOOCs as improving outreach and access. Rather than MOOCs as broadcasting models, we were looking at collaboration models that work on specific challenges and can help create teams and community. It would be interesting to see how this works within TVET. There is a lot of work of customization and localization in developing countries that we should look at.

In terms of content, we are lacking content which can be readily adapted to cultural differences between countries. For instance, in Tanzania, the discussion forums on well-designed MOOCs were not completed and we wondered about the lack of interaction. Then we realized that this specific community was not used to text-based interaction, but rather to aural instruction, so we organized Skype-based interviews and we got the learning outcomes we wanted. We should not get lost with the more fancy AI applications. Some of the methods use very traditional, e-mail-based systems – there are some great examples from UNDP – and you end up with a publication. We need to mix methodology with technology, and then we can speak about accelerated learning processes.

If we want to change teaching and learning paradigms, we have to work with teachers and see how technology can accelerate. The balance between technology and methodology is not always right. There are incremental increases that work. For instance, MOOCs take time to be naturally adopted.

A lot of the methodologies we use in design thinking are leading to creating templates that can guide conversations with teachers and policy-makers where it is not just the consultant who comes in, but the tools include empathy mapping for the audience.

The ILO is celebrating 100 years in 2019 regarding the future of work. What is always interesting is that the discussion is dominated by robots, AI, etc. And yet you look at the top ten skills and there is nothing in these which is technological, these so-called 'twenty-first century skills'. Technology is liberating if it can do things better than we can, and if it enables us to re-focus on the human aspects of life and work. But the complexity has increased – interdisciplinary problems need new solutions, which cannot be developed by a single intervention. Bring the anthropologist back into the conversation, bring the tools to guide the human conversations. It is time to change the way educational scientists work. We need to focus on case studies to encourage better engagement.

Skills specialists may have different views on what will constitute TVET in ten years' time. The world needs interdisciplinary approaches to its problems. Yet teachers need to 'show stuff', so updating TVET tools would be useful in those circumstances. It would be useful to combine the lessons of old school TVET with the new tools. How can we combine old design thinking with those of young people who have grown up with open technologies? Bringing these different paradigms together may contribute to more granular indicators of innovation.

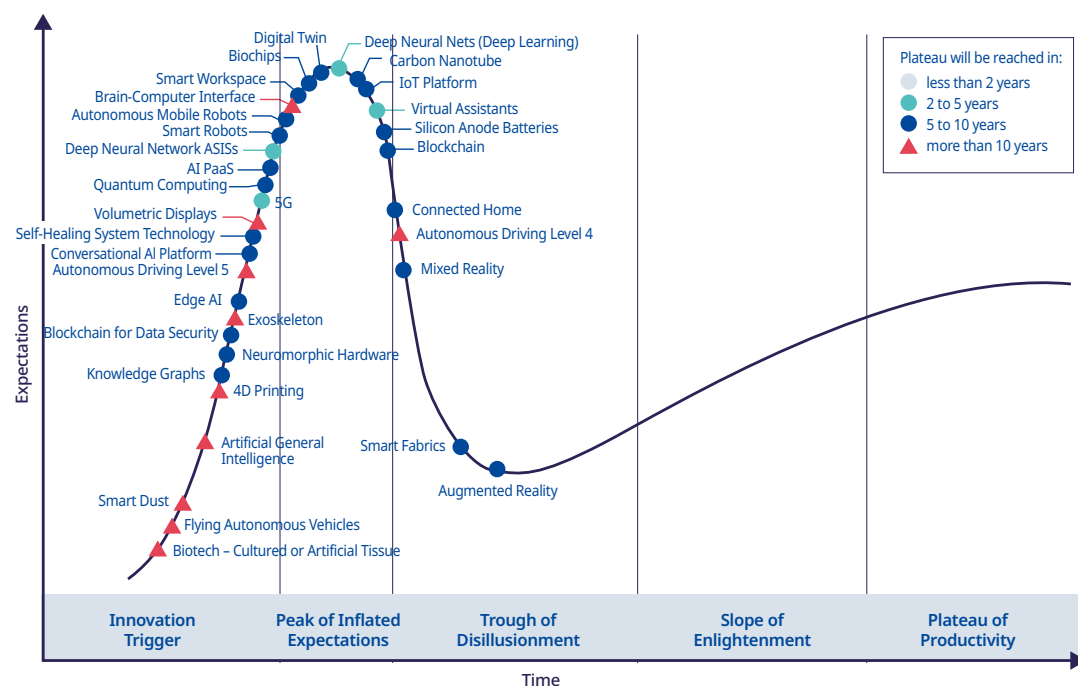
The definition of TVET is so wide as to encompass any kind of education that is in any way linked to employability. Technology innovation requires linkage with real-life trends. We need to systematically engage in foresight, and qualitative conversations with people in the field, as opposed to forecasting predictions. Conversational tools with stakeholders have been developed by the ITCILO that indicate the future of learning and go beyond the buzzwords but are based on very realistic, grounded scenarios. Foresight thinking on the future of TVET can happen at both the local and national levels – for example, turn the Gartner Hype Cycle into foresight projects. People can co-create the future of learning, as opposed to always relying on experts – a vision which has buy-in at the most grounded level. If you go in the wrong direction, technology will get you there faster!

Quality assurance is also being associated with digitization, the perception being that it can improve quality assurance in the future. We already do live benchmarking of training. We can extract data on any intervention and have done so for the past fifteen or twenty years. We want to visualize this in a dashboard that speaks to us directly. The interventions done are not just to capture the data, but to determine how these data feed into the instructional design of a course. If you have the right entry points and make people aware of the tools that are available, you can generate better training cycles – then you have to simplify and see what can work quickly.

Learning analytics need to be considered as entry points to any TVET system, as compared with the Gartner Hype Cycle (Figure 17). It is vital that both governments and TVET institutions talk about ways in which learning analytics can be translated into something that is comprehensible for people who are teaching TVET or setting policy. A new language is appearing in the quality assurance debate as a set of internationally agreed standards, such as ISO2000.

Perhaps we can have a set of agreed standards that can be applied as benchmarks, together with pragmatic tools. The fact that this is systemic implies that educational institutions are serious, although the decision cycles are slow. This should also be the case with the TVET sector.

► Figure 17. Gartner Hype Cycle for Emerging Technologie, 2018



Digitization can help improve feedback on the quality of TVET courses by providing real-time survey results. The ITCILO has a very fast evaluation process that uses tablets given to students. The evaluation is immediately available on the screen and compared to the previous version of the course, the centre average, etc. It is a low-tech approach which, with more tech in the classroom, can be a real game changer. You get hard data from a group in a safe, anonymous context – think Cahoot or Slido, where we gamify solutions. If people vote twenty times, we can use the collective intelligence of an entire group. This is where technology can really add value. Of course, we encounter resistance by people who do not want to have technology in the classroom. Sometimes you have to bring in an external voice to make the case for change. The more technology we insert, the more accountability we have that there is an ROI on the changes being made. The only objective data are sometimes based on experiential indicators. Think of experiential research coupled with new media as a means of fine-tuning the digitization of TVET.

TVET could do with a refresher in terms of perception. It needs to be associated with the future of work, where digitization is not just a catalyst, but a true driver of TVET and in daily life.

There is a need for new learning methodologies, but it requires a different type of person than the traditional TVET teacher. We cannot necessarily reboot and reskill teachers; we need to take learning to the next level through a more collaborative, multidisciplinary approach. This will require a different mindset and approach – this is the foresight approach. It needs to be direct, easily visualizable. There is a higher degree of intelligence that is underestimated.

Getting things from other contexts and putting them into others is always a good way of getting people to consider change. Interdisciplinarity will help people think critically of how technology can really add value to learning and reskilling.

TVET needs to reinvent itself and focus on more modern approaches. There is a need to get the TVET training closer to the labour market. We need to get better at storytelling through the use cases. Success stories need to be used to convince policy-makers to scale up.

National Service of Industrial Training (SENAI), Brazil

Frederico Lamego – Executive Manager of International Relations, SENAI

SENAI is a leader in professional education in Brazil and a major driver for innovation through technology in the national industrial system, along with the Brazilian National Confederation of Industry, the Social Service of Industry and the Euvaldo Lodi Institute. Since its establishment in 1942, 55 million professionals have graduated from SENAI. Currently, SENAI's 809 mobile and fixed operational units throughout the country receive more than 2.5 million applications for around 3,000 courses that prepare workers for 28 industrial areas. Courses range from professional learning to high school, college and graduate degrees. SENAI operates a certified network of 208 laboratories that offer technical and technological services to companies throughout the country.

The drivers for TVET and the impact of digitization have much to do with the relationships developed by key TVET institutions and the government of the day. In addition to providing Brazilian citizens with quality professional education, SENAI has an ongoing partnership with Brazil's Ministry of External Relations, operating workforce-training centres in Cape Verde, Guinea-Bissau, Guatemala, Paraguay and East Timor. In addition, it is creating professional education centres in Mozambique, Peru, Jamaica, São Tomé and Príncipe, and Haiti.

Since 2015, the Brazilian government has pursued a national initiative to expand TVET on a nationwide basis through a programme called Promotech. Under President Rousseff, there was a concerted effort to boost technology training in Brazil to address the low percentage of young people aged between 16 and 21 in TVET (just 5 per cent): the government provided extra funding for TVET through its support of the SENAI system. The key issue when the programme started was that it coincided with a recession. President Rousseff's response to the economic crisis was distinct in that it recognized there was a deficit

in the Ministry of Education in Brazil – in part because of the funding of scholarships – and relied on SENAI as a quasi-arms-length partner to mobilize in the TVET area.

Digitalization was at a very initial stage at the government level, with most conversations taking place about its use in distance learning. The challenge of TVET was to combine hands-on learning with online learning within this ‘distance learning’ cultural context.

In 2013, SENAI researched other countries’ systems to determine if a technology was in a state of readiness to rapidly scale up the use of distance learning. The government was expanding TVET budgets. It took out a US\$1.6 billion loan from the Economic Development Bank to expand the TVET network and create an innovation network. The thinking at the time was that TVET was an independent construct, which could be expanded without any intervention in the conventional school system. The objective was to maximize distance learning, and also introduce new technologies in the TVET classroom that could simulate hands-on learning with the use of 3D components. The conclusion of this expensive exercise was that there was no world-class experience that could be copied for the Brazilian socio-economic context. Most distance learning programmes were theoretical and not rooted in the requirements of TVET.

In 2016, as a response to the impact of Manufacturing 4.0, SENAI started a collaboration agreement with the ILO. A research group of Brazilian companies as well as multinationals was established to determine if there was a common understanding of the potential disruption of Manufacturing 4.0 on existing industrial processes. The conclusions showed that most operators could see Manufacturing 4.0 having some degree of impact on their future industrial processes. Key topics addressed included the use of multiple layers of information, the use of AI in processes and the digitalization of processes.

Under the present government, SENAI has created an initiative to organize or offer consultancy services to SMEs in Brazil. In 2018, SENAI visited some 3,000 SMEs to determine the opportunities for short-term, quick interventions – essentially the introduction of lean manufacturing in SMEs. The core lesson learned was that if you want to adopt Industry 4.0 methodologies within the SME context, you must first organize core internal processes in the factory line: only then can you start to think about monitoring processes through technology and prepare to move up the value chain into other areas. SMEs could not adopt TVET course offerings without focusing on core processes, despite SENAI being in a position to introduce such courses. Topics such as the IOT and AI require the existence and development of many transversal skills. In direct response to these findings, SENAI has created a committee with sectoral responsibilities to review and gradually introduce programmes in Manufacturing 4.0 as applied to TVET, with a specific website created as the primary delivery platform.

Work-based and online training are meshing together. SENAI has created simulation apps in Brazil for some course components to maximize the use of training classrooms. In the process, blended courses were created, with part of the programme delivered online as distance learning, enabling students to complement and blend class-based experiences with studies on digital platforms. SENAI intends to be at the avant-garde of concrete applications and simulations for TVET institutions. For instance, simulations have been created through a tablet app for a mechanic’s training on welding processes.

SENAI’s reputation is built on models of excellence for technical education, which are in turn dependent on an R&D service for the TVET sector. Industry 4.0 is a key agenda item for SENAI, and partnerships are in place with organizations such as the MIT to ensure there is support for innovation institutes and networks. MIT content on Industry 4.0 is being translated into Portuguese and in 2019, companies will be using this content on the SENAI platform as part of online training programmes for engineers and students aged 15 to 21. Around 2,000 participants will have access to a comprehensive course, with all content made available for free. Upon completion of the course, students can receive a joint certificate from MIT and SENAI for a small fee.

SENAI’s challenge is identifying international partners who may be commissioned to produce and adapt content for the Brazilian market: Manufacturing 4.0 cannot commence without content.

Equity and access to marginalized groups in TVET are priority areas, subject to the demands of the labour market. Brazil is trying to emerge from a prolonged crisis period and there is awareness among stakeholders of the need to prepare positively and have initiatives in place for the future. Brazil will become a more open economy, and industry will inevitably be affected. SENAI needs to be responsive to the new employment opportunities that will appear in new sectors. Construction of the new Institute of the Future will start in May 2019, some 40 kilometres outside Brasilia. The space will bring together industry and high-level government representatives to think about emerging technologies, identify the industrial gaps and prepare for the jobs of the future. It will mix sectoral topics to create agendas that can organize the TVET perspective and design the country's innovation agenda for our institutes. More than a more strategic industry perception, the objective is to collaborate with the government and increase awareness of the topics and sectors where global chains can make sense.

Gender is another core SENAI mandate area, where the organization is obliged by law to address the challenge of a more inclusive society in a tangible programme. SENAI is focusing on helping to improve the social level of people at the bottom of the earnings base – the poor and the lower middle class – by trying to boost their careers.

SENAI is working with Congress and the Confederation of Industry on standards for a new high school education system with six tracks, one of which is TVET. The target is to expand students' time in the classroom, with first-year students having the option to enrol in technical courses, including a diploma course. There is a need to find win-win situations for collaboration with public schools. Much is dependent on offering TVET for sectors where there is a link with the labour market.

Openness and OER will become increasingly important. Digital technology needs to be deployed in ways that stimulate young people's interest in joining technical/technology courses. SENAI is working with UNESCO on a free education programme providing slow-drip information to prospective students to create attractiveness. It is vital to employ technologies – particularly mobile phone and gaming technologies, such as 3D components – for TVET to be valued as an attractive training proposition for young people. The message should not be a top-down, one-way option. TVET can form the basis for fantastic engineer programmes; SaaS works with high school education; and health and safety can benefit from structured TVET. We need to focus more on STEM, but also include the arts. We need to have more critical and entrepreneurial students in the future.

High school reform is a great opportunity for SENAI to create applications that are more attractive to students. TVET is expensive, and funding is always a challenge. PPPs are constantly being developed to expand student numbers in TVET. There is a large dropout rate in high school – only 50 per cent of students complete high school. This also means there are students already in the marketplace who did not complete high school and are looking for jobs; we need training to resolve this. These statistics need to be one of the stimuli of reform.

Selangor Human Resource Development Centre (SHRDC), Malaysia

Tan Beng Teong – SHRDC

The SHRDC (www.shrhc.org) was set up in 1992 as a twelve-seat, tri-partite partnership between the federal and state government and industry, with the latter considered to be the primary stakeholder as the centre's Chair. The SHRDC now includes twenty-nine institutional members from the private and public sector. It is run as a not-for-profit, industry-driven training and talent development centre focusing on competence-based training, skills development and job readiness.

The SHRDC training centre in Shah Alam is strategically located in the vicinity of Selangor's manufacturing and high-tech hub, occupying 40,000 square feet of space equipped with the latest technology and infrastructure to accommodate modern and effective learning. It includes labs, workshops and training rooms which are also available for rental.

The centre services the electrical and electronics, pharmaceutical, microsystems, oil and gas, manufacturing, smart factory, solar, ICT and aerospace sectors. Training programmes include courses in aviation maintenance, repair and overhaul; microsystems; solar technologies; ICT; Industry 4.0; leadership and change management; and engineering, design and mechatronics.

The centre is demand-driven, focusing primarily on the young pipeline of talent for industry – those about to enter the labour market. Malaysia faces similar problems to most Asian countries, with the labour supply chain having to play catch up with the immediate and future needs of industry. The SHRDC is vigilant on what works and what does not: pilots that work are rapidly scaled up and supported to ensure sustainability. The past ten or fifteen years are replete with examples of apprenticeships in industry, and curricula that are developed together with industry.

Responsibility for policy development on TVET and digitalization is shared between two main bodies that handle TVET: the educational/academic stream, which runs polytechnics, and the skills arm, run by the National Skills Council. The result is not optimum, with occasionally conflicting agendas. The government is aware of these lacunae and is now trying to streamline the process by establishing a TVET agency to drive the process. The policy paper has yet to be published for public feedback. Eventually there will be two distinct streams – academic and skills-driven.

The government's efforts at policy direction are rarely matched by seamless implementation. For instance, there has always been the belief that an efficient TVET system can resolve youth employment – but in a technology-driven world, all new jobs require ICT literacy at a higher level than that currently provided in foundation schooling.

At a societal level, there is no parity of esteem for TVET with academic pathways, which carry more status. This is not through a lack of awareness at the policy level: the Malaysian TVET committee has developed its own documents and makes frequent references to World Bank/World Economic Forum guidelines. But the social lack of recognition of TVET as a viable alternative to academic pathways inevitably means that TVET is not the learner's first choice. Neither will industry pay for TVET: TVET graduates invariably earn less money than their academic counterparts. This leads to a continuous cycle that cannot – but must – be broken.

In 2018, the Ministry of International Trade and Industry published a framework for Malaysia's Industry 4.0 (Ministry of International Trade and Industry, 2018). This may help change things by associating higher value jobs with digitalization and TVET. Malaysia has low unemployment, yet it still has a problem in that youth are not in optimal jobs and the country needs to do something about moving them up the value chain, and out of the wrong fields. Often, young people are happier working in a supermarket (which offers air-conditioning!) than a TVET career. The challenge is to have a strategy in place to move from low-value to higher-valuation employment: this cannot come about without a shift in the expertise of youth. For instance, Malaysia wants to attract investment in the aerospace industry; this cannot happen without young people with adequate training in this sector. There is a direct correlation between aspirations to move up the value chain and the training of youth: only by activating these relationships can Malaysia attract this kind of investment. The semiconductor industry experienced the same situation in the past.

There are no specific government or labour bodies responsible for digital policy in TVET. Organizations exist in silos. The whole TVET sector is primarily managed by a skills standards agency, under the Ministry of Human Resources. The Ministry of Education has its own TVET governance. The Malaysian Digital Council handles everything digital. It is vital that these organizations either merge when it comes to TVET or at least start to engage in discussions about TVET in a digital world.

One of the challenges in a digital world is that the framework, policy steps and governance developed were based on a non-digital world and have been handed down through generations. Today's classroom has not changed much compared to yesterday's. Compliance remains an issue, and assessment is still dependent on passing tests and exams. The system of evaluation also has to change.

The speed with which technology changes means that there are real risks of static curricula or curricula that are obsolete by the time a product launches. There is a need for a plug-and-play training system to mirror how the digital world operates – yet when you talk to TVET suppliers, they say you did not follow steps a-z in sequence! They still do not acknowledge the need for flexibility. Evaluation, validation – the whole system needs to accept a plug-and-play concept. TVET still needs compliance and assessment, but we are measuring using old ways of thinking.

The private sector can help drive the changes required. Culturally, the government is receptive to the labour market. The onus is on the private sector to demonstrate a model that works, in which case government can normally be relied upon to make policy changes and introduce funding for key areas.

Students these days are not keen to pursue a three- or four-year programme. This is a generation that learns on a needs and modular basis. Learners pick up something, learn it for their needs and move on. The TVET system needs to understand this new type of learner and preferred modes of learning. Inevitably, that means digital learning. In a similar vein to the labour market, the hope is that students will apply pressure to modernize the TVET system and those involved in it. A groundswell from learners could make change happen, particularly by focusing on the importance of plug-and-play models and digitization as an enabler of portable skills. There is definitely at the moment a generational gap being felt.

We are finding that we are becoming more and more open and that whether we like the term '4.0' or not, as a buzzword it does bring people together and makes them aware of the need for change. Industry 4.0 is a good way of getting to engage with target sectors and coalescing energies. Now is a very open time.

The SHRDC is currently looking at financing the TVET model by using 'learning blockchain'. There are excellent technical deposits of programmes already available within industry. If TVET stakeholders start to collaborate by sharing curricula, it is quite possible that different companies will come together and put their curricula into the 'bank'. Some blockchain learning concepts would help lower costs, cut out unnecessary intermediaries and make programmes more accessible.

Other examples may be found within the SHRDC consortium of companies. All the technical programmes (irrespective of levels and whether they are short- or longer- term) are run as apprenticeship models. Costs are lowered by around 50 per cent by applying this approach. At a bare minimum, industry shares the costs – but industry will not pay unless it benefits. This is possible now because of technology.

The SHRDC is working on digital apprenticeships by launching a two-year master's-level higher apprenticeship. Using technology as part of the process and working with a Swiss company, we are developing a plug-and-play remote-access curriculum. The technology can be set up in a common location, with students dialling/logging in from anywhere to learn. You also have shared resource sand assessments 24/7. The plug-and-play mode of small chunks of learning may become the future – bearing in mind that the curriculum is digital but also blended, with a hands-on learning component.

Apprenticeships on average require about 20 per cent of training to be classroom-based instruction. We bring mentors from industry to put together all the technology learned in a performance-based and user experience-based application. Again, the plug-and-play model is deployed.

We see two possible outputs with digitization. Digitization can open up personalized TVET. Industry 4.0 is all about mass customization. The second is optimization. That concept can transfer easily into TVET. We talk about cross competences. It will be possible for someone to customize their own cross-competence learning. For example, in our master's programme, learners can choose to cross over to other modules, such as IT. If a student wants to learn a skill that is not available through an SHRDC training module, we can link to it and put it into/at the disposal of our system. The net result will be that we move away from the prescriptive and predictive learning model. Flexible learning pathways should have a significant impact on the labour market, and employment statistics in particular.

Very little work is being done by institutions to follow up on what students are doing and how they are performing once they have graduated, or whether the training leading to the credential/qualification is being put to good use. Performance-based assessment is vital. With AI, in our digital world, this becomes possible. Can the workplace mentor be an AI solution? If so, then you can make TVET relevant to labour.

A lot of companies in Malaysia do not like TVET, as they find it is not being reflected in the workplace in terms of improved performance. Once they see this kind of new performance-rated assessment as opposed to exam-rated systems, the whole TVET world will gain momentum. Digital systems and AI in particular could help provide post-performance evaluation. If AI is considered to be brain science, we can start to investigate issues such as the length and timing of training programmes and the time taken to learn. Collecting the relevant data is one way of changing learning patterns and classes' start times. Gender-related AI data is very much needed to determine if females learn differently from males. Assessment should certainly become more transparent and inclusive.

Infrastructure has to be in place, and government's role here is vital, for example to provide bandwidth in remote areas to aid learning. Digital highways need to be built.

Digitalization can help address perennial problems with TVET if we adopt a learner-centric approach. If TVET offers them an extension to a more personalized life journey, it will be more attractive. We need to deliver TVET when, where and how learners need training. Digitization is one way of delivering on this requirement.

There is a visible disconnect in the classroom because of the introduction of technology, including mobile devices. Asking young people to switch off phones and stop using tech in the classroom will simply lead to alienation. If technology can be used in the classroom in the same way that young people use it daily, it can make TVET learning more attractive.

Office of the United Nations High Commissioner for Refugees (UNHCR)

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UNHCR is part of a connected learning and crisis consortium that involves a network of universities offering blended learning for higher and further education to refugees.

TVET is complicated territory, with broad definitions: it could range from the delivery of language classes to a six-month immersion programme for community workers. Digitization is inevitably blurring the boundaries between TVET and higher education. Insisting on these boundaries in the twenty-first century may be ill-advised or even lead to silos.

One of the issues is where does TVET start and higher education take over. Conceptually, UNHCR places TVET as a stage between secondary schooling and tertiary education. TVET originally was in our 'livelihood unit' and seen as preparation for employment. We now see TVET as a set of long-term programmes offered by national educational systems that lead to additional life, market and employability skills. For example, we do not use TVET to describe a one-week training course, but we use it to describe the kind of diploma that is recognized by employers and the market, and inevitably includes life skills.

Our role is to ensure that TVET programmes include refugees, in the widest possible context. Refugees should have access to all programmes nationally in their country of residence/of displacement, and that should include TVET courses, not just academic courses.

Refugees face a raft of challenges, such as lack of recognition of their previous learning, gender issues, lack of transport and issues relating to free movement. They may not be allowed or physically able to travel to a TVET centre. There are many barriers to their ability to access – let alone participate in – VET.

UNHCR is in a consortium with the University of Geneva to adapt quality guidelines in higher education for refugees – presumably, the same could be done with TVET. We see connected learning as not only being about using technology to connect, but also about changing communications, i.e. how can we get people not in the same physical space to learn together. That concept is not simply a technology related issue – it is a pedagogical issue that requires propensity to change by TVET operators.

TVET is not about language skills or the training of community workers, but rather the application of life skills to nursing and childcare, for example. Quality guidelines developed by UNHCR for TVET courses require face-to-face and on-site components, coordination, facilitation of exchange and follow-up after the course has been completed. Accreditation and certification are vital for all connected learning programmes to enable students to progress to a ‘next step/stage’ of learning.

Connected learning programmes are being offered by overseas higher education institutions in the United States and Canada to help bridge local gaps and provide accredited learning to take students to a local next step. UNHCR is working to ensure online programmes can offer a local context. For online education to become more credible and useful in the workplace, we need to move away from short-term courses and be able to provide a more educational pathway, with appropriate ongoing stages of learning. This means the ability and flexibility to move seamlessly from TVET to academic pathways, and vice versa.

Ethiopia has an advanced TVET system whereby students who attain Level 4 at TVET can then go on to follow a B.A./B.Sc. at a higher education entity. TVET and traditional academic institutions interlink in this case. The Ethiopian system is similar to the German system in that learners can start even with the short-term courses and work up to Level 4 TVET. At this level, students have attained the credentials to open a business, for example, or supervise others in the workplace. The pathway allows students to slide from one route to another.

With a digital TVET system, you can in theory digitize the content of all courses. The overriding view is that courses such as engineering programmes are more suited to blended learning approaches and are never going to be delivered 100 per cent online.

How permeable are those TVET organizations to those who do not have all the credentials? That depends on the country. In Ethiopia, depending on your education, you enter at different levels, but can go through the system even if there is no entry level that is suitable or applicable to refugees and displaced populations.

The biggest challenges facing refugees in accessing TVET are as follows:

- ▶ TVET schools and centres may not be where refugees are, i.e. in remote areas.
- ▶ There is a lack of transport or accommodation near the schools.
- ▶ Refugee status and other legal issues may deny refugees from being legally allowed to work even when they have obtained TVET qualifications.

The future of credentials and connected learning is dependent on countries recognizing each other's TVET qualifications and giving digital education parity of esteem. TVET needs to collaborate with professional unions and the labour market to ensure such recognition takes place. There needs to be a process of TVET equivalence in different nation-states. Refugees have to work around national government policies on higher education to have their existing credentials recognized. Canadian academic institutions are offering credentials that are a stepping stone to admission to a local university (as in Ethiopia's example) and to the next level of learning. Partnerships between local and overseas universities need to look at entrance-level policies. This are clear examples of connected learning helping at the local level.

To date, UNHCR has only been dabbling in TVET – the focus has been more on higher education in our connected learning work. We recognize at the policy level a lot of scepticism about the quality and rigour of online programmes. In Lebanon and Jordan, we have been bringing together actors to reach this cooperation and consensus. Governments know they need to link to other actors, like unions and employers or labour representatives.

In Jordan, the Ministry of Higher Education is interested in the TVET space as it has a new policy on future work opportunities to prepare the new generation of employees. The Ministry has allowed 25 per cent of a programme to be online; most of the time the prevailing notion is that certain courses can be online, but not others – but this is before policy-makers and those responsible for curricula understand the breadth possible with online programmes.

Competence-based frameworks can be adopted and understood more readily by employers. The labour market can identify students' achievements and see what they have attained in a discipline. Traditional higher learning is more nebulous – take English or similar subjects: what can students actually do with such qualifications? Competence-based degrees, such as those with a business element, can easily demonstrate students' capabilities to the labour market. In Rwanda, Kepler is offering higher education degrees that use blended learning and facilitate fully online internships in subjects such as translation or communications. Rwanda is positioning itself as supportive of technology-based work; this is one country where the labour market can be engaged to support digital TVET. Examples can be found on a small scale with SMEs interested in facilitating online employment. This is good for refugees who could work digitally or for an international company in areas such as design, translation and other digitally delivered services.

There are many barriers to digital work for refugees: they are unlikely to have a bank account, so they cannot receive money. Sometimes, they face very practical barriers: residency status, tax issues, etc. But digital employment has a huge potential to help refugees.

In the case of competence-based learning models, it does not matter if it is digital or face-to-face learning: the important thing is to look at the learning outcomes. Lebanon convened a round table to discuss competence-based online learning. Participants at first doubted its efficacy and credentials, but they changed their minds when they saw it is more about what students are capable of doing. Online learning is often even more rigorous than face-to-face lectures.

When it comes to deciding whether to start with pilot case studies to push the discourse to government, or whether to engage directly with employers and the labour market, education and TVET systems are regulated by governments, so accreditation is dependent on recognizing the role of government and their agencies. But it is possible to start with small training programmes and then bring in employers as partners to prove the validity of the coursework. Conversely, unregulated TVET can be perceived as going against national policy and will inevitably fail. The sustainability of TVET/connected learning depends on the ability to convince government bodies: change can then start to happen much quicker.

The digital divide is not getting any narrower: on the contrary, the world is becoming more digitally biased. Economic inclusion and job opportunities in careers and educational pathways require digital competences and digital skills on a social level, yet access to digital programmes is not necessarily happening through schools, and hence the divide is deepening. Integrating digital learning into programmes to develop competencies and skill sets is vital. We need to adopt this mantra: 'Use technology to teach, do not just teach about technology.'

Kepler provides wraparound programmes. The Colibri Learning Foundation is a not-for-profit development organization dedicated to releasing the potential of immigrants to Canada (including newcomers and temporary residents) to engage in the process of community-building. The Kolibri Learning Equality Platform works with legacy devices, offering tools that provide aids for cognitive and physical impairments and can also be adapted to lower-resource contexts, helping overcome some of the infrastructural barriers (Learning Equality, n.d.). For instance, the lower-resource content tool includes technology that shrinks files and then delivers content in a suitable form to mobile devices. Members of the UNHCR consortium on connected learning are working on approaches to configure the back end of

training systems to ensure they can handle larger numbers of users on a network (and hence facilitate access to larger groups).

Connected learning is also about teams and working together. Tools that help people access information and connect, participate in discussions and find solutions, and also express opinions are important. This kind of collaboration/group work can be both digital or face-to-face.

There are many examples of digitalization facilitating new learning processes for refugees.

► The liberal arts university enabled them to connect with refugees in Cuba. Students reported they were learning to challenge each other, find information and become independent citizens. It was a very impressive outcome – citizenship/soft skills/life skills and digital literacy rolled into one course. Refugees would not have had access to that kind of thinking and approach in a traditional learning environment.

► ‘Leadership for Syria’ is a programme funded by the German Foreign Office and facilitated by the German Academic Exchange Service, a German civic education organization. The programme focuses on leadership skills and democracy and is delivered in a blended learning format. Students/refugees do not normally have this opportunity to voice opinions, and this course enabled them to learn vital thinking and critical civic-education skills. They saw this as the most important learning outcome, rather than just the engineering course or other subjects they followed.

► Also in Germany, Konstanz University offers civic-education courses that secure refugees the European credit transfer and accumulation system (ECTS) accreditation, which can in turn be used as credits in traditional academic programmes. ECTS is a bridge between offline and connected/blended learning.

► Finally, the online learning platform Coursera offers courses that have been packaged for refugees.

Learners need to become critical consumers of information: Teaching TVET students to search for and evaluate sources is vital. The more online content is made readily available, the more these skills are necessary, irrespective of whether you call these soft skills, digital literacy or twenty-first century skills. Intercultural competencies can be acquired more effectively through digital means. Intercultural perspectives and connections are vital and clearly correlated to the affordances of connected learning. These skill sets are not only relevant at the post-secondary level, but also in secondary schooling.

The titles of digital programmes can often seem vague, yet they generate a strategic new pedagogical approach and are appropriate for exploratory and enquiry-based learning, where the mode of delivery is different.

Recognition and equivalency are both important and challenging, as are national government-controlled areas. Students do not usually have all their credentials in their possession when they arrive in a country, and the receiving country may not recognize them at the same level if they do. UNHCR and UNESCO are releasing a paper on the challenges of recognizing migrants’ credentials in the higher education sector (UNESCO, 2019). The lessons from this exercise can surely feed into TVET. It is vital not just to secure local recognition for credentials, but also to link local frameworks to national and international frameworks: advocacy on recognition of credentials at the national and international levels is as critical as exploring the potential of, e.g. blockchain for notarizing of digital credentials.

The following table was submitted by UNHCR after the online interview (Table 2).

► Table 2. Features needed in TVET programming for forcibly displaced persons

CONSIDERATION	DETAILS
Market orientation	<ul style="list-style-type: none"> design new programmes taking into account the current and emerging needs of the local market and the recommendations set out by available market evaluations or assessments that identify and anticipate the specific hard and soft skills needed to successfully engage in employment opportunities realign existing programmes and certification, as needed, to the current and emerging needs of the market so as to maximize gainful employment of graduates end support to programmes that do not follow a clear market orientation
Inclusion	<ul style="list-style-type: none"> ensure that refugees, returnees, asylum seekers and stateless learners have access to programmes within national TVET systems ensure that refugees, returnees, asylum seekers and stateless learners are treated the same as host-country nationals with regard to tuition fees, access to internships and other opportunities facilitate policy development and programme flexibility to allow recognition of prior learning and qualifications in order to eliminate barriers to accessing TVET design curricula to facilitate mobility and portability of credits across institutions advocate for inclusion of refugees in the formal economy, including labour protections, remuneration and financial services include host-community youth in TVET programmes that target refugee students
Support services	<ul style="list-style-type: none"> provide or assist in locating suitable bridging, language or remediation courses to enable programme entry sensitize learners and parents to the advantages of TVET as an alternative to university or other tertiary education provide formal orientation courses with a focus on protection considerations provide academic, career and psychosocial guidance to support TVET learners as they make decisions about coursework and careers before, during and after enrolment ensure that mentorship structures are in place to provide individualized advice to learners from more advanced students, professors or private-sector volunteers
Accreditation	<ul style="list-style-type: none"> ensure that existing programmes are nationally accredited make sure that new programmes are both nationally – and preferably internationally – accredited, having designed and aligned their qualifications frameworks with a view to regional or international mobility
Teacher training	<ul style="list-style-type: none"> develop and implement competence frameworks for TVET professionals provide pre-service, TVET-specific teacher education that includes training on issues of relevance to the needs of refugee learners support continuing professional development (CPD) of TVET teachers and trainers
Life skills	<ul style="list-style-type: none"> facilitate essential skills and competencies through collaborative learning approaches equip learners with effective communication skills for writing, speaking and presenting, as well as digital media skills develop digital and information literacy as it relates to the learner's specialization instil empathy and appreciation for cultural diversity teach critical thinking skills and examination of multiple perspectives
Technology	<ul style="list-style-type: none"> improve TVET delivery through integration of ICT where applicable ensure that facilities have connectivity and students have digital access to a variety of supplementary content make sure that institutes are equipped with the current technology used in the workplace
Bridging to the labour market	<ul style="list-style-type: none"> with external actors: <ul style="list-style-type: none"> provide incentives to employers to create inclusive workplaces advocate for access to services that support entrepreneurship/self-employment; ensure meaningful on-the-job learning experiences and partner with the public and private sectors to connect learners to entry-level work negotiate for paid training, apprenticeships and internships (even at a reduced rate) that are closely aligned to individual specializations with students: <ul style="list-style-type: none"> assist learners with job placement support entrepreneurship or other self-employment ventures provide courses or instruction on job hunting, CV writing and interview preparation provide formal instruction on financial accounting, networking, marketing, business planning, and other core entrepreneurship skills
Cross-cutting considerations	<ul style="list-style-type: none"> gender equality: ensure girls and women have equal access to TVET programmes and avoid isolating girls in gender-biased programmes, e.g. sewing or hairdressing environment: design programmes for environmental sustainability and green jobs innovation: explore opportunities for blended learning delivery methods to promote flexibility and access
Partnerships	<ul style="list-style-type: none"> build active partnerships that engage: <ul style="list-style-type: none"> the private sector in curriculum design, employment and internships, commitment of expertise and time, and in-kind or financial donations the public sector in advocacy, policy and linkages with secondary and tertiary education systems civil society in advocacy, community integration and employment opportunities development partners that support the national TVET system support TVET programme partners with outreach and selection of qualified students, and ensure that staff are trained on protection considerations

► Annex 2: Country Observations on Digitization of TVET and Skills Systems

China

Professor Zhao Zhiqun, Institute of Vocational and Adult Education, Beijing Normal University

China wants to realize a modernization of TVET. The Chinese Government has been promoting the development of TVET and its variants for many years (Zhuang, 2018). It is striving to improve the training quality of TVET, achieve educational-resource sharing, and promote the innovation of teaching and learning modes in TVET.

TVET in China is associated with achieving educational equity, saving money, securing improved ROI and improving efficiency. Typical technologies being introduced for this purpose include office automation systems, big data and supercomputers.

China has been paying attention to Industry 4.0, but it is still in the exploration stage. The organizations responsible for digital policy in TVET are the Ministry of Education, the Commission of Industry and Information Technology, and the Ministry of Human Resource and Social Security. For example, an academy is being set up for robot technology, and the government is organizing a competence competition in IT for teachers and trainers in TVET.

The digitization of TVET is meant to support policies in other areas, such as innovation, regional policy, unemployment and labour policy, and attraction of foreign direct investment (FDI). Office automation is part of a wave of new forms of management facilitated by digitization.

Social partners – particularly enterprises and industry organizations in the field of IT – are involved in discussions around how TVET can respond to digitization. The Chinese are implementing many programmes and projects with these partners. However, the status of these social partners is weak – they are usually project managers or implementers, and not involved in actual policy-making. So there is a disconnect.

New or special financial allocations have been made to enable digital transformation – China has specific funding programmes for TVET, and policy-makers believe that digitization will inevitably raise the quality of TVET. China has increased enrolment and strengthened post-job training through the open universities.

However, digitization does contribute to digital divides. The government is trying to solve this problem through teacher training in IT. New forms of learning in TVET enabled by digitization are associated with blended learning – there are many online resources compared to the past. There is a palpable investment in distance learning courses, resource libraries and network resource libraries. However, the utilization rate of these resources is low, and the impact is not obvious.

Digitization is changing the kinds of skills that are taught in TVET, by increasing the quality and quantity of course content and strengthening the information capability of students. Because of digitization, mastering IT is becoming more important, as is the ability to quickly search for information online. The tools are changing, and the ability to adapt to changing tools is also important.

Blended learning is the most important systemic trend in teaching and learning being accelerated by digitization. Specific technologies in teaching and learning that are changing the way teachers teach include microlectures, special apps and websites such as Moso Teach and Ketangpai (www.ketangpai.com). The technologies that appear to have the highest impact on TVET staff include mobile

communication technology, like WeChat and Ding Talk. Almost every TVET staff and student in China has WeChat, and most important notices are usually sent via WeChat.

TVET teachers need to master the skill to use these technologies. The ability to quickly find knowledge through IT is increasingly important. The tools are changing and the ability to adapt to the tools has to change.

Education departments or TVET schools organize training on IT for teachers. However, many teachers remain passive. Teachers need to master stronger digital ability and secure further information if there is going to be systemic change in teaching and learning – or at least an acceleration due to digitization.

Digitization opens up new pathways for obtaining TVET, in particular through changes in modes of study, duration of study, and place or time of study. For example, the place and time of study in an open university is more flexible. China hopes to achieve resource sharing by using online learning resources – but for most TVET schools, the modes of learning have not changed much. We are still in the early stages of this potential period of transformation.

Digitization opens up new ways of doing quality assurance. The Ministry of Education has established a relevant diagnosis and revision platform (Ministry of Education, n.d.). Quality assurance systems take digitization into account and feature some quality criteria about digitization.

Yet digitization and datafication in particular can also be associated with a permission-based and surveillance society. China has a culture whereby it is fine for training sessions to be recorded. In France, people would go on strike; in China, data are processed as an operational norm.

Digitally enabled flexible learning pathways do not have a significant impact on access, employability or other social policies. Digitization is not necessarily allowing for new ways of improving labour-market relevance through actions taken before, during or after studies.

Digitization does enable new ways of doing guidance in TVET, e.g. through recruitment websites such as www.zhaopin.com, www.chinaHR.com and www.51Job.com. Digitization is deemed to reduce the need for guidance and change the very notion of what constitutes guidance.

The attractiveness of TVET has not changed much. The link with the labour market is closer, qualifications have changed, and the government provides more funding. But technology cannot help address historical/structural issues related to the perception of TVET in China. Perception is very much linked with economic, cultural and social capital.

Nowadays, by contrast – and partly because of globalization – the attractiveness of TVET in China is reduced, because more and more young people want to go into formal higher education – and if possible foreign universities – and follow academic pathways.

Ghana

Professor Martin Gyambrab – Director, University of Applied Management

The TVET sector in Ghana is evolving, with several reforms underway at all levels of education in the country.

Change in TVET in Ghana is happening organically. There are several scattered pieces of government publications that infer government TVET policy to guide the sector and make it more relevant to the labour market. There are also various organizations, such as the Council for Technical and Vocational Education and Training, which are at the forefront of TVET reform and whose annual reports often include policy initiatives. There are policies on apprenticeships and work-placed experience learning and various opportunities for engagements that hire young people. There are also reforms trying to get people with disabilities in the workplace. There are programmes in place to recognize prior learning, focusing on specific technical skills that are gathered informally. For instance, in the case of the transport and construction sectors, people can learn a trade using informal systems.

There is a youthful, unemployed population – and the government is trying to get these people into meaningful employment. There is also a situation where people with academic qualifications are not finding work – and the government is rolling out TVET as a means of trying to inspire entrepreneurship.

Mitigating action includes the work of the Youth Enterprise Authority. Young people can benefit from loan arrangements to try and stimulate an enterprise, self-employment and start-up culture and also trying to encourage people in formal institutions to rely on such skills.

There has been an internet penetration boom as well as mobile phones – one of the highest in Africa. Data is available and young people do have access to reasonably affordable smartphones. So, there is the opportunity to integrate digitization into TVET. There are a couple of government initiatives to support these drives, but these are not comprehensive. In 2016, the government introduced the 'integrated E-learning laboratories' project targeting senior high schools; 240 senior high school e-labs have been set up. The government has also taken up a €13.2 million project loan from Belgium as part of the e-learning project, driving digitization. The TELEVIC project provides the technology backbone, and the 'E-transform' project aims to provide secondary school digitization. At tertiary and higher TVET, out of ten state polytechnics, eight have been transformed into higher education TVET institutions. Not all of the processes have been digitized in these institutions; there is still an over-reliance on traditional tools, pedagogy and in some cases, paper practices.

The linkages between TVET and technology remain tenuous because of policy silos. Policy-makers do not necessarily collaborate or talk to each other. The Ministry for National Communications is driving the country's technological development. While it drives the overall sectoral strategy, it expects each sector to tap into the infrastructure. An e-governance project has yet to reach a maturity stage. There is a vacuum, in that the country is still missing some central authority that can develop and deploy a uniform national strategy, sector by sector.

Industry is calling for graduates with specific skills. When it comes to manufacturing and technical skills, there is an emerging mining, oil and gas sector that brings specific requirements for specific field skills. Some companies have to import experts from outside Ghana. Social partners are supporting TVET colleges by donating equipment and providing ad hoc expertise.

Competition among TVET institutions is coming about as a result of digitization processes.

There are more career-centred programmes: industry is dictating the fields and expertise it needs. TVET colleges have no choice but to change and refine their programmes to align them to the labour market. These changes are happening because of pressure from the labour market.

Institutions are using blended learning to ensure parity of esteem for online programmes. The institution plans face-to-face sessions and students have to show up for assessments.

There are attempts to synchronize TVET qualifications. People still have a perception that TVET may be inferior. To create parity of esteem, institutions are going for blended learning. There are fewer online and more blended courses. That is the workaround required to address the prejudice against digital TVET.

Regulatory frameworks for accrediting distance learning institutions are still under development. Unfortunately, assessors are still using traditional tools – they are looking for bricks and mortar libraries. The institution has to find workarounds, with physical presence with seminar rooms and administrators, even if the programmes are being delivered online. The regulators have to be educated and they are being encouraged by the labour market to update their quality assurance and accreditation practices.

Institutions are using learning management systems (LMS) to assess course materials, webinars are organized for group discussions, and Skype is used to manage students who are very far away from the campus. LMS make course materials accessible, lower staff costs and make students feel part of a community. Looking at literature and organizing presentations also opens up the staff's world view. Digital education can change the dynamics of teaching. It makes students more aware of what constitutes good teaching and what does not. Digital natives have the tools to become more critical of the quality of TVET and the potential ROI of their learning pathways.



There may be transformations in the teaching and sharing of experiences, and securing overseas experts to actually teach a module of a course. There are opportunities for sharing expertise. We can get around the challenges of time and place. People who have something to teach but do not wish to embark on a full-time teaching career can also contribute to the TVET sector, for instance with e-logistics – without technology, you would be limited to your own environment. Students can now take bachelor's courses and fine-tune their careers to fit their objectives. Mature students can be exposed to a lot of expertise they would not have had access to the first time around.

Digitization does open up new, flexible pathways. With a concentrated effort, communication campaigns can be developed to make people understand that digital TVET opens up employment opportunities.

You are better able to improve on quality systems if you are exposed to better systems than the ones you are used to: that means knowing about better experiences, processes and ways of doing things. Students have been known to get frustrated by their experience of the traditional environment. The world moves on, and yet the end product is still what it is. Digital learning enables people to challenge the processes and consider new benchmarks by looking at competitors – even looking at other institutions' websites can help! Most quality assurance regimes are still looking at traditional processes, and then try to apply them to a digital environment.

Students have sometimes asked for traditional course materials to be dropped in return for real-life case studies. This is a direct result of digitization. It is forcing educators through this pressure of digitally connected students to change materials and approaches, and ultimately improve the learning outcome. This will eventually filter into better guidance procedure. Storytelling as a way of really grounding TVET in the real world is an option that should be considered; so is incorporating YouTube material in the curriculum.

The government is aware of the need to become militant and support change and the demands of young people in their search for meaningful employment. It is aware of mobile internet penetration, smartphone sales and a lack of return on its investment in traditional education. Even in national elections, there is already a system where tribal communities can vote via digital workarounds, and making them faster than the traditional systems in place.

Digitalization has increased students' awareness of quality, and they will demand more from service providers, institutions and the labour market.

A new era of entrepreneurship is underway through the start-up economy. People are relying on new media to rebrand and package themselves on labour sites such as Jobberman (<https://caihub.foundationccc.org/>). Job boards are mushrooming online.

Typically, marginalized groups such as migrants, females and people with a disability are the last to be provided with access to TVET programmes. This is a global phenomenon and a major barrier to delivering inclusive TVET (ILO, 2017).

'Bring-your-own-device' schemes are also being explored. Universities do not have to invest in technical infrastructure other than broadband and relevant content, such as scripts, videos, OER or repurposed material. This concept is due to digitization and enables people to access larger groups.

Digitization improves TVET access – that is an obvious benefit. Job mobility will be improved: digitally proficient people have a market value, even if the market is not outside their door.

In sectors where there is limited local expertise, a country can access these skills online, with clear benefits to the labour market.

While some countries are still thinking of using digitization, Ghana will keep investing in technology to try and upskill its labour market and move up the value chain.

Kenya

David Maduri – Founder, Refuge Network and Ainves

In Kenya and many other African countries, there is a predominantly negative perception of TVET programmes as being inevitably inferior to traditional academic pathways. There are issues relating to access, equity, quality and relevance that are contributing to this long-standing situation in the country. TVET is normally taken as the last option and not as the preferred option or choice of most Form V graduates in Kenya.

Enrolment levels at TVET institutions are low. There are few properly trained TVET teachers, both professionally and pedagogically. There is a lack of clear admission and progression structures in TVET. Career guidance is poor, even when conducted for people with basic education or even limited access to education. Career advisers inevitably position progress to a university education as the desired outcome for young people, as opposed to pursuing a TVET pathway. This has much to do with branding, where TVET is perceived as an inferior alternative to academia and unlikely to reap a ROI.

TVET institutions suffer from a lack of infrastructure and equipment. This is also reflected in outdated curricula. Curriculum reforms are definitely not in phase with emerging technologies or the skills needs of the labour market. Yet the cost of technical vocational training remains relatively high.

There is no national qualifications framework, with a knock-on effect on weak TVET examination and competence assessment procedures.

Kenya has a general problem in that many graduates out of the formal higher education system find no meaningful work opportunities in labour market. The jobs to which graduates aspire simply do not exist. To get a job means having access to an offline network and social capital. Young people that are new to the job market do not have access to either.

The Kenyan Government has been trying to change the formal approach to education to a more informal, practical method built on praxis. This means getting the entire country into a training mindset. There is a situation where top students who are great academically and students who are not as good are all ending up in TVET institutes to learn basic skills and try and get off the unemployment register. White-collar jobs are not proving as attractive as engineering.

Against this rudimentary TVET background, start-ups are connecting the formal economy with the informal economy and considering using blockchain for connections. Kenya is a major tech hub, together

with South Africa. In recent years, there has been support from the Ministry of Technology to set up co-sharing workspaces and hubs, in the hope that this will create an ecosystem that will also attract external investors and help change long-standing paradigms on what constitutes valuable education and training.

The informal economy is creating eight out of ten jobs globally. When M-Pesa came into Kenya, it came with the traditional model, but soon realized it would not work in the specific sociocultural context. M-Pesa learned that when the economy is set up in a very informal manner, when every single person is more into scratch and prepaid cards that can be purchased in person from the corner shop, the business model has to adapt. Although M-Pesa is still controlled by the government, you will go into slums and you find M-Pesa everywhere. The mobile market in Kenya has been very much driven by this combination of new technologies and business models adapting to long-standing practices.

The informal economy runs the country – not necessarily in providing tax revenues to the government, but in that it feeds families. There are huge gaps between the informal market and the global economy. There are so many pharmaceutical firms that sell their products through the informal economy and peer-to-peer (P2P) systems in slums and are acceptable in traditional lifestyles.

We need a better ecosystem, where technology such as the blockchain enables us to control these transactions – an ecosystem that supports business credits and access to resources. The new ecosystem needs to be supported by external funding from the global economy – that is a market potential of USD 11 trillion. It can only happen through digitization – from micro-payments to a blockchain-empowered ecosystem that can tap into a latent market. We start from micropayments – can they enable people to have access to learning?

In Kenya, M-Pesa is a cash, digital and credit card. All payments are micropayments, from buying candy to paying school fees and digital transactions – virtual payments that were not here five years ago. M-Pesa has contributed to a huge wave of change, which most citizens associate with the affordances of mobile technologies. TVET needs to modernize by looking at examples like M-Pesa; it also needs to go mobile.

To have an idea of what is possible in the future, do not look at the rich kids, look at how mobile has changed the lives of ordinary people. Five years ago, only the privileged had a smartphone – now everyone has one. Mobile has to be the driver of digitization, in the same way that blockchain and distributed ledger technology (DLT) will drive the future.

If technology means that nobody can rob you, that is a game changer for the informal economy. The informal economy could be run by digital transactions on DLT – that is the future.

The biggest challenge to the Kenyan economy remains unemployment and miseducation: neither of these are necessarily linked to the state or the needs of the labour market, or even linked to the changes needed in the labour market. There are people who have never had access to any form of education. Kenya does have a TVET authority and leads skills training. In slums, a hairdressing institute is not necessarily available. There are institutes that are using technology for quick training – but if you have EdX on your phone, that is probably more useful. But a lot of people do not even know that these MOOCs exist! That is a huge challenge.

The only sector that is benefiting from digitization is agriculture – but most farmers are not literate, let alone technologically literate. You need someone who is academically literate to understand how technology can be used for sustainable change in the sector. Most people believe that using a phone is not the same as being able to use mobile technologies strategically. A farmer needs help from someone else. The TVET sector is still a by-product of the academic sector, with the same problems.

Even if the ILO were to subsidize online content for specific sectors – such as agriculture – you are still subject to culture, doing things in a certain way. Educated people are too ignorant to realize that they are looking for formal jobs when the economy is driven by the informal economy. In the case of technologies that are either advanced (e-commerce) or in their infancy (blockchain), citizens will still find reasons to resist take-up until there is a very compelling reason to change current practices. The fear is that the

government's or even the labour market's efforts to convince them that digitization will bring them a vastly larger market share may take decades to come about.

Policies set by governments are built on existing social capital and are inevitably top-down. The ecosystem is based on something unrealistic, where 'formal' and 'informal' economy simply means 'adapting for survival'. The government does not see value in the informal economy and only sees digitization within the context of the formal economy and formal education.

Technology has made inroads to get people paid for their services, but mobile has still not been adapted for TVET learners, and traditional VET skills are still dependent on face-to-face teaching and learning – often in a very informal environment. Mobile phones are for voice calls, mobile payments and social status, as opposed to the TVET opportunities the technology presents. It becomes a structural strategy to make that change, and needs-inspired central leadership – or the labour market – to disrupt the teaching institutions.

How can we make emerging technologies compelling to the informal economy? Twenty per cent of the population knows that the smartphone can be used for Uber or audiobooks, but the remainder has no idea. There is a stark divide – and this needs a seismic change in culture. The challenge is in securing, promoting and driving this basic literacy in all facets of society, starting with primary school. If this is not done, then digitization and TVET will just remain 'a project', as opposed to delivering real change in people's lives.

Malta

Vince Maione – Director, National Skills Council

Government investment in TVET is assumed to have a direct correlation with economic performance and reducing skills gaps in specific target sectors. Education and technology (blockchain, AI, etc.) are associated with improvements in the skills base.

Digital TVET policy is primarily driven by the Ministry of Education and Employment, supported by the Parliamentary Secretary for Digital Economy within the Office of the Prime Minister.

The needs of Industry 4.0 still have to be understood – but the establishment of the National Skills Council indicates that public policy is getting aligned with TVET. Nevertheless, the link between TVET and other areas, such as innovation, regional policy, unemployment, labour policy and attraction of FDI is weak.

The issue of educational certificates using blockchain technology is an early indicator of the government's support of emerging technologies and their deployment in core TVET 'needs' areas, such as credentials.

Social partners are regularly engaged in discussions on how TVET can respond to digitization through representation on committees and councils. They have always fully supported the digitization of TVET but are increasingly putting pressure on the government to acknowledge the need to train properly some of the key players in the sector, including teachers and administration staff.

Marginalized groups' access to TVET is perceived to improve their skill sets through the use of simulations, AR and blended learning (particularly at MCAST) – although there are no available data to support this assertion.

In principle, digitization should create a need for re-admissions to lifelong learning, but to date, only marginal effects are seen. Digitization can certainly empower people with physical disabilities. The fact that people can access TVET in their own time allows marginalized learners to cope better. Simulations and AR are extending the use of 'workshops'.

Digital divide challenges are being addressed by presenting digitization as a key subject to all students and intensifying retraining programmes for adults. New forms of learning in TVET are possible by extending the classroom use of gamification. AR may well become a very effective instrument within simulation contexts. Simulations have been in use for some time and have a significant impact, since

parameters can be changed on the fly and various types of solutions can be tried at no extra cost. Digitization should change the kinds of skills taught within TVET institutions. TVET is not 'hands-on skills alone' but needs to be supported by knowledge and a high level of thinking skills. The fact that through digitization many different types of virtual experiments can be tried and tested allows more use and development of thinking skills.

Information management is a key skill. Some manual skills will become less important because of digitization, but this is very much dependent on the specific sector. Communication skills are extremely important, but the mode of communication in the digital age has changed. Media literacies, for instance, need to be incorporated in CPD programmes. Similarly, mobile technologies are slowly being used to update curricula.

Digitization must open new TVET pathways through changes in modes of study, duration of study, and the place or time of study – the most obvious change being the emergence of online learning.

Digitally enabled flexible learning pathways have a significant impact on access. The acquisition of relevant qualifications is still a prerequisite for meaningful employment.

There are no data available yet to indicate that digitization opens up new ways of doing quality assurance. Quality assurance systems in TVET are not taking digitization into account – an indication that quality assurance policies are slow to change. In some cases, the process of accreditation has actually hindered the uptake of perfectly suitable online courses.

Regular analysis of skills gaps surveys can influence changes to training and curricula.

Using good LMS and learning analytics, better guidance is possible. Digitization does not specifically require more guidance, but in practice it induces it and changes the nature of guidance. Digitization may improve the attractiveness of TVET, since working with digital equipment is perceived to be closer to 'white-collar' than 'blue-collar work'. Also, qualifications are more easily available.

Mauritius

Ricaud Auckbur – CIO Ministry for Education, TVET expert, Mauritius

The government is developing policies that recognize a need for systemic change and may resonate with target stakeholders. However, Mauritius first has to address significant barriers to accessing the affordances of the digital economy. For instance, we need to provide high-speed connectivity and Wi-Fi and tools that can support twenty-first century teaching. We intend to solve the connectivity issue by end 2020.

Irrespective of this, we need to address marginalization in all its forms first, before addressing TVET. Parents and students may have a smartphone, but there is a cost to connecting that phone to the internet. Until all parents and students have cheap connectivity, systemic change is difficult, if not impossible.

Changes to curricula in recognition of the need to encourage digital skills are not enough. There are basics that need to be addressed, such as using mobile as the primary interface and developing TVET-related apps. A school companion app that can be accessed by both students and parents has been developed for secondary schools. Right now, the app is only available to students on academic – not TVET – pathways, but it can be extended to TVET students with a minimum of investment.

It is uncertain if digitization will actually lower the cost of TVET. It can support it, but there will still be a cost to produce the TVET resources, and TVET by its very nature cannot avoid tech. Digitization will help to communicate and disseminate TVET, but the cost will not be lower.

Local content for OER is ideal and can be repurposed from international OER. Curricula have some exposure to digital tools and OER, which are in their infancy in terms of technology in the class. There is a low digital divide, simply because of the 'low-tech' teaching approach. The situation is much better in terms of connectivity within the labour market and within private educational institutions.

The government is very much reliant on the labour market to invest in both tech infrastructure and apprenticeships.

New Zealand

Terry Neil – Education Specialist, Technical and Vocational Skills Development, Commonwealth of Learning (COL)

New Zealand has a rich heritage of distance learning and VET. The first time the country established the need for a qualification in order to work as a plumber was in the 1900s. The Open Polytechnic was founded in the 1940s to conduct the vocational training of apprentices. It is New Zealand's only specialist provider of open and distance flexible learning at the tertiary level. It helps adults who need to gain vocational skills for their current or future career while still remaining in the workforce.

Technology must be used to benefit learners and the future workforce. New Zealand recognizes the rapid changes it is enabling for industries, business and employers. It also means that some jobs and careers are fast disappearing, while new specialized fields are emerging. The field of education has a significant part to play in ensuring current and future workforces have the new skills employers will need, and that its graduates can adapt to future shocks to their career pathways caused by technological changes.

Open Polytechnic is committed to moving to a fully digital model to maximize the benefits of technological advances to the distance learning experience. Open Polytechnic has the following objectives for its learner experience:

- ▶ convenient: giving learners greater choice about when and what they can enrol in, the pace of their learning, and how they will be supported
- ▶ relevant: offering a more personalized learning experience that can be self-directed, is supported by learner analytics, and meets current and future industry needs
- ▶ connected: so that learners can engage with interactive courseware and access their learning community, as well as having access to a tiered system of support
- ▶ smart: using feedback and data to improve the learner experience

Technology can change the rules of TVET like it has in other sectors – just look at how paper-based processes are being changed by technology. Yet TVET is complicated territory in that it happens in all forms, at all levels of life.

If we look at formal qualifications, New Zealand has a legacy of recognizing skills. The national qualifications framework and the creation of industry training organizations is unusual: they perform the roles of skills councils in establishing occupational standards, they moderate institutions' assessment tools and they also oversee on-the-job training. They are 40 per cent funded by industry and support the training that is happening in industry.

The boundary is hard to define between higher education and TVET, and depends on funding. With the move to e-learning and the use of technology in a broader way than just delivering theory, the boundaries are even more blurred.

Industry 4.0 tends to be associated with the trend towards more automation and the potential of AI and cloud-based computing.

There is a need to demonstrate live case studies as models for evaluation – but it is too early to provide evidence that distance and technology-enhanced learning does add value. TVET is always a poor relation to higher education in terms of research – even when it comes to the compulsory sector. It is also challenging to persuade the labour market that these studies are worth funding.

It is becoming standard assessment practice in TVET that assessments are partly carried online. Open Polytechnic is working to remove the need for textbooks for its online courses, further reducing the costs of study for learners.

An active player in digital TVET is MITO, an industry training organization that designs qualifications and training programmes for the automotive, transport, logistics, industrial textile and extractive industries. MITO also provides leadership regarding skills and training needs for these industries in order to enhance careers in their workforces and increase workplace productivity, innovation and sustainability. MITO advises that learners are happier in having their phones with them in a class. Learners can ask questions asynchronously and have these answered coherently at a later time. Automated feedback on an assessment is contributing to learners' understanding. Mobiles are being incorporated in the quality of praxis, as a primary interface. In the change from face-to-face to online, from print to online, it is vital to migrate online using a top-down approach. MITO's Board just pushed for change – but in this case, you are looking at industry representatives driving the change. The assumption is that technology will make us do things better.

We need to rethink the roles of human beings in the teaching and learning processes. The power of the academics is inevitably changing – they have needed to become a blend of coach, subject expert and motivator. Perhaps these functions can now be de-coupled from the one individual. We can get increased quality and decreased costs. This is a business process re-engineering approach to industry training models.

The ITF represents New Zealand's recognized industry training organizations, with an Independent Chair. Another player takes the lead in promoting the merits of digitization as a means of increasing the profile of the TVET sector. Digital TVET is positioned to encourage young people to follow industry training as a means of securing meaningful and rewarding employment, and responding to New Zealand's skills shortages in the process.

Micro-credentials are being recognized as part of New Zealand's qualifications framework. Industries have been looking for new and more flexible ways to recognize skill sets developed in response to changing technologies, employment structures and work requirements. The future of work it is that people will need to upgrade skills throughout their careers. Qualifications will remain important, but micro-credentials will help people have their additional skills recognized and will be a more efficient way to recognize additional skills and specialities, especially those gained through the workplace. Industry is enthusiastic, and the industry training sector is looking forward to more flexible and efficient ways to develop workforce skills through micro-credentials.

The history of distance learning has always been about access – especially for people in remote places and islands in a rural context. The Open Polytechnic was created as a technical correspondence college providing access to people in small towns who needed to build up skills. There is a legacy of second-chance learners, people who want to consider job change, etc. Lifelong learning is enabled because of distance learning, which is increasingly technology enhanced. Learning materials in the TVET sector are increasingly delivered in an online context. There is also significant investment in distance learning in prisons, using multimedia to overcome literacy challenges. This is a way of getting people to re-enter the labour market. There is an opportunity for multimedia to get over the obsession with literacy.

Models vary when it comes to teachers and teaching organizations. The best models are those that rethink what people do, and where not everyone needs to know everything. The implication of digitization is that it has to be linked to project management. The pressure for teachers to secure a raft of digital skills varies from institution to institution. Technology has the potential to change the fundamentals of teachers' jobs – what they do in their time in and out of the classroom, including administrative tasks.

Blockchain may contribute to repurposing lifelong learning. The type of people drawn to digitally enhanced learning tends to be those who are rethinking credentials.

Quality assurance may be in classroom feedback and measuring of TVET impact. The biggest challenge is that quality assurance has become tantamount to looking at a piece of paper as if that is what determines quality, as opposed to the relations between the educator and the student, which are difficult to measure

– so we measure other things that are measurable. The growth of technology driven by competence-based assessments and coupled with performance management tools that companies use may point to what we should do with quality assurance in the TVET sector. We need to look at CPD in the professions and then determine how digitization can become tantamount to evidence-based learning. Can we use technology to determine the quality of evidence-based learning?

The challenge is to get human beings to change their ideas about technology when it comes to TVET: we are not spending enough time thinking about the way technology can solve current problems. Nobody is talking about the real potential for technology within the context of demand-driven competences, and it is very difficult to define what these standards are in industry. Once you define them, they become redundant – think of collision repair within the context of driverless cars! Panel beaters are going to be impacted by these new technologies.

There is a national and global tension in everyone developing their own national standards, and technology has the potential to get these processes completed quicker. There is little that is being done in this space. We need to tap into global knowledge, rather than keep looking at nation-state fixes. Only case studies can persuade nation-states to learn from each other.

COL should look into partnering with international organizations like the ILO to consider the impact of technology-enhanced TVET. We need to create a bridge between pedagogy and praxis.

There is a need for collaboration between the early movers. New Zealand has been into TVET for twenty years, yet it remains the domain of academics and universities – and then there is the labour market that just gets on with it, rather than write about it. TVET institutions do not reward you for your research output. If anything, researchers are expected to go and work in industry.

Slovenia

Jasmina Poličnik, Institute for Vocational Education and Training (CPI)

Technology is at the forefront of public policy. Digital Slovenia 2020 is the government's strategy for a digital society. It calls for the digitization of entrepreneurship and society, increased overall awareness of the developmental importance of ICT and the internet, improved digital literacy, improved e-skills of the active population, and greater numbers of trained ICT professionals (Republic of Slovenia, 2016). Formal and informal education is associated with the opening up of society to new ideas for new generations – the need to change education to make it relevant for new digital jobs, and the equal participation of all generations in the European digital society. The internet leads to a better quality of life for all citizens – albeit with caveats for personal data protection and privacy of communication in order to create confidence in digitization and cyberspace.

The Ministry for Education has an action plan for Slovenian education online and tries to identify crucial projects for the information infrastructure.

There is also the national provider for ICT infrastructure. A lot of schools use MOOCs and specific programmes for technical education – but a lot is left up to the schools to decide on which tools to use.

All stakeholders in education are aware of the need for a greater use of digitalization – but many are still just paying lip service, rather than using technology for systemic change in TVET frameworks.

Slovenia has a Centre for Vocational Education and Training and a national quality assurance agency that is preparing an online database to provide all institutions with digitalized monitoring and accreditation of processes. The first year of the practice track is enabling the monitoring of practical training by various stakeholders, including students. There is a tangible attempt at transparency.

The motivation for digital TVET is to associate it with standards for practical education – a more efficient, transparent, comparative system that is recognized as equivalent to academic tracks.

There are struggles with infrastructure and teacher training, and a fear of greater workload and more bureaucracy rather than greater efficiencies. There is scepticism as to whether digitization will actually translate into tangible benefits for citizens – a culture of bureaucracy may yet dominate. In most institutions with staff capacity there is optimism, but not in smaller institutions, which clearly need external help and perceive this to mean increased costs.

Government is providing minimal funding for staff training, but not necessarily for infrastructure improvements.

The teaching and learning processes in the classroom and training room are slow to respond to the opportunities provided by digitalization – unless these relate to the introduction of ICT and specialist equipment (such as robotics). In some areas, there are the usual off-the-shelf software applications, which are regularly upgraded – but these would not be associated with digital transformation.

The e-learning initiatives that make inroads into the class are dependent on the initiatives of lone trainers and educators who incorporate MOOCs in their lectures. Those who seek to provide online studies are really on their own, as opposed to being supported by the structures of the institutions they work for.

Change in pedagogy is inevitably being driven by the personal initiatives of teachers. Increased initiative in digitization is leading to more transversal skills than systemic change. There is, however, early promise that online courses are being used to supplement in-class tuition – so blended learning is quietly getting embedded in TVET.

The labour market is aware that skills need to be rebooted. A very large percentage of lecturers in TVET schools are coming from industry. By their very presence and the need for CPD, they are inevitably delivering new approaches and demonstrating they have up-to-date skills and knowledge.



United States

Dr Dan Hughes – President, Learning Machine

The recent spate of apprenticeship programmes and the attempts to do generational work are uniquely the work of the government, not of the labour market. You do not hear the labour market saying, 'we need to increase x apprenticeships by x'. You can see this in the Bahamas, where there is a National Apprenticeship programme to have education occur close to the ports, docks and tourism agencies, where the jobs are – and then to take education, training and certification directly to that point of work. The Bahamas are not unique – the same happens with the California Apprenticeship Initiative (<https://caihub.foundationccc.org/>) programme, which aims to give VET a big uplift so that people are no longer corralled into higher education, but given the opportunity to try things out and go directly out of compulsory schooling into the labour market: there is already a skill set which has been built into the compulsory schooling system.

The Department of Buildings in New York City is developing security training that leads to a credential being earned by each successful participant in the training programme. As ongoing in-field training, accreditation is to a degree dependent on self-attestation, making it difficult to determine quality and mitigate against fraud. The Department is exploring digital credentialing as a means of solving the quality assurance challenge – being in a position to issue digital, immutable credentials that cannot be easily forged, that can be shared and where there is also the means to do on-site validation. The Department can oversee the accreditation of the training providers on the basis of a regime that encourage new entrants into an open market capable of running training and issuing certificates. The move to digital credentialing and blockchain notarization can provide a solution from an economic and incentive perspective, as well as a means of monitoring the quality assurance of the training programmes.

Automation in general, and data exchanges in particular, have driven most sectors of the economy. In general, policy has been a trailing indicator, often drafted in retrospect, after the market has changed. There is a tension that is difficult for various parties to change. If government bodies create policy in a vacuum, it may stymie innovation. There is a constructive difference between government and industry, and you need to have a sense of what you are solving for. It is up to the government to find its optimum role in TVET; business is politics. The government needs to have the imagination to bring about framework initiatives. The European Union has been better at this than the United States.

Business and government are both going through a reboot because of this move to a decentralized set of technologies as a wave of innovation begins to refactor the institutional life, whether it is for-profit business or for good governance. There is a risk of falling into the trap of the bureaucratic momentum created by these waves of technology whose impact is difficult to recognize or even see – until it is almost too late.

Invoking Industry 4.0 is interesting philosophically in that it helps us to be humbler about what it is we can know about the future. This is part of the reason why there is a purpose for government. These are fighting words at the moment in the United States, where people do not believe that the government exists for the common good – it is seen as the enemy and a force going against their business and family. There is an opportunity in this new technological wave where people can reimagine what is possible, using the institutions at their disposal. We can reimagine government as an institutional form that has a different set of objectives, but has the same kind of impact. How do we think about technology in these environments? We need to assume that Industry 4.0 is a way of demarcating industry and societal gains from past waves of industry innovation. In five-year slices, these kinds of rubrics are interesting. What is most formative is what is on the other side of these legalities. A decentralized credential could not have been achieved five years ago! There is this groundswell or subthread of impact that is mounting with these fundamental technological shifts. Taking it back to the more mundane, we will see change first not in traditional areas of education, but in these various workforce-oriented areas of education – TVET on the edges – yet in very pragmatic, recognizable applications when related to 'real life'.

As an example of innovation, Lambda School is reinventing what it means to learn computer sciences. Students are trained online to become software engineers, with no upfront costs. Instead of paying tuition fees, they can agree to pay a percentage of their income after they are employed, and only if they are earning more than US\$50,000 per year. If students do not find a job, or do not secure that level of income, they do not pay their tuition fees – ever. The Lambda School website (<https://lambdaschool.com/>) also serves as a marketing space for students, linking them to the labour market. This is true workforce-technology innovation, since students do not have all the baggage to carry with them. The institution is prepared to support students' livelihood while they are in the training phase, and then gets remunerated once they have secured employment gains. All the incentives are aligned.

This is the real hidden gem technology can bring to TVET. Technology can compress the cycle time and take steps out: that is the real digital revolution for TVET. Lambda School could not have existed five years ago. We had to first get SaaS in place and recognize that we did not need a PhD to work for Google, or a bachelor's degree for IT roles. All of these social and tech advantages had to come together, and someone put risk capital on the line to create a whole new way of creating computer science – in a totally new way. Tech and social change together condition innovation.

In the same way that young people in Ghana are putting pressure on educators to upgrade teaching materials and approaches for TVET, in other parts of the world people still get themselves into debt for following a TVET course or a higher education qualification. It could well be that we cannot quite bypass the higher education pathway – but more and more it is going to be an exception, and TVET should leverage the affordances of technology to provide more flexible learning pathways. For law and medicine, it will remain that way; other disciplines in the United States and elsewhere will eventually find their Lambda School. Disciplines will find some way to find more affordable workable – and probably digital – models. The guild system in the past used to be about passing your apprenticeship to get the warrant – ironically, we may be getting back to that.

The demand for more flexible learning pathways is also related to the known university mill problem – such as the University of Phoenix – which illustrates. Digitization and TVET may represent an early example of flexible, in-service education that may help students on their way to securing registered nurse education, for example, and eventually reaching nurse status at a hospital. This was not the normal approach, but it did generate first-generation demand and demand from people of colour. Much as we critique these models, there are some indicators that are interesting as they indicate the underlying demand. By definition, these kinds of in-service education forms are providing an uplift to traditionally marginalized groups. The more interesting thing here is the way that mobile, internet and decentralized technologies are coming together to enable institutions to collect fees and empower the end user (the student) in the process by taking out the middleman. People can advertise what they want globally. They rely on cash apps or crypto currency, without having to deal with incumbent and predatory fees in the traditional arrangements.

This is interesting – not necessarily because of the gig economy, which remains centralized, but the decentralized gig economy may mean that people are able to practice what they know and can do from anywhere in the world, for anyone willing to pay. That is empowering and will be one of the things that requires a new type of accounting from the government.

Technology has come back in more compelling form: P2P, mobile and decentralized tech challenge our notions of economic activity, law, geography, regulation and policy. It may even be that the buying and serving party do not know where the other party is. This is going to be the norm. P2P is coming back because of the failings of the teaching system, the rise of networked individualism and people who are born digital, with access to affordable mobile technologies.

The common interface is the screen. The biggest MOOC is YouTube. Most learning today is uncredentialed and often wildly decontextualized. People are learning logistics through gaming! They fight with virtual battalions inside a game. Education as a category is fundamentally changing and will soon be changed. People will have to seek out what they need credentialed in the geography they are in – but if we think of lifelong learning, it feels quaint. People are learning every day and people have micro-engagements.

Today, youngsters are learning new skills on YouTube, through curated troves of knowledge where people are looking at what works and what does not. People are focusing more on outcomes than the process.

The precocious child now has skills that were not possible in the past because he has flown seventeen different flight simulators and is a pilot – the only thing the child is lacking is a plane or a certificate! As long as there is a passionate small group of people carrying forward their knowledge of the area, there is a chance the child will become the savant. Lifelong learning is being disrupted and few people are noticing.

People who want to become solopreneurs are getting it – the labour market, not so much.

If you do stay in traditional TVET, you are often just marking time to getting your certification. Digitization hollows out all the hubris of our institutions. The notion that the student's life should orbit the institution is ridiculous. Institutions need to understand why they exist, why they have physical plants that are not central to education. The whole mission of traditional education has to be questioned by a new generation of leaders. This whole dynamic of bottom-up and top-down forces has always been there – what tech has done is speed things up. It has enabled people to do more in less time.

Nothing is final. You are not condemned to be a lawyer if you wish to change halfway and start a motorcycle mechanics course that enables you to work with something you are passionate about. This will be a fundamentally liberative wave – a new set of conditions. There is an anxiety about choice and some people do feel there are too many options! There is no panacea. Under these conditions compared to past conditions, there is a chance to do more emancipatory education.

Someone whose business is spraying cars may be inclined to invest in some technology to speed up the process. We may well be at a tipping point, where digitization starts to actually contribute to making TVET more attractive by making the linkage between learning and meaningful work more relevant. In the process, we may well end up with relevant and meaningful education.

We have been looking at megatrends. What is most interesting about this moment is that digitization aligns TVET training with first-job vocational preparation in every corner of the world where there is internet access. There are downsides, i.e. concerns of privacy and surveillance. One of the biggest upsides of digitization is its potential to be universal. You can grow up in a small US town. In the past, you would not have had access to the training to become a software developer in a small community where tech was frowned upon. There is a need to seize the opportunity and engage with entire body of knowledge for a specific industry by engaging with a digital school. Whether going to Lambda or watching YouTube, or exchanging a PDF of a textbook, there is a formal and informal knowledge-exchange system that is empowering global citizens, a veritable trending universality. When we talk about labour-market training and how people can get, keep and grow certain jobs – there is a sense in which we are trying to use outmoded forms of measurement to obtain data on things that are fundamentally new.

One of the biggest challenges we have are corporations and government getting new sets of tools to derive better sets of metrics and track whether they are seeding successful investment and policy. This is where we are getting into privacy issues, of course – and requires a whole new set of data points, because it is not strictly payroll data or number of graduates. These metrics from the past may not be useful anymore.

There are new sets of opportunities because of P2P technologies. The key is self-sovereignty and trustless technologies. If we really put the power of datafication in the citizens' hands, then something seismic will happen. Can this power shift really happen – or are data always going to ebb in the hand of big brother and Facebook et al.?

Annex 3:

Initial Set of Questions for Target Interviewees

► Table 3. Initial set of questions for target interviewees

POLICIES & GOVERNANCE		DIGITAL INNOVATION (how tech enables new forms/pedagogies of teaching & learning in TVET)	DIGITAL ADAPTATION (how tech requires teaching of new skills in TVET to adapt to changing needs of society & labour market)	DIGITAL ACCELERATION (how tech may accelerate existing policies - massification, inclusion, exclusion, unemployability)
Policy Development	1. Does government have any formal policy documents in the TVET area? 2. What are the main tenets of such policies? 3. What were the main drivers causing these policies to be formulated? 4. What social and or economic outcomes are they expected to bring about?	5. What technologies have been introduced or are being considered for introduction by your organisation?	6. Have any specific policies been developed to prepare for or respond to 'industry 4.0'?	7. Does the digitisation of TVET support policies in other areas such as innovation, regional policy, unemployment, labour policy attraction of FDI etc.?
Governance & Regulatory Framework	8. Which bodies and organizations are responsible for digital policy in TVET?	9. Could you share some examples of new forms of management in TVET made possible by digitisation?		10. Do you have examples of digital technologies being used to make TVET management more efficient and/or effective?
Social Dialogue	11. Are social partners involved in discussions around how TVET can respond to digitisation? How?	12. Do social partners have a position on the digitisation of TVET? If so, please explain.		
Financing	13. Have any new or special financial allocations been made to enable digital transformation?	14. Does tech enable new forms of financing for TVET? If so, please explain.		15. Is digitisation raising or lowering the cost of TVET generally?
Equity & Access		16. Are you aware of specific technologies that improve marginalised groups' access to, participation in, or completion of TVET?	17. Is digitisation creating a need for more readmissions?	18. Does digitisation of TVET have an impact on access? 19. Does digitisation create digital divide problems? How are these being addressed?

QUALITY & RELEVANCE		DIGITAL INNOVATION (how tech enables new forms/pedagogies of teaching & learning)	DIGITAL ADAPTATION (how tech requires teaching of new skills to adapt to changing needs of society & labour market)	DIGITAL ACCELERATION (how tech may accelerate existing policies - massification, inclusion, exclusion, unemployability)
Learning Processes		<p>20. Please identify new forms of learning in TVET enabled by digitisation.</p> <p>21. Which will have the highest impact? Why? Can you point us to specific relevant cases and/or examples?</p>	<p>22. How is digitisation changing the kinds of skills which are taught in TVET?</p> <p>23. Which skills are becoming more important, and which skills are becoming less important?</p>	<p>24. Can you identify any systemic trends in teaching & learning being accelerated by digitisation?</p>
TVET Staff		<p>25. Can you provide examples of specific technologies in teaching & learning which are changing the way teachers teach?</p> <p>26. Which will have the highest impact? Why? Can you point us to specific relevant cases and/or examples?</p>	<p>27. How is digitisation changing the kinds of skills which are required by teachers in TVET?</p> <p>28. Which skills are becoming more important, and which skills are becoming less important?</p> <p>29. How are teachers being prepared for these careers?</p>	<p>30. Can you identify any systemic trends in teaching & learning being accelerated by digitisation?</p>
Learning Pathways		<p>31. Does digitisation open up new path ways for obtaining TVET, in particular via changes in modes of study, duration of study, place or time of study?</p> <p>32. What is the prevalence of such new modes?</p>		<p>33. Do digitally-enabled flexible learning pathways have a significant impact on access, employability or other social policies?</p>
Quality Assurance		<p>34. Does digitisation open up new ways of doing quality assurance, e.g. through adoption of new metrics, learning analytics etc? Can you provide specific examples?</p>	<p>35. Do quality assurance systems in TVET take digitisation into account?</p> <p>36. Are there examples where quality criteria have been changed to encourage digitisation? Any examples of QA hindering digitisation?</p>	
Relevance to Labour Market	<p>37. Does digitisation allow for new ways of improving labour market relevance through actions taken before, during or after studies? Any examples?</p>			
Information and Guidance		<p>38. Does digitisation enable new ways of doing guidance in TVET? Any examples?</p>	<p>39. Does digitisation increase or decrease the need for guidance?</p>	<p>40. Does digitisation change the nature of guidance given?</p>
Generic		<p>41. How can digitalisation help address challenges that TVET has been facing for many years? For example: attractiveness, link with labour market, qualifications, funding, etc. To what extent can technology help in addressing historical/ structural TVET issues/ challenges?</p>		

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